2021 HAZARD VULNERABILITY RISK ASSESSMENT
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Section 01
Introduction

1.1 Overview

On October 30, 2000, the President signed into law the Disaster Mitigation Act of 2000, also known as DMA 2000. Among its other features, DMA 2000 established a requirement that in order to remain eligible for federal disaster assistance and grant funds, local and state governments must develop and adopt hazard mitigation plans. On February 26, 2002, the Federal Emergency Management Agency (FEMA) published an Interim Final Rule (IFR) that set forth the guidance and regulations under which such plans are supposed to be developed. The IFR provides detailed descriptions of both the planning process that states and localities are required to observe and the contents of the plan that emerges.

This California State University (CSU) Hazard Vulnerability and Risk Assessment (HVRA) serves as a component of the hazard mitigation plan process, that will support the larger California State Hazard Mitigation Plan.

Hazard mitigation is often defined as actions taken to reduce the effects of natural hazards on a place and its population. California State University developed this HVRA because of increasing awareness that hazards have for the potential to affect people, physical assets, and operations throughout the university system.

Each campus, as well as the Chancellor’s Office, within the CSU system has chosen separate hazards that are applicable to their individual areas. The HVRA includes detailed descriptions of the process that was used to assess and prioritize the planning area’s risks from and vulnerability to hazards, and quantitative and qualitative risk assessments for each campus. The Planning Team considered such factors as the history of occurrence, the probability of a future occurrence, the potential vulnerabilities in their communities, and the availability of data regarding the hazard. After discussion and consideration, the Planning Team for each campus determined the hazards that had the potential to impact the entire planning area.
Section 02
Planning Process

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2.1 Description of the Planning Process

The California State University Hazard Vulnerability and Risk Assessment (CSU HVRA) project evaluated natural hazard risk for all 23 Campuses and the Chancellor’s Office and focused on both individual and campus-wide hazard vulnerability.

Two planning teams were established: a Core Planning Team and Campus Planning Teams. The Core Planning Team was smaller and made overall decisions on the direction of the HVRA. The Campus Planning Team consisted of at least one member from each campus that provided representation and assisted with coordination at the campus level.

Both Planning Teams participated in a project kickoff call in September 2020 to discuss the scope, schedule, and expectations of the HVRA project. Also in September 2020, the Core Planning Team met to select the overall hazards that would be included as part of the planning process.

Individual campus meetings were conducted with each campus to select the applicable hazards for the HVRA and to discuss campus hazard history details, capabilities, and social resilience.

There were other Planning Team Meetings to discuss project outcomes and draft review processes as well as to address any follow-up items from the campuses.

2.2 Review and Incorporation of Other Plans, Studies, Reports, and Other Information

Throughout the HVRA, other plans, studies, reports, and information were collected, reviewed, and incorporated into this HVRA. A file structure with those documents is included as part of the final HVRA deliverable.
Section 03
System-wide Hazard Vulnerability

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3.1 University Profile

Individual California State Colleges were brought together as a system by the Donahoe Higher Education Act of 1960. In 1972, the system became The California State University and Colleges, and then in 1982, the system became The California State University.
The CSU System is currently made of 23 campuses across California and nearly 500K students are enrolled annually. CSU has one of the most diverse student bodies in the United States.

3.2 Interim Final Rule for Hazard Vulnerability and Risk Assessment

Requirement §201.6(c)(2): The plan shall include a risk assessment that provides the factual basis for activities proposed in the strategy to reduce losses from identified hazards. Local risk assessments must provide sufficient information to enable the jurisdiction to identify and prioritize appropriate mitigation actions to reduce losses from identified hazards.

Requirement §201.6(c)(2)(i): [The risk assessment shall include a] description of the type...location and extent of all natural hazards that can affect the jurisdiction. The plan shall include information on previous occurrences of hazard events and on the probability of future hazard events.

Requirement §201.6(c)(2)(ii): [The risk assessment shall include a] description of the jurisdiction’s vulnerability to the hazards described in paragraph (c)(2)(i) of this section. This description shall include an overall summary of each hazard and its impact on the community.

Requirement §201.6(c)(2)(ii): [The risk assessment] must also address National Flood Insurance Program (NFIP) insured structures that have been repetitively damaged floods.

Requirement §201.6(c)(2)(ii)(A): The plan should describe vulnerability in terms of the types and numbers of existing and future buildings, infrastructure, and critical facilities located in the identified hazard area.

Requirement §201.6(c)(2)(ii)(B): [The plan should describe vulnerability in terms of an] estimate of the potential dollar losses to vulnerable structures identified in paragraph (c)(2)(ii)(A) of this section and a description of the methodology used to prepare the estimate.

Requirement §201.6(c)(2)(ii)(C): [The plan should describe vulnerability in terms of] providing a general description of land uses and development trends within the community so that mitigation options can be considered in future land use decisions.

Requirement §201.6(c)(2)(iii): For multi-jurisdictional plans, the risk assessment must assess each jurisdiction’s risks where they vary from the risks facing the entire planning area.
3.3 Hazard Identification and Risk Assessment

Overview of California State University’s History of Hazards

Numerous federal agencies maintain a variety of records regarding losses associated with hazards. Unfortunately, no single source is considered to offer a definitive accounting of all losses. The Federal Emergency Management Agency (FEMA) maintains records on federal expenditures associated with declared major disasters. The US Army Corps of Engineers (USACE) and the Natural Resources Conservation Service (NRCS) collect data on losses during the course of some of their ongoing projects and studies. Additionally, the National Oceanic and Atmospheric Administration’s (NOAA) National Centers for Environmental Information (NCEI) database collects and maintains data about natural hazards in summary format. The data includes occurrences, dates, injuries, deaths, and estimated costs. Many of these databases and other data collection services, including the NCEI, have inherent data limitations when searching for information at a university scale.

The best available data and records were used throughout this assessment.

Hazard Identification

As part of the initial hazard identification process, the Core Assessment Team considered potential hazards with the most chance to significantly affect the planning area. The hazards include those that have occurred in the past and may occur in the future. A variety of sources were used to develop the list of hazards considered by the Core Assessment Team, including national, regional, and local sources such as emergency operations plans, FEMA’s How-To Series, websites, published documents, databases, and maps, as well as discussion among the Core Assessment Team members.

In the initial phase of the planning process, the Core Assessment Team considered 14 hazards and the risks they create for the University system-wide footprint and its material assets, population, and operations. The hazards initially considered, and the determinations as to the treatment of those hazards, are shown in Table 3-1 (following).
<table>
<thead>
<tr>
<th>Hazard</th>
<th>Determination (Yes/No)</th>
<th>Reason for Determination</th>
<th>Future Occurrence Probability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Communicable Disease</td>
<td>Yes</td>
<td>Covid-19 Pandemic; seasonal events for other diseases on campuses</td>
<td>Highly Likely</td>
</tr>
<tr>
<td>Dam and Levee Failure</td>
<td>Yes</td>
<td>Ongoing risk posed by aging infrastructure and/or human error; some campuses lie in dam or levee protected areas</td>
<td>Unlikely</td>
</tr>
<tr>
<td>Drought</td>
<td>Yes</td>
<td>Numerous severe historic drought periods statewide and ongoing climate change impacts affect all geographic levels</td>
<td>Possible</td>
</tr>
<tr>
<td>Earthquake</td>
<td>Yes</td>
<td>History of catastrophic events in the state, frequent (annual) lower-magnitude events and future severe events projected; some campuses located along fault lines</td>
<td>Possible</td>
</tr>
<tr>
<td>Erosion</td>
<td>Yes</td>
<td>Limited history of severe impacts on campuses, but erosion is ongoing, with erosion-prone locations on many campuses and statewide</td>
<td>Likely</td>
</tr>
<tr>
<td>Extreme Temperature</td>
<td>Yes</td>
<td>History of events and ongoing potential for temperature extremes and related impacts affects all geographic levels</td>
<td>Possible</td>
</tr>
<tr>
<td>Flood</td>
<td>Yes</td>
<td>Historic and seasonal flood events in SFHA’s in communities surrounding CSU campuses; no CSU campuses are located in a SFHA, but localized flooding on a given campus is possible.</td>
<td>Unlikely</td>
</tr>
<tr>
<td>Hazardous Materials</td>
<td>Yes</td>
<td>History of events on some campuses; daily low-level occurrences statewide;</td>
<td>Possible</td>
</tr>
<tr>
<td>Hazard</td>
<td>Occurrence</td>
<td>Risk Description</td>
<td>Probability</td>
</tr>
<tr>
<td>---------------</td>
<td>------------</td>
<td>----------------------------------------------------------------------------------</td>
<td>-------------</td>
</tr>
<tr>
<td>Landslide</td>
<td>Yes</td>
<td>No history of events on campus, but some campuses located in or near landslide susceptibility zones.</td>
<td>Unlikely</td>
</tr>
<tr>
<td>Power Outage</td>
<td>Yes</td>
<td>History of occurrence on some campuses; potential ongoing due to rolling blackouts and other (beyond campus) factors</td>
<td>Possible</td>
</tr>
<tr>
<td>Tsunami</td>
<td>Yes</td>
<td>History of events in coastal areas near some CSU campuses; some campuses lie in or near inundation zones</td>
<td>Unlikely</td>
</tr>
<tr>
<td>Volcano</td>
<td>Yes</td>
<td>No recent history of events in the state, but concern for the secondary impacts to air quality</td>
<td>Unlikely</td>
</tr>
<tr>
<td>Wildfire</td>
<td>Yes</td>
<td>Numerous severe events throughout the state; limited history of fire impacts to campuses, but occasional impacts to air quality from smoke</td>
<td>Possible</td>
</tr>
</tbody>
</table>

**Future Occurrence Probability**

In order to determine the probability of future occurrences of each hazard profiled, the following scale was developed:

- Highly Likely- 76%-100% that the hazard would occur annually.
- Likely- 50%-75% that the hazard would occur annually.
- Possible- 11%-49% that the hazard would occur annually.
- Unlikely- 0%-10% that the hazard would occur annually.
Communicable Disease

Description of the Hazard

Communicable diseases are illnesses that occur due to infectious agents or their toxic products and are infectious due to their potential of transmission from one person or species to another by a replicating agent.¹ They may be transmitted from a reservoir to a susceptible host either directly as from an infected person or animal or indirectly through the agency of an intermediate plant or animal host, vector, or the inanimate environment. Communicable diseases are clinically evident illness resulting from the presence of pathogenic microbial agents, including pathogenic viruses, pathogenic bacteria, fungi, protozoa, multi-cellular parasites, and aberrant proteins known as prions.² The degree of spread of a communicable disease depends on both the ability of an organism to enter, survive and multiply in the host and the comparative ease with which the disease is transmitted to other hosts.³

Some ways in which communicable diseases spread are by:

- Travel through the air, such as tuberculosis, measles, or COVID-19;
- Physical contact with an infected person, such as through touch (staphylococcus), sexual intercourse (gonorrhea, HIV), fecal/oral transmission (hepatitis A), or droplets (influenza, TB, COVID-19);
- Contact with a contaminated surface or object (Norwalk virus), food (salmonella, E. coli), blood (HIV, hepatitis B), or water (cholera); and
- Bites from insects or animals capable of transmitting the disease (mosquito: malaria and yellow fever; flea: plague)⁴

Descriptions of Communicable Disease Hazards by CSU System Campuses

The following are brief descriptions of each of the nine (9) communicable disease hazards that have been identified across the CSU system. The descriptions are presented in decreasing order of frequency.

COVID-19 (SARS-CoV-2)

Coronaviruses are a family of viruses that can cause illnesses such as the common cold, severe acute respiratory syndrome (SARS) and Middle East respiratory syndrome

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(MERS). In 2019, a new coronavirus was identified as the cause of a disease outbreak that originated in China. This virus is now known as the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2). The disease it causes is called Coronavirus Disease 2019 (COVID-19). In March 2020, the World Health Organization (WHO) declared the COVID-19 outbreak a pandemic.

Signs and symptoms of coronavirus disease 2019 (i.e., COVID-19) may appear two to 14 days after exposure. Common signs and symptoms can include fever, cough, and tiredness. Early symptoms of COVID-19 may also include a loss of taste or smell.

The virus that causes COVID-19 spreads easily among people, and more continues to be discovered over time about how it spreads. Data has shown that the COVID-19 virus spreads mainly from person to person among those in close contact (within about 6 feet, or 2 meters). The virus is transmitted by respiratory droplets being released when someone with the virus coughs, sneezes, breathes, sings or talks. These droplets can be inhaled or land in the mouth, nose or eyes of a person nearby. In some situations, the COVID-19 virus can spread by a person being exposed to small droplets or aerosols that stay in the air for several minutes or hours (i.e., airborne transmission). It's not yet known how common it is for the virus to spread this way. The COVID-19 virus can also spread if a person touches a surface or object with the virus on it and then touches his or her mouth, nose or eyes; however, this is not considered to be a main way it spreads.

The severity of COVID-19 symptoms can range from very mild to severe. Some people may have only a few symptoms, and some people may have no symptoms at all. However, some people may experience worsened symptoms, such as worsened shortness of breath and pneumonia. People who are older have a higher risk of serious illness from COVID-19, and the risk increases with age. People who have existing medical conditions also may have a higher risk of serious illness from COVID-19. In some cases, the disease can cause severe medical complications and may even lead to death. ⁵

**Meningitis**

Meningitis is an inflammation of the fluid and membranes (meninges) surrounding the brain and spinal cord. The swelling from meningitis typically triggers signs and symptoms such as headache, fever and a stiff neck. Early meningitis symptoms may mimic the flu (influenza). Symptoms may develop over several hours or over a few days.

Most cases of meningitis in the United States are caused by a viral infection, but bacterial, parasitic and fungal infections are other causes. Some cases of meningitis improve without treatment in a few weeks. Others can be life-threatening and require emergency antibiotic treatment. Bacterial meningitis is particularly serious and can be fatal within

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days without prompt antibiotic treatment. Delayed treatment also increases the risk of permanent brain damage or death.\(^6\)

**Measles**

Measles (also known as rubeola) is a highly contagious childhood infection caused by a virus. The measles virus replicates in the nose and throat of an infected child or adult. Then, when someone with measles coughs, sneezes or talks, infected droplets spray into the air, where other people can inhale them. The infected droplets may also land on a surface, where they remain active and contagious for several hours. The virus is contracted by putting touching one’s nose, mouth, or eyes after touching the infected surface.

Measles can be serious and even fatal for small children. The disease still kills more than 100,000 people a year worldwide, most under the age of 5. However, as a result of high vaccination rates in general, measles hasn't been widespread in the United States for more than a decade.\(^7\)

**Influenza (Including sub-type H1N1/Swine Flu)**

Influenza is a viral infection that attacks the respiratory system (i.e., nose, throat, and lungs). Influenza viruses travel through the air in droplets when someone with the infection coughs, sneezes or talks. Influenza is transmitted either by inhaling virus-laden droplets directly, or by coming into physical contact with an object (e.g., telephone or computer keyboard) and then transferring the virus to the eyes, nose or mouth. People with the virus are likely contagious from about a day before symptoms appear until about five days after symptoms begin.

Common signs and symptoms of the flu include: fever, aching muscles, hills and sweats, headache, dry and persistent cough, shortness of breath, tiredness and weakness, runny or stuffy nose, sore throat, and eye pain. (Vomiting and diarrhea are also influenza signs and symptoms, but these are more common in children than in adults.)

Influenza viruses are constantly changing, with new strains appearing regularly. As a result, antibodies against influenza viruses that have been encountered in the past may not offer protection from new influenza strains, as the new strains can be very different viruses from previous strains.\(^8\)

**H1N1 Flu (Swine Flu)**

The H1N1 flu, commonly known as swine flu, is a type of influenza A virus and is one of several flu virus strains that can cause the seasonal flu. It is primarily caused by the H1N1

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strain of the flu (influenza) virus. Symptoms of the H1N1 flu are the same as those of the seasonal flu.

The H1N1 virus is a combination of viruses from pigs, birds and humans that causes disease in humans. The virus enters your body when you inhale contaminated droplets or transfer live virus from a contaminated surface to your eyes, nose or mouth. It then infects the cells that line your nose, throat and lungs. 

**Tuberculosis**

Tuberculosis (TB) is a potentially serious infectious disease that mainly affects the lungs. Tuberculosis is caused by bacteria that spread from person to person through microscopic droplets released into the air. This can happen when someone with the untreated, active form of tuberculosis coughs, speaks, sneezes, spits, laughs or sings.

Although tuberculosis is contagious, it's not easy to catch. It is more likely for someone to get tuberculosis from a close family member or coworker than from a stranger. Most people with active TB who have had appropriate drug treatment for at least two weeks are no longer contagious. Many strains of tuberculosis resist the drugs most used to treat the disease. People with active tuberculosis must take several types of medications for many months to eradicate the infection and prevent development of antibiotic resistance.

**Norovirus**

Norovirus is a highly contagious virus commonly spread through food or water that is contaminated by fecal material during food preparation or by contaminated surfaces. Specifically, this virus can be transmitted through consuming contaminated food, drinking contaminated water, and touching one’s hand to one’s mouth after the hand has been in contact with a contaminated surface or object.

Norovirus can also be transmitted through close contact with an infected person.

Norovirus infections occur most frequently in closed and crowded environments such as hospitals, nursing homes, child care centers, schools and cruise ships. Noroviruses are difficult to kill off because they can withstand hot and cold temperatures and most disinfectants.

Symptoms such as diarrhea, stomach pain and vomiting typically begin 12 to 48 hours after exposure, and usually last one to three days. Most people recover from norovirus completely without treatment. However, for some people — especially infants, older

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adults and people with underlying disease — vomiting and diarrhea can be severely dehydrating and require medical attention.\textsuperscript{11}

**Mumps**

Mumps is a viral infection that primarily affects saliva-producing (salivary) glands that are located near the ears. Mumps can cause swelling in one or both of these glands, and is contracted by breathing in saliva droplets from an infected person who has just sneezed or coughed. Mumps can also be contracted from sharing utensils or cups with someone who has mumps.

Complications of mumps, such as hearing loss, are potentially serious but rare. There’s no specific treatment for mumps.

Mumps outbreaks far less common than they used to be, but can affect people who aren't vaccinated – especially in close-contact settings such as schools or college campuses.\textsuperscript{12}

**E. Coli**

Escherichia coli (E. coli) bacteria normally live in the intestines of healthy people and animals. Most types of E. coli are harmless or cause relatively brief diarrhea. But a few strains, such as E. coli O157:H7, can cause severe stomach cramps, bloody diarrhea and vomiting. The E. coli O157:H7 strain belongs to a group of E. coli that produces a powerful toxin that damages the lining of the small intestine. Potential sources of exposure to E. coli O157:H7 include contaminated food or water – especially raw vegetables and undercooked ground beef – and person-to-person contact.

Signs and symptoms of E. coli O157:H7 include diarrhea (which may range from mild and watery to severe and bloody), stomach cramping, pain or tenderness, and nausea and vomiting. Infection can occur anytime from one day to one week after exposure to the bacteria, but usually begin three or four days after exposure.\textsuperscript{13}

**Sexually Transmitted Diseases (STDs)**

Sexually transmitted diseases (STDs) are generally acquired by sexual contact. STDs can be caused by: bacteria (gonorrhea, syphilis, chlamydia), parasites (trichomoniasis), or viruses (human papillomavirus, genital herpes, HIV). The organisms (bacteria, viruses or parasites) that cause STDs may pass from person to person in blood, semen, or vaginal and other bodily fluids. Sometimes STDs can be transmitted non-sexually, such as from mother to infant during pregnancy or childbirth, or through blood transfusions or shared needles.


STDs can have a range of signs and symptoms, including: sores or bumps on the genitals or in the oral or rectal area, painful or burning urination, pain during sex, soreness or discharge in genital areas, sore, swollen lymph nodes, particularly in the groin but sometimes more widespread, fever, lower abdominal pain, or rash over the trunk, hands or feet. Signs and symptoms may appear a few days after exposure, or it may take years before any noticeable problems occur, depending on the organism. STDs don't always cause symptoms, and may go unnoticed until complications occur or a partner is diagnosed.14

Location of the Hazard

Communicable diseases have the potential to affect the entire CSU planning area equally. As a result, the communicable disease hazard can be found at all the twenty-three (23) California State University (CSU) System campuses, at the CSU Office of the Chancellor, and at all CSU-owned satellite campuses, remote agricultural research, coastal research, and recreational facilities, and off-campus conference spaces. 15

Table CD.3 shows the locations of all CSU campuses and affiliated facilities. Because of the ubiquitous nature of communicable diseases, all of these locations are vulnerable to communicable disease hazard. As a result, students, faculty, staff at (and visitors to) all CSU campuses and affiliated facilities are at risk of exposure to the communicable disease hazard.

Table 3-2: Locations of All CSU Campuses and Affiliated Facilities.

<table>
<thead>
<tr>
<th>CSU Campus</th>
<th>Main (M), Satellite (S), Research (R), or Other (O)</th>
<th>City</th>
<th>County</th>
</tr>
</thead>
<tbody>
<tr>
<td>CSU Bakersfield</td>
<td>M</td>
<td>Bakersfield</td>
<td>Kern</td>
</tr>
<tr>
<td>CSUB-Antelope Valley</td>
<td>S</td>
<td>Lancaster</td>
<td>Los Angeles</td>
</tr>
<tr>
<td>CSU Channel Islands</td>
<td>M</td>
<td>Camarillo</td>
<td>Ventura</td>
</tr>
<tr>
<td>CSUCI-Extended University</td>
<td>S</td>
<td>Goleta</td>
<td>Santa Barbara</td>
</tr>
<tr>
<td>CSUCI-Boating Center</td>
<td>S</td>
<td>Oxnard</td>
<td>Ventura</td>
</tr>
<tr>
<td>CSUCI-SRIRS</td>
<td>R</td>
<td>Santa Rosa Island</td>
<td>Santa Barbara</td>
</tr>
<tr>
<td>Chico State</td>
<td>M</td>
<td>Chico</td>
<td>Butte</td>
</tr>
</tbody>
</table>


<table>
<thead>
<tr>
<th>Institution</th>
<th>Type</th>
<th>Location</th>
<th>City</th>
</tr>
</thead>
<tbody>
<tr>
<td>CSU Dominguez Hills</td>
<td>M</td>
<td>Carson</td>
<td>Los Angeles</td>
</tr>
<tr>
<td>Cal State East Bay</td>
<td>M</td>
<td>Hayward</td>
<td>Alameda</td>
</tr>
<tr>
<td>CSUEB-Concord Campus</td>
<td>S</td>
<td>Concord</td>
<td>Contra Costa</td>
</tr>
<tr>
<td>Oakland Professional Development and Conference Center</td>
<td>S</td>
<td>Oakland</td>
<td>Alameda</td>
</tr>
<tr>
<td>Fresno State</td>
<td>M</td>
<td>Fresno</td>
<td>Fresno</td>
</tr>
<tr>
<td>Cal State Fullerton</td>
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<td>Fullerton</td>
<td>Orange</td>
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<tr>
<td>Humboldt State</td>
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<td>Arcata</td>
<td>Humboldt</td>
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<td>Cal State Long Beach</td>
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<td>Long Beach</td>
<td>Los Angeles</td>
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<tr>
<td>Cal State LA</td>
<td>M</td>
<td>Los Angeles</td>
<td>Los Angeles</td>
</tr>
<tr>
<td>Cal Maritime</td>
<td>M</td>
<td>Vallejo</td>
<td>Solano</td>
</tr>
<tr>
<td>Training Ship <em>Golden Bear</em></td>
<td>R</td>
<td>Vallejo (Base)</td>
<td>Solano (Base)</td>
</tr>
<tr>
<td>CSU Monterey Bay</td>
<td>M</td>
<td>Seaside &amp; Marina</td>
<td>Monterey</td>
</tr>
<tr>
<td>CSUN (Northridge)</td>
<td>M</td>
<td>Los Angeles</td>
<td>Los Angeles</td>
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<tr>
<td>Cal Poly Pomona</td>
<td>M</td>
<td>Pomona</td>
<td>Los Angeles</td>
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<tr>
<td>CPP - Pine Tree Ranch</td>
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<td>Santa Paula</td>
<td>Ventura</td>
</tr>
<tr>
<td>CPP - Westwind Ranch</td>
<td>S</td>
<td>Chino</td>
<td>San Bernardino</td>
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<tr>
<td>CPP - Spadra Ranch</td>
<td>R</td>
<td>Pomona</td>
<td>Los Angeles</td>
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<tr>
<td>CPP - Lanterman</td>
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<td>Pomona</td>
<td>Los Angeles</td>
</tr>
<tr>
<td>Neutra VCL Studio/Residences</td>
<td>O</td>
<td>Los Angeles</td>
<td>Los Angeles</td>
</tr>
<tr>
<td>Sacramento State</td>
<td>M</td>
<td>Sacramento</td>
<td>Sacramento</td>
</tr>
<tr>
<td>Julia Morgan House Conf. Ctr.</td>
<td>O</td>
<td>Sacramento</td>
<td>Sacramento</td>
</tr>
<tr>
<td>Aquatic Center</td>
<td>O</td>
<td>Gold River</td>
<td>Sacramento</td>
</tr>
<tr>
<td>Hornet Commons</td>
<td>O</td>
<td>Sacramento</td>
<td>Sacramento</td>
</tr>
<tr>
<td>Folsom Hall</td>
<td>O</td>
<td>Sacramento</td>
<td>Sacramento</td>
</tr>
<tr>
<td>Cal State San Bernardino</td>
<td>M</td>
<td>San Bernardino</td>
<td>San Bernardino</td>
</tr>
<tr>
<td>CSSB-Palm Desert Campus</td>
<td>S</td>
<td>Palm Desert</td>
<td>Riverside</td>
</tr>
<tr>
<td>San Diego State</td>
<td>M</td>
<td>San Diego</td>
<td>San Diego</td>
</tr>
<tr>
<td>SDSU-Imperial Valley</td>
<td>S</td>
<td>Brawley</td>
<td>Imperial</td>
</tr>
<tr>
<td>SDSU-Imperial Valley</td>
<td>S</td>
<td>Calexico</td>
<td>Imperial</td>
</tr>
<tr>
<td>San Francisco State</td>
<td>M</td>
<td>San Francisco</td>
<td>San Francisco</td>
</tr>
</tbody>
</table>
CSU Student Housing Locations and Populations

Although CSU-campus-owned student housing opportunities have been severely limited due to the COVID-19 pandemic, this situation is temporary. Eventually, students will be allowed back on campus at full capacity, and many of these students will be living in campus-owned housing. When this occurs, over 53,000 students (i.e., just over 11% of the CSU total enrollment) will be at increased risk of exposure to communicable disease hazards, owing to the “close-quarters” living arrangements in student housing. Table CD.4 shows the number of students that were living in CSU-campus-owned housing in Fall, 2019, prior to the COVID-19 pandemic.  

Table 3-3: CSU Campus Student Housing Populations

<table>
<thead>
<tr>
<th>CSU Campus</th>
<th>Approximate Enrollment Population (Fall 2019)</th>
<th>Approximate Proportion of Students Living in School Housing</th>
<th>Approximate School Housing Population (Fall 2019)</th>
</tr>
</thead>
<tbody>
<tr>
<td>CSU Bakersfield</td>
<td>11,199</td>
<td>5%</td>
<td>560</td>
</tr>
</tbody>
</table>

16 California State University. *Enrollment*. Retrieved 04.30.2021 from: [https://www2.calstate.edu/csu-system/about-the-csu/facts-about-the-csu/enrollment/Pages/default.aspx](https://www2.calstate.edu/csu-system/about-the-csu/facts-about-the-csu/enrollment/Pages/default.aspx)

17 California State University. *CSU Campus Match*. Retrieved 04.30.2021 from: [https://www2.calstate.edu/attend/campuses/campus-match/Pages/campus-match.aspx](https://www2.calstate.edu/attend/campuses/campus-match/Pages/campus-match.aspx)
<table>
<thead>
<tr>
<th>CSU Channel Islands(^{18})</th>
<th>7,093</th>
<th>6%</th>
<th>432</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chico State</td>
<td>17,019</td>
<td>2%</td>
<td>340</td>
</tr>
<tr>
<td>CSU Dominguez Hills</td>
<td>17,027</td>
<td>5%</td>
<td>851</td>
</tr>
<tr>
<td>Cal State East Bay</td>
<td>14,705</td>
<td>15%</td>
<td>2,206</td>
</tr>
<tr>
<td>Fresno State</td>
<td>24,139</td>
<td>5%</td>
<td>1,207</td>
</tr>
<tr>
<td>Cal State Fullerton</td>
<td>39,868</td>
<td>6%</td>
<td>2,392</td>
</tr>
<tr>
<td>Humboldt State</td>
<td>6,983</td>
<td>9%</td>
<td>628</td>
</tr>
<tr>
<td>Cal State Long Beach</td>
<td>38,074</td>
<td>9%</td>
<td>3,427</td>
</tr>
<tr>
<td>Cal State LA</td>
<td>26,361</td>
<td>4%</td>
<td>1,054</td>
</tr>
<tr>
<td>Cal Maritime</td>
<td>911</td>
<td>85%</td>
<td>774</td>
</tr>
<tr>
<td>CSU Monterey Bay (Watterson)</td>
<td>7,123</td>
<td>46%</td>
<td>3,277</td>
</tr>
<tr>
<td>CSUN (Northridge)(^{19})</td>
<td>38,391</td>
<td>8%</td>
<td>3,071</td>
</tr>
<tr>
<td>Cal Poly Pomona</td>
<td>27,914</td>
<td>9%</td>
<td>2,512</td>
</tr>
<tr>
<td>Sacramento State</td>
<td>31,156</td>
<td>6%</td>
<td>1,869</td>
</tr>
<tr>
<td>Cal State San Bernardino</td>
<td>20,311</td>
<td>8%</td>
<td>1,625</td>
</tr>
<tr>
<td>San Diego State</td>
<td>35,081</td>
<td>15%</td>
<td>5,262</td>
</tr>
<tr>
<td>San Francisco State</td>
<td>28,880</td>
<td>13%</td>
<td>3,754</td>
</tr>
<tr>
<td>San José State</td>
<td>33,282</td>
<td>13%</td>
<td>4,327</td>
</tr>
<tr>
<td>Cal Poly San Luis Obispo</td>
<td>21,242</td>
<td>37%</td>
<td>7,860</td>
</tr>
<tr>
<td>CSU San Marcos(^{20})</td>
<td>14,519</td>
<td>11%</td>
<td>1,597</td>
</tr>
<tr>
<td>Sonoma State</td>
<td>8,649</td>
<td>37%</td>
<td>3,200</td>
</tr>
<tr>
<td>Stanislaus State</td>
<td>10,614</td>
<td>8%</td>
<td>849</td>
</tr>
<tr>
<td>Office of the Chancellor</td>
<td>0</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>CSU System-Wide</td>
<td>480,541</td>
<td>11%</td>
<td>53,076</td>
</tr>
</tbody>
</table>


Extent of the Hazard

Various communicable diseases are categorized by the Center for Disease Control and Prevention (CDC) by levels of containment called Biosafety Levels (or BSLs). The higher the BSL, the greater the level of containment and level of effort necessary to prevent transmission of the disease, and therefore the greater the hazard. The communicable disease hazards identified CSU campuses fall into Biosafety Levels prescribe procedures and levels of containment for a particular microorganism or material (including research involving recombinant or synthetic nucleic acid molecules) and procedures associated with that containment. BSLs also consider primary barriers (e.g., biosafety cabinets), secondary barriers, facility design, air handling, laboratory security, etc. BSLs are graded from 1 to 4; as the BSL increases so does the relative risk of the agent/procedures as well the stringency of procedures and facility design.

Figure 3-1 describes the different BSLs, and provides examples of communicable diseases that would typically fall in to these classifications, as well as the typical protections that would be necessary to prevent transmission of each of the diseases. Figure 3-1: Biosafety Levels (BSLs)21

The Extent of CSU System-Wide Communicable Disease Hazards Except COVID-19:

Before the COVID-19 pandemic, there were cases of Meningitis, Measles, Influenza, Tuberculosis, Norovirus, Mumps, E. Coli, and Sexually Transmitted Diseases (STDs) reported at campuses throughout the CSU system. Five (5) of the non-COVID communicable diseases reported at CSU campuses – Meningitis, Measles, Norovirus, Mumps, and E. coli – would each be classified at the BSL-2 containment levels. Three (3)

of the communicable diseases – Influenza, Tuberculosis, and STDs would be classified at either the BSL-2 or BSL-3 containment levels. COVID-19 is classified at the BSL-3 containment level. 22 23

The Extent of CSU System-Wide COVID-19 Communicable Disease Hazard:

There is a considerable amount of data on the extent of COVID-19 throughout the CSU system. Over an approximately one-year period, from mid-March, 2020 to March 23, 2021, there were a reported 5,165 cases of COVID-19 across all CSU campuses. CSU campus-specific COVID-19 case data can be found in the History of the Hazard section below. As a microorganism, the SARS-CoV-2 (COVID-19) virus requires a high level of containment and is therefore classified at BSL-3. For the planning committee, this level corresponds to a High extent ranking for the CSU 23-campus system. Collectively, the twenty-three (23) campuses and Chancellor’s Office of the California State University (CSU) system have identified nine (9) communicable disease hazards that have had significant impacts on their respective student, faculty, and staff populations. Of these communicable diseases, COVID-19 is considered to be the most prominent and widespread agent across all CSU campuses. (See Table 3-4 below.)

Table 3-4: Communicable Diseases Identified CSU Campuses

<table>
<thead>
<tr>
<th>Collective List of Communicable Diseases Identified by All CSU Campuses</th>
<th>Number of CSU Campuses (Including Chancellor’s Office) Identifying Communicable Disease Having Significant Impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>COVID-19 (SARS-CoV-2)</td>
<td>24</td>
</tr>
<tr>
<td>Meningitis</td>
<td>7</td>
</tr>
<tr>
<td>Measles</td>
<td>6</td>
</tr>
<tr>
<td>Influenza (Including H1N1/Swine Flu)</td>
<td>6</td>
</tr>
<tr>
<td>Tuberculosis</td>
<td>5</td>
</tr>
<tr>
<td>Norovirus</td>
<td>4</td>
</tr>
<tr>
<td>Mumps</td>
<td>2</td>
</tr>
<tr>
<td>E. Coli</td>
<td>2</td>
</tr>
<tr>
<td>Sexually Transmitted Diseases (STDs)</td>
<td>2</td>
</tr>
</tbody>
</table>


With the exception of COVID-19, there is variability among CSU campuses regarding which communicable diseases have had the greatest impact on individual campus communities. Table CD.2 shows the communicable disease hazards that have had the greatest impact on each CSU campus.

Table 3-5: Communicable Disease Hazards at CSU Campuses with Greatest Impact

<table>
<thead>
<tr>
<th>CSU Campus</th>
<th>Identified Communicable Disease Hazards with the Greatest Impact on CSU Campus</th>
</tr>
</thead>
<tbody>
<tr>
<td>CSU Bakersfield</td>
<td>COVID-19, Meningitis</td>
</tr>
<tr>
<td>CSU Channel Islands</td>
<td>COVID-19, Measles</td>
</tr>
<tr>
<td>Chico State</td>
<td>COVID-19, Tuberculosis</td>
</tr>
<tr>
<td>CSU Dominguez Hills</td>
<td>COVID-19</td>
</tr>
<tr>
<td>Cal State East Bay</td>
<td>COVID-19, Meningitis</td>
</tr>
<tr>
<td>Fresno State</td>
<td>COVID-19, Meningitis, Tuberculosis</td>
</tr>
<tr>
<td>Cal State Fullerton</td>
<td>COVID-19, Influenza</td>
</tr>
<tr>
<td>Humboldt State</td>
<td>COVID-19, Measles, Norovirus, Influenza, STDs</td>
</tr>
<tr>
<td>Cal State Long Beach</td>
<td>COVID-19</td>
</tr>
<tr>
<td>Cal State LA</td>
<td>COVID-19, E. coli, Measles</td>
</tr>
<tr>
<td>Cal Maritime</td>
<td>COVID-19</td>
</tr>
<tr>
<td>CSU Monterey Bay</td>
<td>COVID-19</td>
</tr>
<tr>
<td>CSUN (Northridge)</td>
<td>COVID-19, Measles</td>
</tr>
<tr>
<td>Cal Poly Pomona</td>
<td>COVID-19, Influenza (Swine Flu - H1N1)</td>
</tr>
<tr>
<td>Sacramento State</td>
<td>COVID-19</td>
</tr>
<tr>
<td>Cal State San Bernardino</td>
<td>COVID-19, Tuberculosis</td>
</tr>
<tr>
<td>San Diego State</td>
<td>COVID-19, Meningitis, Mumps</td>
</tr>
<tr>
<td>San Francisco State</td>
<td>COVID-19</td>
</tr>
<tr>
<td>San José State</td>
<td>COVID-19, H1N1</td>
</tr>
<tr>
<td>Cal Poly San Luis Obispo</td>
<td>COVID-19, Meningitis, Norovirus</td>
</tr>
<tr>
<td>CSU San Marcos</td>
<td>COVID-19</td>
</tr>
<tr>
<td>Sonoma State</td>
<td>COVID-19, H1N1, Norovirus</td>
</tr>
<tr>
<td>CSU Stanislaus</td>
<td>COVID-19, Tuberculosis</td>
</tr>
</tbody>
</table>
History of the Hazard

Each CSU campus is an integral part of the surrounding community. Any event that occurs on a CSU campus has an effect on both the adjacent areas of campus and on the community-at large – and vice-versa. Communicable disease hazard events are no exception. Most communicable disease data are maintained by at the state and at the county levels and are not generally available at the municipal or campus levels, unless (a) the CSU campus falls under the jurisdiction of a city-level health department, or (b) a geographically specific outbreak occurs on campus or in the local community. The exception to this is the current COVID-19 pandemic, where both campus and County-level case data have been collected. As a result, it is important to provide COVID-19 case statistics for both CSU campuses and the counties where CSU campus assets are located.

Data limitations preclude providing the history or case data of non-COVID-19 communicable diseases at CSU campuses. However, the history of COVID-19 is well documented for the CSU system and for the State of California. Table below shows COVID-19 case data for CSU system campuses and for the State of California, respectively. These data have been extracted from a wide variety of CSU campus websites, and all CSU campuses except CSU San Bernardino and the CSU Chancellor’s office have been able to provide COVID-19 case numbers. CSU COVID Case Reports are updated on a weekly basis. Each CSU campus provides its own definition of a “case,” and COVID-19 case reporting start dates vary across CSU campuses. COVID-19 case data for CSU Bakersfield are in the table below.
Table 3-6: CSU Campus COVID-19 Case Data

<table>
<thead>
<tr>
<th>CSU Campus</th>
<th>Cumulative Number of On-Campus COVID-19 Cases Reported at CSU Campus since March, 2020 (as of 03/23/2021)</th>
<th>Cumulative Number of Off-Campus COVID-19 Cases Reported at CSU Campus since 03/2020 (as of 03/23/2021)</th>
<th>Cumulative Number of COVID-19 Cases Reported as a Combination of On- and Off-Campus Stats at CSU Campus since 03/2020 (as of 03/23/2021)</th>
<th>Cumulative Number of All COVID-19 Cases Reported at CSU Campus since 03/2020 (as of 03/23/2021)</th>
</tr>
</thead>
<tbody>
<tr>
<td>CSU Bakersfield</td>
<td>120</td>
<td>28</td>
<td>148</td>
<td></td>
</tr>
<tr>
<td>CSU Channel Islands</td>
<td>27</td>
<td></td>
<td>27</td>
<td></td>
</tr>
<tr>
<td>Chico State</td>
<td></td>
<td>325</td>
<td>325</td>
<td></td>
</tr>
<tr>
<td>CSU Dominguez Hills</td>
<td>50</td>
<td>49</td>
<td>99</td>
<td></td>
</tr>
<tr>
<td>Cal State East Bay</td>
<td>29</td>
<td></td>
<td>29</td>
<td></td>
</tr>
<tr>
<td>Fresno State</td>
<td></td>
<td>145</td>
<td>145</td>
<td></td>
</tr>
<tr>
<td>Cal State Fullerton</td>
<td>68</td>
<td>345</td>
<td>413</td>
<td></td>
</tr>
<tr>
<td>Humboldt State</td>
<td></td>
<td>108</td>
<td>108</td>
<td></td>
</tr>
<tr>
<td>Cal State Long Beach</td>
<td>157</td>
<td>326</td>
<td>483</td>
<td></td>
</tr>
<tr>
<td>Cal State LA</td>
<td>95</td>
<td>103</td>
<td>198</td>
<td></td>
</tr>
<tr>
<td>Cal Maritime</td>
<td></td>
<td>10</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>CSU Monterey Bay</td>
<td>20</td>
<td>35</td>
<td>55</td>
<td></td>
</tr>
<tr>
<td>CSUN (Northridge)</td>
<td></td>
<td>244</td>
<td>244</td>
<td></td>
</tr>
<tr>
<td>Cal Poly Pomona</td>
<td>99</td>
<td>198</td>
<td>297</td>
<td></td>
</tr>
<tr>
<td>Sacramento State</td>
<td></td>
<td>293</td>
<td>293</td>
<td></td>
</tr>
<tr>
<td>Cal State San Bernardino</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td></td>
</tr>
<tr>
<td>San Diego State</td>
<td>121</td>
<td></td>
<td>121</td>
<td></td>
</tr>
<tr>
<td>San Francisco State</td>
<td></td>
<td>32</td>
<td>32</td>
<td></td>
</tr>
</tbody>
</table>

24 California State University. *Coronavirus.* Retrieved 03.23.2021 from: https://www2.calstate.edu/coronavirus/
<table>
<thead>
<tr>
<th>Jurisdiction</th>
<th>Cases</th>
<th>Deaths</th>
</tr>
</thead>
<tbody>
<tr>
<td>California</td>
<td>3,566,464</td>
<td>57,788</td>
</tr>
</tbody>
</table>

Potential Impacts of the Hazard

Communicable disease outbreaks and pandemics have (and will continue to have) direct impact on life, health, and safety across the CSU system. The extent of this impact is contingent on the type of infection or contagion, the severity of the outbreak, and the speed at which it is transmitted. Property and infrastructure integrity may be affected if large portions of CSU campus populations contract communicable diseases at the same time and are therefore unable to perform maintenance, operations, and educational tasks. This would be particularly disruptive if those impacted are first responders or other essential personnel. Long-term outbreaks affecting large numbers of CSU students could result in cancelled classes, delayed matriculation, or other disruptions to the CSU System’s mission. This has already occurred with the current COVID-19 pandemic and

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could occur again with more virulent strains of communicable diseases, including COVID-19.

Communicable disease hazards found across the CSU system vary both by level of containment (BSL) (described previously) and by level of individual/public health risk, or Risk Group (RG) level. While BSLs describe the procedures and required levels of containment in a laboratory setting, Risk Groups (RGs) reflect the potential effects of disease exposure on humans or animals. Like BSLs, RGs range from Level 1 (RG1) to Level 4 (RG4), with Level 1 (RG1) posing minimal risk to healthy individuals and public health and Level 4 (RG4) posing a very serious or extreme risks to individuals and public. BSLs generally correlate with Risk Group (RG) Levels (e.g., a RG2 agent is worked with at

The World Health Organization’s (WHO) Laboratory Biosafety Manual, 3rd ed., NIH Guidelines, categorizes Risk Groups (RGs) in the following way:

Table 3-8: WHO Risk Group Categorization\textsuperscript{26}

<table>
<thead>
<tr>
<th>Risk Group (RG)</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>RG1</td>
<td>Rarely associated with disease in healthy adult humans or animals and pose no-to-little public health risk (e.g., Saccharomyces cerevisiae, E. coli K-12 strain derivatives often used for recombinant/molecular biology, many environmental organisms)</td>
</tr>
<tr>
<td>RG2</td>
<td>Associated with mild to moderate disease for which preventative measures or post exposure treatments are often available; public health impact is limited (e.g., Streptococcus pyogenes, Salmonella, hepatitis B virus)</td>
</tr>
<tr>
<td>RG3</td>
<td>Associated with serious to lethal human disease for which preventative vaccines or post-exposure therapies may be scarce. Public health impact is limited-to-moderate (e.g., Mycobacterium tuberculosis, hantaviruses, West Nile virus, SARS)</td>
</tr>
<tr>
<td>RG4</td>
<td>Associated with serious to lethal human disease for which preventative vaccines or post exposure therapies are not usually available. Public health impact is high (e.g., Ebola virus, Marburg virus, smallpox virus, etc.)</td>
</tr>
</tbody>
</table>

Table below describes the four (4) Risk Group Levels (RGs), and provides examples of communicable diseases that would typically fall into these classifications, and the typical protections that would be necessary to prevent transmission of the disease. It is

important to note that all but two (2) communicable disease hazards identified by CSU campuses fall under either the lower-risk RG1 or RG2 categories. COVID-19 and tuberculosis are the two (2) communicable diseases that fall under the higher-risk RG3 category. However, with the advent of the recently developed COVID-19 vaccine, and with the expectation of an increasingly robust vaccine supply, it is possible that the RG level for COVID-19 could be lowered in the future, thereby reducing both the extent and the potential impact of COVID-19.

Table 3-9: Risk Group Levels (RGs) with Example Diseases and Recommended Precautions

<table>
<thead>
<tr>
<th>Level</th>
<th>Examples</th>
<th>Typical Protection to Prevent Transmission</th>
</tr>
</thead>
<tbody>
<tr>
<td>RG 1</td>
<td>E. Coli</td>
<td>Precautions are minimal, most likely involving gloves and some sort of facial protection. Usually, contaminated materials are left in open (but separately indicated) waste receptacles. Decontamination procedures for this level are similar in most respects to modern precautions against everyday viruses (i.e.: washing one’s hands with anti-bacterial soap, washing all exposed surfaces of the lab with disinfectants, etc.).</td>
</tr>
<tr>
<td>RG 2</td>
<td>Chicken Pox, Hepatitis A, B, C, Lyme disease, Salmonella, Mumps, Measles, Malaria, Scrapie, Dengue Fever, HIV</td>
<td>These bacteria and viruses cause mild disease in humans or are difficult to contract via aerosol. Routine diagnostic work with clinical specimens can be done safely at BSL-2, using BSL-2 practices and procedures.</td>
</tr>
</tbody>
</table>

### RG 3

<table>
<thead>
<tr>
<th>Anthrax</th>
<th>West Nile Virus</th>
</tr>
</thead>
<tbody>
<tr>
<td>SARS Virus (Including COVID-19)</td>
<td></td>
</tr>
<tr>
<td>Tuberculosis</td>
<td></td>
</tr>
<tr>
<td>Typhus</td>
<td></td>
</tr>
<tr>
<td>Yellow Fever</td>
<td></td>
</tr>
<tr>
<td>Hantaviruses</td>
<td></td>
</tr>
<tr>
<td>Avian Flu</td>
<td></td>
</tr>
</tbody>
</table>

These bacteria and viruses cause severe to fatal disease in human, but vaccines or other treatments do exist to combat them. Laboratory personnel have specific training in handling pathogenic and potentially lethal agents and are supervised by competent scientists who are experienced in working with these agents. This is considered a neutral or warm zone.

### RG 4

<table>
<thead>
<tr>
<th>H5N1 (Bird Flu)</th>
<th>Dengue Hemorrhagic Fever</th>
</tr>
</thead>
<tbody>
<tr>
<td>Marburg Virus</td>
<td>Ebola Virus</td>
</tr>
<tr>
<td>Smallpox</td>
<td>Lassa Fever</td>
</tr>
<tr>
<td>Crimean-Congo Hemorrhagic Fever</td>
<td>Other Hemorrhagic Diseases</td>
</tr>
</tbody>
</table>

These viruses and bacteria cause severe to fatal disease in humans, for which vaccines or other treatments are not available. When dealing with biological hazards at this level the use of a Hazmat suit and a self-contained oxygen supply is mandatory. The entrance and exit of a BSL-4 lab will contain multiple showers, a vacuum room, an ultraviolet light room, autonomous detection system, and other safety precautions designed to destroy all traces of the biohazard. Multiple airlocks are employed and are electronically secured to prevent both doors opening at the same time. All air and water service going to and coming from a BSL-4 lab will undergo similar decontamination procedures to eliminate the possibility of an accidental release.

### Probability of Future Occurrence of the Hazard

There have been cases of a variety of communicable disease throughout the CSU system, including COVID-19 (SARS-CoV-2), Meningitis, Measles, Influenza (Including H1N1/Swine Flu), Tuberculosis, Norovirus, Mumps, E. Coli, and Sexually Transmitted Diseases (STDs). However, there are significant data limitations regarding non-COVID-19 communicable disease cases, as the information thereof is outdated, anecdotal, and/or inadequate. As a result, it is not feasible to provide quantitative probabilities of future occurrence for non-COVID-19 communicable disease hazards. However, based on the limited data, it is feasible to present qualitative probabilities of future occurrence based on ranges of communicable disease frequency.
The following table shows an annual probability scale of future occurrence for the nine (9) communicable disease hazards profiled in this assessment. This scale is divided into four (4) levels of probability:

Table 3-10: Likelihood of Future Hazard Occurrence

<table>
<thead>
<tr>
<th>Likelihood</th>
<th>Parameters for Determining Likelihood</th>
</tr>
</thead>
<tbody>
<tr>
<td>Highly Likely</td>
<td>76 – 100% probability that hazard will occur annually (high to very high frequency)</td>
</tr>
<tr>
<td>Likely</td>
<td>50 – 75% probability that hazard will occur annually (moderate to high frequency)</td>
</tr>
<tr>
<td>Possible</td>
<td>11 – 49% probability that hazard will occur annually (low to moderate frequency)</td>
</tr>
<tr>
<td>Unlikely</td>
<td>0 – 10% probability that hazard will occur annually (very low to low frequency)</td>
</tr>
</tbody>
</table>

Due to significant data limitations surrounding non-COVID communicable diseases, the probability of future occurrence of CSU-system-wide communicable disease is measured by the proportion of campuses that have identified a particular communicable disease as having an impact on the campus community. In this measure, the more frequent a communicable disease is seen as impactful CSU-wide, the greater the probability of future occurrence. It is important to note here that a communicable disease can be rated as having a probability of future occurrence CSU-system-wide that is different from that at the individual CSU campus level.

Table 3-11: Probability of Future Occurrence of Communicable Disease Hazard for CSU System

<table>
<thead>
<tr>
<th>Collective List of Communicable Diseases Identified by All CSU Campuses</th>
<th>Number of CSU Campuses (Including Chancellor’s Office) Identifying Communicable Disease Having Significant Impact</th>
<th>Proportion of CSU Campuses Identifying Communicable Disease as Having Significant Impact System-Wide</th>
<th>CSU System-Wide Probability Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>COVID-19 (SARS-CoV-2)</td>
<td>24</td>
<td>1.00</td>
<td>Highly Likely</td>
</tr>
<tr>
<td>Meningitis</td>
<td>7</td>
<td>0.29</td>
<td>Possible</td>
</tr>
<tr>
<td>Measles</td>
<td>6</td>
<td>0.25</td>
<td>Possible</td>
</tr>
<tr>
<td>Influenza (Including H1N1/Swine Flu)</td>
<td>6</td>
<td>0.25</td>
<td>Possible</td>
</tr>
<tr>
<td>Tuberculosis</td>
<td>5</td>
<td>0.21</td>
<td>Possible</td>
</tr>
<tr>
<td>Disease</td>
<td>Likelihood</td>
<td>Probability</td>
<td>Vulnerability</td>
</tr>
<tr>
<td>----------------------------------------------</td>
<td>------------</td>
<td>-------------</td>
<td>---------------</td>
</tr>
<tr>
<td>Norovirus</td>
<td>Possible</td>
<td>0.17</td>
<td>High</td>
</tr>
<tr>
<td>Mumps</td>
<td>Unlikely</td>
<td>0.08</td>
<td>Low</td>
</tr>
<tr>
<td>E. Coli</td>
<td>Unlikely</td>
<td>0.08</td>
<td>Low</td>
</tr>
<tr>
<td>Sexually Transmitted Diseases (STDs)</td>
<td>Unlikely</td>
<td>0.08</td>
<td>Low</td>
</tr>
</tbody>
</table>

(Source: Interviews with staff at CSU campuses and at the CSU Chancellor’s Office.)

Vulnerability to the Hazard

Vulnerability to a communicable diseases hazard resides in the population of a given area – both human and animal – not in the infrastructure or physical assets. While CSU assets and infrastructure could be impacted indirectly by the communicable disease hazard, these impacts would be secondary to the impact that the communicable disease hazard would have on students, faculty, staff, and visitors at CSU campuses.

CSU campus settings are geographically diverse, with locations ranging from small towns to medium-sized cities to densely populated urban areas. Hundreds of thousands of people work, study, and/or pass through CSU campuses on any given day. (As of Fall 2019, the CSU System had 480,541 students and 53,763 faculty and staff.) Each of these persons is vulnerable to communicable disease, particularly if it is a pathogen that individual has not been immunized against, or for which no immunization exists. Prolonged outbreaks could result in a loss of services, failure of infrastructure (from lack of operators or maintenance), and closure of facilities. This exact scenario has played out in the current COVID-19 pandemic.

Estimate of Potential Losses

COVID-19 Pandemic Health Impact on CSU Campuses and Surrounding Communities

The nationwide campus-related COVID-19 death rate of 0.02% remains well below the average COVID-19 death rate in the U.S. However, due to data limitations, there is no information on CSU-campus-specific deaths by COVID-19 or by any other communicable diseases. In fact, COVID-19 is the only communicable disease for which case reports have been readily available for CSU campuses.

At some point in the future, CSU campuses will return to full capacity. Without adequate surveillance regarding campus access and student and employee interaction, CSU

28 The California State University. Enrollment. Retrieved 05.03.2021 from: https://www2.calstate.edu/csu-system/about-the-csu/facts-about-the-csu/enrollment/Pages/default.aspx
29 The California State University. Employee Head Count by Campus. Retrieved 05.03.2021 from: https://www2.calstate.edu/csu-system/faculty-staff/employee-profile/csu-workforce/Pages/employee-headcount-by-campus.aspx
campuses are at risk of developing an extreme incidence of COVID-19 and may become “super-spreaders” for adjacent communities.\(^\text{30}\) The emergence of more virulent COVID-19 variants would only add to the potential for high negative impacts on life safety, operations, and service delivery across the CSU system. (Other communicable diseases would also re-emerge, but with low to moderate negative impacts on life safety, operations, and service delivery.)

**Economic Impact of COVID-19 Pandemic on CSU Financial Health**

During the first few months of the COVID-19 pandemic in 2020, the CSU system suffered tremendous negative fiscal impacts. From March through July of 2020 alone, over $146 million worth of revenue losses were sustained across the CSU system due to refunds to students for parking, housing and dining service fees during Spring Semester, 2020. Several CSU campuses saw refund losses surpass $10 million.

Figure 3-2: CSU COVID-19 Cost Tracking Showing Revenue Refund Losses and Increased Costs\(^\text{31}\)

![Figure 3-2: CSU COVID-19 Cost Tracking Showing Revenue Refund Losses and Increased Costs](https://calmatters.org/wp-content/uploads/2020/08/July-summary.pdf)

During Spring Semester, 2020, campus shutdowns, the shift to remote learning, shrinking revenue from sources like dorm fees and student bookstores, and changes in enrollment patterns across the system unrelated to COVID-19 all hit the California State University

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system simultaneously with well over a $300 million loss from reduced revenues and from new costs.

Figure 3-3: Change in CSU Total Operating Budget, 2017-2021

<table>
<thead>
<tr>
<th>Fiscal Year</th>
<th>State General Fund</th>
<th>% Change</th>
<th>Gross Tuition &amp; Fees</th>
<th>% Change</th>
<th>Total Operating Fund Budget</th>
<th>% Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>2017-2018</td>
<td>$3,474,230,000</td>
<td>-</td>
<td>$3,275,294,300</td>
<td>-</td>
<td>$6,749,524,300</td>
<td>-</td>
</tr>
<tr>
<td>2018-2019</td>
<td>$3,772,707,000</td>
<td>8.6%</td>
<td>$3,277,627,000</td>
<td>0.1%</td>
<td>$7,050,334,000</td>
<td>4.5%</td>
</tr>
<tr>
<td>2019-2020</td>
<td>$4,021,849,000</td>
<td>6.6%</td>
<td>$3,155,887,000</td>
<td>-3.7%</td>
<td>$7,177,736,000</td>
<td>1.8%</td>
</tr>
<tr>
<td>2020-2021</td>
<td>$3,722,806,000</td>
<td>-7.4%</td>
<td>$3,140,097,000</td>
<td>-0.5%</td>
<td>$6,862,903,000</td>
<td>-4.4%</td>
</tr>
</tbody>
</table>

While there has been a more recent surge in enrollment at CSU campuses during Fall Semester, 2020, the loss of future tuition and fee revenue due to COVID-19 is not yet known, as resident enrollment patterns are not yet fully understood by individual campuses. However, it is expected that non-resident and international student enrollments could be down by at least one-third compared to their pre-pandemic enrollment levels.

Mitigative Relief from Federal Assistance

The $1.5 billion in total federal assistance sent to the CSU system will help relieve the losses of revenues from services like dorms, parking and dining services during a year of mainly empty campuses. (See Table CD.10) However, because of staggering COVID-related revenue losses, the CSU system is planning for three (3) years of fiscal duress.

Table 26-12: Total Federal Assistance to CSU for COVID-19-Related Losses, 2020-2021

<table>
<thead>
<tr>
<th>Institution</th>
<th>December 2020 Stimulus</th>
<th>CARES Act</th>
<th>APLU Projection of HEERF Total ARP Act Funding Allocation</th>
<th>Total Estimated Federal COVID Relief Funding</th>
</tr>
</thead>
</table>


<table>
<thead>
<tr>
<th>Institution</th>
<th>Fiscal Year 1</th>
<th>Fiscal Year 2</th>
<th>Fiscal Year 3</th>
<th>Fiscal Year 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>California Polytechnic State University</td>
<td>$20,752,799</td>
<td>$14,725,000</td>
<td>$37,000,928</td>
<td>$72,478,727</td>
</tr>
<tr>
<td>California State Polytechnic University, Pomona</td>
<td>$48,614,353</td>
<td>$31,102,000</td>
<td>$86,044,649</td>
<td>$165,761,002</td>
</tr>
<tr>
<td>California State University Channel Islands</td>
<td>$14,288,099</td>
<td>$8,512,000</td>
<td>$24,915,170</td>
<td>$47,715,269</td>
</tr>
<tr>
<td>California State University Maritime Academy</td>
<td>$1,381,700</td>
<td>$1,204,000</td>
<td>$2,472,622</td>
<td>$5,058,322</td>
</tr>
<tr>
<td>California State University - Sacramento</td>
<td>$59,891,260</td>
<td>$35,643,000</td>
<td>$104,900,133</td>
<td>$200,434,393</td>
</tr>
<tr>
<td>California State University, Bakersfield</td>
<td>$22,855,632</td>
<td>$12,483,000</td>
<td>$40,285,565</td>
<td>$75,624,197</td>
</tr>
<tr>
<td>California State University, Chico</td>
<td>$31,603,856</td>
<td>$20,019,000</td>
<td>$55,754,538</td>
<td>$107,377,394</td>
</tr>
<tr>
<td>California State University, Dominguez Hills</td>
<td>$31,843,563</td>
<td>$18,312,000</td>
<td>$55,915,410</td>
<td>$106,070,973</td>
</tr>
<tr>
<td>California State University, East Bay</td>
<td>$24,243,652</td>
<td>$14,394,000</td>
<td>$42,929,208</td>
<td>$81,566,860</td>
</tr>
<tr>
<td>California State University, Fresno</td>
<td>$52,725,317</td>
<td>$32,557,000</td>
<td>$92,926,594</td>
<td>$178,208,911</td>
</tr>
<tr>
<td>California State University, Fullerton</td>
<td>$67,736,949</td>
<td>$41,088,000</td>
<td>$120,859,884</td>
<td>$229,684,833</td>
</tr>
<tr>
<td>California State University, Long Beach</td>
<td>$67,421,424</td>
<td>$41,202,000</td>
<td>$119,508,329</td>
<td>$228,131,753</td>
</tr>
<tr>
<td>California State University, Los Angeles</td>
<td>$61,905,561</td>
<td>$40,067,000</td>
<td>$108,543,672</td>
<td>$210,516,233</td>
</tr>
</tbody>
</table>
Vulnerability Assessment Conclusions

Before the COVID-19, pandemic, populations at all CSU campuses and CSU-affiliated facilities were substantial. Collectively, as of Fall 2019, CSU campuses had 480,541 students and 53,763 faculty and staff. All were at risk from the communicable disease events, with 534,304 people being directly vulnerable. The COVID-19 pandemic has caused campus population numbers to plummet to a small fraction of full capacity. At some point in the future, campus population numbers will return to their pre-pandemic levels, and students, faculty, and staff will again be vulnerable to the communicable disease hazard. If just 10% of the total CSU population were to become ill with a highly infective communicable disease like influenza or another strain of SARS, this would mean that approximately 53,430 people would be sick at the same time. This

| California State University, Monterey Bay | $13,455,716 | $8,705,000 | $23,922,768 | $46,083,484 |
| California State University, Northridge  | $74,004,088 | $47,458,000 | $131,021,450 | $252,483,538 |
| California State University, San Bernardino | $42,438,131 | $27,924,000 | $74,982,459 | $145,344,590 |
| California State University, San Marcos  | $26,602,684 | $15,542,000 | $46,496,808 | $88,641,492 |
| California State University, Stanislaus   | $22,007,207 | $12,928,000 | $38,636,391 | $73,571,598 |
| Humboldt State University                 | $16,130,016 | $11,146,000 | $28,831,619 | $56,107,635 |
| San Diego State University                | $45,914,127 | $30,394,000 | $80,592,358 | $156,900,512 |
| San Francisco State University            | $47,404,409 | $30,000,000 | $83,075,470 | $160,479,879 |
| San Jose State University                 | $46,631,939 | $30,977,000 | $82,976,130 | $160,585,069 |
| Sonoma State University                   | $13,980,795 | $9,153,000  | $24,732,994 | $47,866,789  |
| CSU System-Wide Totals                    | $853,833,277 | $535,535,000 | $1,507,325,177 | $2,896,693,454 |
scenario would likely overwhelm available on-campus medical services could even overwhelm portions of the larger community’s medical resources – especially if there were large numbers of infected people with immune system compromises or other underlying health problems. The following table shows the “10% outbreak scenario” projections both for each CSU campus and for the entire CSU system.

Table 3-13: Scenario of Communicable Disease Hazard Affecting 10% of the CSU Population

<table>
<thead>
<tr>
<th>CSU Campus</th>
<th>Approximate Enrollment Population (Fall 2019)</th>
<th>Approximate Total FT/PT Faculty/Staff Population (Fall 2019)</th>
<th>Total Combined Approximate Student and Faculty/Staff Population</th>
<th>10% Outbreak Scenario (Students and Faculty/Staff Combined)</th>
</tr>
</thead>
<tbody>
<tr>
<td>CSU Bakersfield</td>
<td>11,199</td>
<td>1,277</td>
<td>12,476</td>
<td>1,248</td>
</tr>
<tr>
<td>CSU Channel Islands</td>
<td>7,093</td>
<td>994</td>
<td>8,087</td>
<td>809</td>
</tr>
<tr>
<td>Chico State</td>
<td>17,019</td>
<td>1,969</td>
<td>18,988</td>
<td>1,899</td>
</tr>
<tr>
<td>CSU Dominguez Hills</td>
<td>17,027</td>
<td>1,761</td>
<td>18,788</td>
<td>1,879</td>
</tr>
<tr>
<td>Cal State East Bay</td>
<td>14,705</td>
<td>1,764</td>
<td>16,469</td>
<td>1,647</td>
</tr>
<tr>
<td>Fresno State</td>
<td>24,139</td>
<td>2,534</td>
<td>26,673</td>
<td>2,667</td>
</tr>
<tr>
<td>Cal State Fullerton</td>
<td>39,868</td>
<td>3,736</td>
<td>43,604</td>
<td>4,360</td>
</tr>
<tr>
<td>Humboldt State</td>
<td>6,983</td>
<td>1,171</td>
<td>8,154</td>
<td>815</td>
</tr>
<tr>
<td>Cal State Long Beach</td>
<td>38,074</td>
<td>4,004</td>
<td>42,078</td>
<td>4,208</td>
</tr>
<tr>
<td>Cal State LA</td>
<td>26,361</td>
<td>2,821</td>
<td>29,182</td>
<td>2,918</td>
</tr>
</tbody>
</table>

---

36 The California State University. *Enrollment*. Retrieved 05.04.2021 from: [https://www2.calstate.edu/csu-system/about-the-csu/facts-about-the-csu/enrollment/Pages/default.aspx](https://www2.calstate.edu/csu-system/about-the-csu/facts-about-the-csu/enrollment/Pages/default.aspx)

37 The California State University. *Employee Head Count by Campus*. Retrieved 05.04.2021 from: [https://www2.calstate.edu/csu-system/faculty-staff/employee-profile/csustaffworkforce/Pages/employee-headcount-by-campus.aspx](https://www2.calstate.edu/csu-system/faculty-staff/employee-profile/csustaffworkforce/Pages/employee-headcount-by-campus.aspx)
<table>
<thead>
<tr>
<th>Institution</th>
<th>Total Cases</th>
<th>New Cases</th>
<th>Total Enrollment</th>
<th>COVID-19 Cases</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cal Maritime</td>
<td>911</td>
<td>329</td>
<td>1,240</td>
<td>124</td>
</tr>
<tr>
<td>CSU Monterey Bay</td>
<td>7,123</td>
<td>1,059</td>
<td>8,182</td>
<td>818</td>
</tr>
<tr>
<td>CSUN (Northridge)</td>
<td>38,391</td>
<td>3,832</td>
<td>42,223</td>
<td>4,222</td>
</tr>
<tr>
<td>Cal Poly Pomona</td>
<td>27,914</td>
<td>2,650</td>
<td>30,564</td>
<td>3,056</td>
</tr>
<tr>
<td>Sacramento State</td>
<td>31,156</td>
<td>3,228</td>
<td>34,384</td>
<td>3,438</td>
</tr>
<tr>
<td>Cal State San Bernardino</td>
<td>20,311</td>
<td>2,118</td>
<td>22,429</td>
<td>2,243</td>
</tr>
<tr>
<td>San Diego State</td>
<td>35,081</td>
<td>3,702</td>
<td>38,783</td>
<td>3,878</td>
</tr>
<tr>
<td>San Francisco State</td>
<td>28,880</td>
<td>3,401</td>
<td>32,281</td>
<td>3,228</td>
</tr>
<tr>
<td>San José State</td>
<td>33,282</td>
<td>3,568</td>
<td>36,850</td>
<td>3,685</td>
</tr>
<tr>
<td>Cal Poly San Luis Obispo</td>
<td>21,242</td>
<td>2,871</td>
<td>24,113</td>
<td>2,411</td>
</tr>
<tr>
<td>CSU San Marcos</td>
<td>14,519</td>
<td>1,687</td>
<td>16,206</td>
<td>1,621</td>
</tr>
<tr>
<td>Sonoma State</td>
<td>8,649</td>
<td>1,338</td>
<td>9,987</td>
<td>999</td>
</tr>
<tr>
<td>CSU Stanislaus (Stanislaus State)</td>
<td>10,614</td>
<td>1,276</td>
<td>11,890</td>
<td>1,189</td>
</tr>
<tr>
<td>Office of the Chancellor</td>
<td>0</td>
<td>673</td>
<td>673</td>
<td>67</td>
</tr>
<tr>
<td>CSU System-Wide</td>
<td>480,541</td>
<td>53,763</td>
<td>534,304</td>
<td>53,430</td>
</tr>
</tbody>
</table>

While the case numbers of COVID-19 have been significantly lower (about 1% of the total CSU population) than those in the 10% scenario, the degree of virulence and resultant morbidity and mortality caused by COVID-19 have led to widespread campus shutdowns, educational disruption, and economic harm to the CSU system. In short, the real-time COVID-19 communicable disease outbreak scenario has proven far more devastating than the 10% simulated scenario.
Another potential vulnerability for the CSU system is highly decentralized nature of the CSU system itself. The 23-campus CSU system maintains facilities located within twenty-six (26) local Health Department jurisdictions. Some individual CSU campuses have facilities located within the jurisdictions of three (3) different local health departments. As a result, well-integrated and coordinated communicable disease mitigative measures across the CSU system are challenging and may prove both cumbersome and unfeasible. The following table shows the local Health Department jurisdictions under which each CSU campus falls.

Table 3-14: Local Health Department Jurisdictions for CSU Campuses.

<table>
<thead>
<tr>
<th>CSU Campus</th>
<th>Local Health Department Jurisdiction 1</th>
<th>Local Health Department Jurisdiction 2</th>
<th>Local Health Department Jurisdiction 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>CSU Bakersfield</td>
<td>Kern County</td>
<td>Los Angeles County</td>
<td></td>
</tr>
<tr>
<td>CSU Channel Islands</td>
<td>Ventura County</td>
<td>Santa Barbara County</td>
<td></td>
</tr>
<tr>
<td>Chico State</td>
<td>Butte County</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CSU Dominguez Hills</td>
<td>Los Angeles County</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cal State East Bay</td>
<td>Alameda County</td>
<td>Contra Costa County</td>
<td></td>
</tr>
<tr>
<td>Fresno State</td>
<td>Fresno County</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cal State Fullerton</td>
<td>Orange County</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Humboldt State</td>
<td>Humboldt County</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cal State Long Beach</td>
<td>City of Long Beach</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cal State LA</td>
<td>Los Angeles County</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cal Maritime</td>
<td>Solano County</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CSU Monterey Bay</td>
<td>Monterey County</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CSUN (Northridge)</td>
<td>Los Angeles County</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cal Poly Pomona</td>
<td>Los Angeles County</td>
<td>Ventura County</td>
<td>San Bernardino County</td>
</tr>
<tr>
<td>Sacramento State</td>
<td>Sacramento County</td>
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<td>Cal State San Bernardino</td>
<td>San Bernardino County</td>
<td>Riverside County</td>
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Identified Data Limitations

There is a wealth of technical information available for communicable disease. However, there is also limited non-COVID-19 communicable disease data available regarding risk or vulnerability of specific populations throughout the CSU. Much of the data that does exist is protected by privacy policies, and therefore cannot be obtained for more specific populations. As a result, performing a detailed quantitative assessment for this hazard is difficult.

Data that could be collected prior to the next update in order to improve this methodology includes:

- Data regarding infection rates at the campus level and for specific populations;
- Data regarding communicable disease case numbers and outcomes, by CSU campus;
- Data regarding projected population changes;
- Data regarding absenteeism; and
- Data regarding increased operating costs as a result of absenteeism (i.e., temporary shifting of duties resulting in business interruption).
**Dam and Levee Failure**

**Description of the Hazard**

Dam failure is the uncontrolled release of impounded water from behind a dam. Flooding, earthquakes, blockages, landslides, adverse geological conditions, lack of maintenance, aging infrastructure, improper operation, poor construction, vandalism, and terrorism can all cause dam failure. Dam failure from overtopping is a specific failure mechanism resulting from inadequate spillway capacity or other spillway issues and seiches. Prolonged precipitation may result in overtopping of the dam resulting in structural compromise. The tremendous energy generated by a sudden breach of the dam will have significant downstream effects. Flood damage resulting from dam failures potentially will result in economic losses, environmental damage, destruction of agriculture, and human casualties. This type of incident is extremely dangerous as it can occur rapidly, with no warning resulting in an inability to effectively evacuate threatened communities.

Dam failures are most likely to happen for one of the following reasons:

- **Overtopping** - caused by water spilling over the top of a dam. Overtopping of a dam is often a precursor of dam failure.
- **Foundation Defects** - including settlement and slope instability, cause about 30% of all dam failures.
- **Cracking** - caused by movements like the natural settling of a dam.
- **Inadequate maintenance and upkeep.**
- **Piping** - is when seepage through a dam is not properly filtered and soil particles continue to progress and form sink holes in the dam.

National statistics show that overtopping due to inadequate spillway design, debris blockage of spillways, or settlement of the dam crest account for approximately 34% of all U.S. dam failures. Dam failure from overtopping can occur when the inflow volume into a reservoir (primarily caused by stormwater runoff) exceeds the volume of water that can be stored and evacuated from a reservoir via its spillway. 20% of all U.S. dam failures have been caused by piping (internal erosion caused by seepage). Seepage often occurs around hydraulic structures, such as pipes and spillways; through animal burrows; around roots of woody vegetation; and through cracks in dams, dam appurtenances, and dam foundations.³⁸

**Location of the Hazard**

A jurisdictional dam in California has a height greater than six feet while impounding 50 acre-feet or more or a height greater than 25 feet with storage capacity of 15 acre-feet or more. As of early 2018, there are more than 1,537 dams of jurisdictional size in California. Approximately 1,250 of these dams are under jurisdiction of the California Department of Water Resources (DWR), Division of Safety of Dams (DSOD),

³⁸ https://damsafety.org/dam-failures
and approximately 287 dams owned by federal government agencies. Los Angeles County leads the state with 91 jurisdictional dams, followed by Sonoma County with 64 dams. Del Norte County is the only county in the state that has no dams of jurisdictional size. Please refer to each campus Annex for the locations of dams relative to each campus.

Figure 3-4: Dams located in the State of California

Extent of the Hazard

Dams are classified according to the hazard that they pose to life and property in the event of failure, rather than the likelihood of that failure. The DWR Division of Safety of Dams (DSOD) reviewed the hazard classification of all its dams and sub-divided the high hazard classification into two classifications: High Hazard and Extremely High Hazard.

- **High hazard potential dams** may result in loss of human life, and will likely result in economic, environmental, or lifeline losses.
- **Significant hazard potential dams** are not expected to result in loss of life, but are expected to cause economic, environmental, and lifeline losses. 
- **Low hazard potential dams** are not expected to result in loss of life, and there is a low expectation of economic, environmental, or lifeline losses. What losses do occur are generally limited to the dam owner.

Dams classified as high hazard are required to have Emergency Action Plans (EAP). EAPS are formal documents that identify potential emergency conditions at the dam and

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39 State of California. Division of Dam Safety. Retrieved on 03.31.2021 from: https://water.ca.gov/Programs/All-Programs/Division-of-Safety-of-Dams
specify preplanned actions to be followed in case of failure. An EAP is required for all high hazard dams and is recommended for all significant hazard dams.

Note: Please refer to the annex for each campus for a listing and ranking of high hazard dams in the vicinity of the campus.

For the CSU system as a whole, some campuses are located within the inundation zone while the majority of campuses are located outside of it. In the event of catastrophic failure of a given dam, some campuses will experience indirect impacts such as disruption of transportation routes, while others will experience direct impacts damaging assets, threatening life and a total shut-down of all campus operations. Based on these wide-ranging conditions, the CSU system-wide planning committee ranks the extent of dam failure overall as Moderate.

History of the Hazard

Since 1929, the State of California has regulated dams to prevent failure, safeguard life, and protect property. The California Water Code entrusts dam safety regulatory power to DWR, Division of Safety of Dams (DSOD). DWR provides oversight to the design, construction, and maintenance of over 1,200 jurisdictional sized dams in California.

In the past 50 years, there have been only a small number of dam failures in California. The most catastrophic dam failure in California’s history is that of the infamous St. Francis Dam in Los Angeles County, which failed in March 1928, shortly after construction of the dam was completed. This failure resulted in the deaths of more than 450 people and the destruction of nearly 1,000 homes and buildings. Numerous roads and bridges were also destroyed or damaged beyond repair. It was a landmark event in the history of state dam safety legislation, spurring legislation not only in California, but in neighboring states as well. The Division of Safety of Dams (DOSD) was established as a direct result of this catastrophe. Other significant dam incidents in California’s history include the Baldwin Hills Dam failure in 1963, the near failure of the Lower San Fernando Dam in 1971, and the failure of the spillway system at Oroville Dam in 2017.

Note: Please refer to each campus Annex for any historical occurrence of dam failure relative to the campus’ location. Data indicate that minor dam failures have occurred in a small minority of communities where CSU campuses are located. However, based on best available data, no dam failure events directly impacting a CSU campus have taken place.
Potential Impacts of the Hazard

Dam failures have the potential to cause immense property and environmental damages and take lives. Water that is released due to a dam that has failed generates tremendous energy and force causing a flood that will be catastrophic to life and property. Water levels from the failed dam could be significantly higher than those experienced in worst case scenario flood events. Areas closer to the failed dam will be more likely to experience complete devastation while other areas within the inundation zone will see varying levels of flood waters. The extent of the impacts of a failed dam would vary based on a number of factors such as the volume of water released, the base flow of the river, the time of the failure, the amount of warning provided, and the distance from the dam. Impacts resulting from a dam failure include:

- Loss of life
- Property destruction or damage
- Loss of property contents
- Infrastructure damage
- Flooded or destroyed lifelines/supply routes
- Damaged or destroyed utilities
- Loss of community economic base
- Employment losses
- Agricultural (crops and livestock) damages or destruction
- Environmental damage
- Floods generating threats to public health
- Flood generated debris

As the state’s dams age and population increases, the potential for deadly damage failures grows. The American Society of Civil Engineers’ 2017 Infrastructure Report Card reported that dam failures not only risk public safety, they also can cost the economy millions of dollars in damages. Failure is not just limited to damage to the dam itself. It can result in the impairment of many other infrastructure systems, such as roads, bridges, and water systems. When a dam fails, resources must be devoted to the prevention and treatment of public health risks as well as the resulting structural consequences.40

Probability of Future Occurrence of the Hazard

With a changing climate that includes an expectation of increased extreme weather events in California, including prolonged periods of severe drought and intense wet periods with less snowpack and degraded conditions in source watersheds, dam operation and maintenance becomes more difficult and the risk of spillway activation and dam failure from overtopping may increase. However, given current monitoring and maintenance protocols are highly regulated and adaptive by nature, the system-wide planning committee ranks the probability of occurrence as Possible.

Vulnerability to the Hazard

The DWR Division of Safety of Dams (DSOD) reviewed the hazard classification of all its dams and sub-divided the high hazard classification into two classifications: High Hazard and Extremely High Hazard. As of August 2017, there are 1,249 dams under state jurisdiction, of which 474 are High Hazard and 196 are Extremely High Hazard (670 High Hazard per FEMA definitions). Remediation needs at this time have been identified at 97 dams, of which 60 are High or Extremely High Hazard.

DSOD engineers inspect over 1,200 dams on a yearly schedule to ensure they are performing and being maintained in a safe manner. The DSOD also periodically reviews the stability of dams and their major appurtenances in light of improved design approaches and requirements, as well as new findings regarding earthquake hazards and hydrologic estimates in California.

According to FEMA, most people living downstream of a dam are unaware of the potential hazards associated with dam failure, have never seen the respective dam failure inundation map, and are unaware of an evacuation plan or an EAP associated with the failure of that dam.

That said, given that most CSU campuses lie outside of dam inundation zones, and that highly regulated dam monitoring, inspection and maintenance practices are in place, a catastrophic dam or levee failure is highly unlikely. However, in the unlikely event of a dam failure somewhere within a CSU-located community, the effects of flooding on campus would most likely be limited to indirect or secondary effects in terms of disruption to local or regional transportation networks utilized by the campus community and a disruption of campus operations and services.

Certain campus populations will experience greater challenges to a post-dam failure environment. During low probability, extensive dam failure events, vulnerable populations will likely need to navigate through flood generated debris, face extreme health safety issues from flood waters, experience extreme stresses of a disaster, an inability to communicate to or gain access to support networks, and find difficulty in accessing equipment or supplies to aid in a specific need. In addition, even with minor flooding, the potential for flood damaged structures being left uninhabitable is possible, including campus residence halls on the minority of campuses located within dam inundation zones.

Estimate of Potential Losses

Estimates of potential losses for those campuses at risk will be influenced by a variety of factors. The volume and force of the water will determine the scale of damages affecting campus infrastructure, equipment, and other impacted features. The proximity to the failure and elevation above flood waters will affect the level of damage and individuals exposed. The time of the academic year, the day of week, and hour in which the failure was to occur will influence the number of people on campus and potential casualties.
Losses will be generated by the physical damages, the loss of revenue, loss of academic research, loss of building contents, and community wide economic reductions.

Vulnerability Assessment Conclusions

Although the occurrence of dam failures has historically been limited throughout the state, the potential for failures related to the region’s levees and dams still exists. The presence of earthquake faults in proximity to many state dams presents a significant risk to dam structure in the event of an earthquake. In the unlikely event of a high priority dam’s total failure, the consequences would generate catastrophic results to downstream communities. The proximity to the rivers and the levees providing a barrier between the campus and the rivers further presents a hazard facing campus at risk. The potential for dam or levee failure generates the added potential for a number of cascading effects such as disruptions to the local economy, utility failures, disruptions to providing for the needs of the community, and development of public health hazards. These effects would be exacerbated by effects of seasonal flooding, ongoing heavy precipitation, or excessive run-off from the watershed contributing to the river system. The potential for widespread flooding and damage of structures due to the force of water has exponentially powerful impacts on particular segments of campus communities including those with access or functional needs, international students, the homeless, and students residing in the residence halls.

Identified Data Limitations

Although we know which factors produce variability in the degree of dam failure risk and potential economic loss from one campus to another, quantifying dollar losses is currently limited and will require a HAZUS analysis or other type of analysis at the campus level and CSU system-wide. The CSU system’s leadership may consider developing such data sets in the future.

Levee

Description of the Hazard (Levee)

Levees in California protect land from peak flood levels and/or protect land that is below sea-level. Levees are embankments whose primary purpose is to furnish flood protection from seasonal high water or divert the flow of water.[1] Most levees in California are intended to withstand peak water levels generated by heavy precipitation or rapid snowmelt in a watershed. Examples are the levees along the Russian River or the Sacramento River near Sacramento. The second type of levee is intended to withstand nominal water levels on a continuous basis as well as peak flood levels. Examples are the levees throughout Sacramento-San Joaquin Delta. The Bay-Delta is a complex system in which there are three rivers bring in fresh water and tidal fluctuations cycle in salt water or brackish water.

A levee failure is similar to dam failures as the result will be a breach causing flooding on the dry side of the levee. Levee failures can vary from over toppings to small uncontrolled discharge to catastrophic failure. Areas downstream of the failure will be subject to
inundation dependent on the volume of water released. These levee failures are also
typically the result of structural age, damage to the structure caused by earthquake or
flooding, slumping, seepage underneath the levee, high velocity flows eroding the levee,
inadequate capacity, inadequate maintenance, improper construction materials, or
extreme inflow of water into the system. Flood damage resulting from levee failures
potentially will result in economic losses, environmental damage, destruction of
agriculture, and human casualties.

Six main failure mechanisms are a function of the three loading functions. The six
mechanisms are bearing failure, sliding failure, slump or spreading failure, seepage
failure, erosion failure, and overtopping, which may be described as follows:

- A bearing failure in levees is typically deep-seated and can be induced by seismic
ground shaking or a loss of soil shear strength. Failure can be triggered by a
seismic event that either causes a loss of soil strength or produces destabilizing
inertial loading conditions.
- A sliding failure may occur if the foundation soil has a weak or brittle zone
resulting in a preferred failure plane. Both seismic-induced inertial loading and
high-water levels can cause sliding failures.
- Slumping and spreading can be generated by two loading conditions. Cyclic
loading from earthquakes may generate increased pore pressures and reduced soil
strength, leading to volumetric and/or deviatoric strains in the foundation. The
same results can also occur due to increased pore pressures from high water
levels and increased seepage.
- Seepage is one of the most common failure mechanisms in levees. Levees are
built in fluvial depositional environments, and it is common to find levees with an
existing sandy layer beneath the foundation. The sandy layer can be a conduit for
flow underneath the levee, resulting in critical conditions at the landside toe of the
levee. This can lead to erosion of the foundation during high water or a consistent
weakening of the foundation over a long period of time, both eventually leading to
failure. Biogenic agents can also lead to destabilizing seepage. These can include
rodent holes, tree roots, or other biological activity that create conduits for
seepage. Some of the materials used in the construction of levees historically are
also susceptible to through seepage. This through seepage can also result in a
failure.
- High-velocity flows can erode material from the outboard or waterside of the
levee, which may lead to instability and failure. Erosion can occur at once or over
time as a function of the storm cycle and the scale of the peak storms.
- The failure mechanism of overtopping occurs when high water exceeds the
elevation of the levee crest. The water energy is then concentrated at the landside
toe of the levee, leading to soil erosion and decreased levee stability. Once
overtopping starts, the erosion can quickly lead to a large failure. Some areas in
California have experienced land subsidence due to groundwater depletion or
other reasons. Land subsidence can cause overtopping to occur in areas that have
not had overtopping risk in the past.
Location of the Hazard

Most levees in California are in the Bay-Delta and, for the most part, protect land that is at or below sea-level. There are vast areas in the Delta that are already below sea-level. The Bay-Delta is a complex system in which there are three rivers bring in fresh water and tidal fluctuations cycle in salt water or brackish water. In addition to facing risks to its water system from Delta levee failures, the Bay Area also has numerous substandard levees protecting both low-lying and below-sea-level urban areas and infrastructure, including the Oakland International Airport. That said, neither CSU campus in the Bay area (CSU-East Bay and San Francisco State) are located within a levee protected inundation zone. In addition, only 6 of the 23 CSU campuses lie within a levee protected inundation zone.

Extent of the Hazard

Ground shaking in and around levees resulting from earthquakes 100 kilometers or more away can affect levee performance. The type of foundation the levee is constructed upon (such as peat or alluvium) will influence a levee’s performance during a seismic event or under certain static loading conditions.

Millions of people and billions of dollars of assets in California are protected by levees. Levees in California protect land from peak flood levels and/or protect land that is below sea-level. The first type of levee is intended to withstand peak flood levels that are caused by intense rainfall or rapid snow melt within the watershed. Examples are the levees along the Russian River or the Sacramento River near Sacramento. The second type of levee is intended to withstand nominal water levels on a continuous basis as well as peak flood levels. Examples are the levees throughout Sacramento-San Joaquin Delta. The San Francisco Bay-San Joaquin-Sacramento Delta region (a.k.a. “the Delta” or “the Bay-Delta”) contains levees critical for delivering irrigation water to 3 million acres and drinking water to over 23 million people. A failure in one of the Delta levees in 1972 interrupted the state and federal water supply systems and required approximately 500,000 acre-feet of fresh water to restore export water to acceptable quality. Recent studies indicate the levees in the Delta are susceptible to damage from close or more distant seismic events.

Some of the areas protected by these levees were originally intended to have land use compatible with agriculture but have subsequently become urban. Some of the levees in California have been augmented in recent years but many remain as originally constructed or have deteriorated. Changes in climate affecting hydrologic patterns in California, as well as sea-level rise, are bringing additional loading to levees.

With the reclaimed floodplains not being replenished with new sediment and the drying out of some of the boggy areas, the land protected by the levees began to drop in elevation via subsidence and wind erosion of topsoil. Land behind the levees will continue to drop in elevation with the addition of potential sea-level rise exacerbating the situation.
DWR is evaluating and upgrading aging and deteriorating levees along the Sacramento River and San Joaquin River valleys and the Delta. To expedite efforts to protect these communities, levee evaluations were conducted in a fast-track manner over an eight-year period. To date, nearly 250 levee repair sites have been identified, with more than 100 of the most critical sites having already been repaired. Repairs to others are either in progress or scheduled to be completed in the near future, and still more repair sites are in the process of being identified, planned, and ranked.

FOR CSU system-wide, levees are located along numerous irrigation channels and other waterways surrounding six (6) campuses in part or in whole, and, as such, lie in levee protected areas, and are, to varying degrees, vulnerable to levee failure. Said campuses include Bakersfield, Channel Islands, Chico, Northridge, Sacramento and San Bernardino. And all six maintain a Moderate extent ranking for levee failure. For campuses at greatest risk, levee failure could substantially alter the ability of the given campus to maintain operations as damages would be extensive. Depending on the location of a breach, the campus community would be heavily affected with the loss of life and homes, access to campus would be limited, and student financial capacity to support ongoing education being diminished.

The remaining 17 campuses are not located within such areas and are not at risk or vulnerable to direct impacts from levee failure, though they may experience indirect effects such as transportation route disruption. Based on these wide-ranging sets of conditions, the planning committee ranks the overall extent of the levee failure hazard system-wide as Low to Moderate.

History of the Hazard

When the levees began being constructed in California’s Central Valley in the 1850s to protect or claim floodplains including islands in the Delta, for agricultural purposes, soil was either scraped from adjacent land or dredged from adjacent channels and placed onto existing natural levees. The soil generally made poor foundation material for levees. During the same time period, hydraulic mining occurred in the mountains at the headwaters of the rivers that feed the Delta and huge amounts of sediment were flushed downstream raising riverbeds and causing increased flooding. To prevent buildup of this sediment, levees were built and/or heightened to increase flows through the low-lying areas to aid in moving the sediment pulses through the Delta.

The levees have been augmented since then to produce the current system. After several devastating floods the U.S. Army Corps of Engineers (USACE) started modifying and constructing levees as early as the early 1900s using sediment from adjacent rivers and channels. Levees were also constructed by others in the 1900s in areas subject to coastal influences, such as in San Francisco and San Pablo Bays. Until about the 1940s to 1950s, most levees were not engineered and frequently failed. Some of the levees in California have been augmented in recent years but many remain as originally constructed or have deteriorated. Changes in climate affecting hydrologic patterns in California, as well as sea-level rise, are bringing additional loading to levees.
With the reclaimed floodplains not being replenished with new sediment and the drying out of some of the boggy areas, the land protected by the levees began to drop in elevation via subsidence and wind erosion of topsoil. Land behind the levees will continue to drop in elevation with the addition of potential sea-level rise exacerbating the situation.

California voters have approved billions of dollars in bonds over the years to finance various critical infrastructure improvements and retrofit projects. A November 2006 bond election resulted in provision of $4.9 billion of levee repair and improvement funding. The 2006 levee bond election led to formation of the California Department of Water Resources (DWR) Delta Risk Management Strategy (DRMS) program and to initiation of a comprehensive flood mitigation program in the Central Valley. Additionally, the Delta Stewardship Council was created to lead a multi-agency effort to update priorities for state investments in the Delta levee system. The Delta Levees Investment Strategy (DLIS) released in 2017 updated priorities for state investments in the Delta levee system to reduce the likelihood and consequences of levee failures and to protect people, property, and state interests. Overall, no CSU campuses have experienced a levee failure impact.

Potential Impacts of the Hazard

The type of foundation the levee is constructed upon (such as peat or alluvium) or the composition of the levee itself (such as loose sand) will influence a levee’s performance during a seismic event or under certain static loading conditions. Many levees in the Delta are designed nominally to 100-year design flood levels. In parts of California, both the chances and the consequences of flooding are ranked the highest in the nation. Many of the levees in California are intended to protect against a storm related flood event with a 1 percent chance of occurring in any year. Some areas have an even lower level of protection.

As an example, Sacramento-San Joaquin Delta Levees failures would likely stop the export of Delta water until water quality is restored. Approximately 60 percent of the water supply of the San Francisco Bay Area is extracted from or passes through the Delta. The intrusion of saltwater would force the State of California and Bureau of Reclamation to stop pumping and would endanger the water supply for 3 million acres of irrigated land and over 23 million people. A levee failure would result in an encroachment of brackish or seawater into the Delta. The presence of the saltwater would also have a significant impact on local agriculture and salt-sensitive native species.

In general, a levee failure may result in substantial amounts of water to enter into developed areas protected by the levee. The force and volume of water that is generated by a levee failure may cause extensive structural damage in proximity to the breach and effects of flooding spreading well beyond the point of the failure. The extent of the impacts would vary based on several factors such as the volume of water released, the time of the failure, the amount of warning provided, the location of the breach, elevation, and distance from the breach. Potential impacts resulting from a levee failure include:
- Loss of life
- Property destruction or damage
- Loss of property contents
- Infrastructure damage
- Public health hazards resulting from mold, mildew, and disease due to flood water
- Flooded or destroyed lifelines/supply routes
- Damaged or destroyed utilities
- Loss of community economic base
- Employment losses
- Agricultural (crops and livestock) damages or destruction
- Environmental damage
- Prolonged periods of necessary dewatering
- Disruptions to education delivery to community
- Hazardous/toxic material impacts
- Disruption of evacuation routes

**Probability of Future Occurrence of the Hazard**

The California Water Policy Council and Federal Ecosystem Directorate (CALFED's “Seismic Vulnerability of the Sacramento-San Joaquin Delta Levees” report of April 2000 concluded that 3 to 10 failures are likely to occur on critical Delta levees during an earthquake with a 1 percent chance of occurring in any year (100-year level of protection).

Climate change in California is expected to increase the risk of flooding significantly. Increased flood frequency and magnitude are predicted consequences of climate change. As annual temperature increases more of the precipitation that would have fallen into the mountains as snow may fall instead as rain, increasing winter flows in the rivers downstream into the Delta system. As sea-levels rise, flood stages also rise, putting increasing pressure on levees. This threat may be particularly significant because recent estimates indicate that the additional force exerted upon the levees is equivalent to the square of the water level rise. For example, estimates using historical observations and climate model projections suggest that extreme high-water levels in the Bay and Delta will increase markedly if sea-level rises above its historical rate. These extremes are most likely to occur during storm events, leading to more severe damage from waves and floods. As water levels in the Delta increase, water levels upstream in the Sacramento and San Joaquin Rivers will also increase, putting additional pressure on levees located there.
That said, the probability of occurrence is tied to the extent to which such data and analysis of current conditions lead to a proactive and effective set of inspection, monitoring, maintenance, and improvement/mitigation measures. For the communities where CSU campuses are located, such measures and protocols are in place and are highly regulated. As such, the planning committees unanimously rank the probability of levee failure as Unlikely.

Vulnerability to the Hazard

The stability of levees is a function of several variables. Three main loading functions related to levee failure are water level changes, ground shaking, and static loading. Water level changes can be due to peak flood levels or rapid drawdown; both are known to adversely affect the stability of levees. Other hydrostatic influences known to affect levee stability are constant load, cyclical influx of seawater from bay (tidal changes), and reverse flows in some areas. Ground shaking is a function of earthquakes in and around the levees but can occur up to 100 kilometers or more away and still affect levee performance. Static loading represents the nominal loading conditions that regularly exist, but documented levee failures have occurred with no adverse conditions other than static loading.

However, as previously discussed, both the stability of the levee and the related vulnerability of downstream communities are a function of the extent to which proactive and effective sets of inspection, monitoring, maintenance, and improvement/mitigation measures are in place. For the communities where CSU campuses are located, such measures and protocols are in place and are highly regulated. For the CSU system, 6 of 23 campuses lie within highly regulated levee protected areas. As such, the vulnerabilities and impacts tied to a catastrophic levee failure as discussed within each campus Annex should regarded as extremely remote population and asset exposures.

Estimate of Potential Losses

Millions of people and billions of dollars of assets in California are protected by levees. The consequences of the levee failures is in terms of dollar figures associated with crop loss, building destruction, life loss, or saltwater intrusion that brings to a halt the pumping of fresh water to Central and Southern California as well as potential for environmental losses. Some of the areas protected by levees were originally intended to have land use compatible with agriculture but have subsequently become urban.

Vulnerability Assessment Conclusions

Earthquakes and high water are two of the greatest geo-physical risks to levees. The levee failure mechanism resulting from an earthquake deemed most likely was liquefaction of sand with levee fills if ground motions are sufficient. In addition, with climate change, floods and winds are projected to become more severe. A combination of higher tides, wind-driven surges, and high river discharge creates a significant high-water threat to levees. Offsetting geo-physical risks is human intervention, including levee inspection,
monitoring, maintenance, and improvement/mitigation measures. Such measures are effectuated consistently across CSU-based communities. As such, catastrophic events and related vulnerabilities for CSU campuses are represent extremely unlikely worst case scenarios.

Identified Data Limitations

Although we know which factors produce variability in the degree of levee failure risk and potential economic loss from one campus to another, quantifying dollar losses is currently limited and will require a HAZUS analysis or other type of analysis at the campus level and CSU system-wide. The CSU system’s leadership may consider developing such data sets in the future.
**Drought**

Description of the Hazard

Drought is defined as a condition where moisture levels fall significantly below normal for an extended period of time over a large area that adversely affects plants, animal life, and humans. Drought is a gradual phenomenon. Although droughts are sometimes characterized as emergencies, they differ from typical emergency events. Most natural disasters, such as floods or forest fires, occur relatively rapidly and afford little time for preparing for disaster response. Droughts occur slowly, over a multi-year period, and it is often not obvious or easy to quantify when a drought begins and ends.

Throughout California, one dry year does not normally constitute a drought. California’s extensive system of water supply infrastructure (reservoirs, groundwater basins, and conveyance assets) mitigates the effect of short-term dry periods for most water users. Defining when a drought begins is a function of drought impacts to water users. Drought in one location may not constitute a drought for all water users, as some users in relative proximity may have a different water supply. For example, individual water suppliers may use a combination of sources such as rainfall/runoff, water in storage, or expected supply from a water wholesaler to define their water supply conditions.

Drought can be characterized as one or more of the four following types:

- **Meteorological drought** is defined on the basis of the degree of dryness (in comparison to some “normal” or average amount) and the duration of the dry period. A meteorological drought must be considered as region-specific since the atmospheric conditions that result in deficiencies of precipitation are highly variable from region to region.

- **Hydrological drought** is associated with the effects of periods of precipitation (including snowfall) shortfalls on surface or subsurface water supply (e.g., streamflow, reservoir and lake levels, ground water). The frequency and severity of hydrological drought is often defined on a watershed or river basin scale. Although all droughts originate with a deficiency of precipitation, hydrologists are more concerned with how this deficiency plays out through the hydrologic system. Hydrological droughts are usually out of phase with or lag the occurrence of meteorological and agricultural droughts. It takes longer for precipitation deficiencies to show up in components of the hydrological system such as soil moisture, streamflow, and ground water and reservoir levels. As a result, these impacts are out of phase with impacts in other economic sectors.

- **Agricultural drought** focus is on soil moisture deficiencies, differences between actual and potential evaporation, reduced ground water or reservoir levels, and so forth. Plant water demand depends on prevailing weather conditions, biological characteristics of the specific plant, its stage of growth, and the physical and biological properties of the soil.
- **Socioeconomic drought** refers to when physical water shortage begins to affect health, well-being, and quality of life of people, or when the drought starts to affect the supply and demand of an economic product that relies on water.

The drought issue in California is further compounded by water rights. The central challenge is how to prioritize water usage among a broad variety of contexts. It is for this reason that water is a commodity possessed and utilized under a variety of legal doctrines. As such, many competing sets of interests create a dynamic prioritization process between, for example, farming and federally protected fish habitats and water supply for municipal/public use (including usage at CSU’s 23 campuses across the state) versus water usage for wildfire abatement or natural resource protection.

**Location of the Hazard**

Drought conditions have been identified in all of the municipalities, counties and regions wherein the 23 CSU campuses are located. Drought is not a location-specific hazard and affects the entire planning area equally. Drought location is not isolated to each campus footprint but occurs as a geographic sub-set of drought conditions occurring at larger scales. From 2000-2020, drought conditions existed continuously somewhere in the state, with 80-100% of the state impacted for 12 of the last 20 years.

**Extent of the Hazard**

Given the historical occurrence of severe drought impacts throughout the planning area and across the state and the potential future impact exacerbated by climate change, the CSU Planning Committee recognizes that drought will continue to pose a high degree of risk, potentially impacting crops, livestock, water resources, the natural environment at large, buildings and infrastructure (from land subsidence), and local economies. In addition, although drought affects the entire CSU planning area equally, the potential impacts may be variable and specific to each campus/jurisdiction, depending on contextual factors such as the degree of assets and types of activities, historically impacted by drought within each campus and surrounding community. For example, five (5) CSU campuses maintain agricultural programs with assets and products particularly vulnerable to drought (Cal Poly San Luis Obispo, Humboldt State, Fresno State, CSU-Chico, Cal Poly Pomona).

In addition, land subsidence has occurred and will continue in areas where the groundwater basin has been subject to overdraft and long-term recharge is inadequate to maintain the water table elevation, leaving underground voids. Subsidence levels have been measured up to 30-feet with subsidence bowls covering hundreds of square miles. As such, drought-related subsidence may result in serious structural damage to buildings, roads, irrigation ditches, underground utilities, and pipelines. Overall, based on the above

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factors, the CSU planning committee ranks the extent of the hazard for its campuses as **Moderate**.

The U.S. Drought Monitor developed tables of impacts reported during past droughts in California in order to depict the extent of drought risk for each level of drought on the U.S. These possible extent conditions for California complement the general impacts column of the U.S. Drought Monitor Classification Scheme.

Table 3-15: Impacts of Drought Levels as Determined by US Drought Monitor

<table>
<thead>
<tr>
<th>Category</th>
<th>Impact</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>D0</strong></td>
<td>Soil is dry; irrigation delivery begins early</td>
</tr>
<tr>
<td></td>
<td>Dryland crop germination is stunted</td>
</tr>
<tr>
<td></td>
<td>Active fire season begins</td>
</tr>
<tr>
<td></td>
<td>Winter resort visitation is low; snowpack is minimal</td>
</tr>
<tr>
<td><strong>D1</strong></td>
<td>Dryland pasture growth is stunted; producers give supplemental feed to cattle</td>
</tr>
<tr>
<td></td>
<td>Landscaping and gardens need irrigation earlier; wildlife patterns begin to change</td>
</tr>
<tr>
<td></td>
<td>Stock ponds and creeks are lower than usual</td>
</tr>
<tr>
<td></td>
<td>Grazing land is inadequate</td>
</tr>
<tr>
<td></td>
<td>Producers increase water efficiency methods and drought-resistant crops</td>
</tr>
<tr>
<td></td>
<td>Fire season is longer, with high burn intensity, dry fuels, and large fire spatial extent; more fire crews are on staff</td>
</tr>
<tr>
<td><strong>D2</strong></td>
<td>Wine country tourism increases; lake- and river-based tourism declines; boat ramps close</td>
</tr>
<tr>
<td></td>
<td>Trees are stressed; plants increase reproductive mechanisms; wildlife diseases increase</td>
</tr>
<tr>
<td></td>
<td>Water temperature increases; programs to divert water to protect fish begin</td>
</tr>
<tr>
<td></td>
<td>River flows decrease; reservoir levels are low and banks are exposed</td>
</tr>
<tr>
<td><strong>D3</strong></td>
<td>Livestock need expensive supplemental feed, cattle and horses are sold; little pasture remains, producers find it difficult to maintain organic meat requirements</td>
</tr>
<tr>
<td></td>
<td>Fruit trees bud early; producers begin irrigating in the winter</td>
</tr>
<tr>
<td></td>
<td>Federal water is not adequate to meet irrigation contracts; extracting supplemental groundwater is expensive</td>
</tr>
</tbody>
</table>

42 United States Drought Monitor. *Drought Classification*. Retrieved 05.04.2021 from: [https://droughtmonitor.unl.edu/About/AbouttheData/DroughtClassification.aspx](https://droughtmonitor.unl.edu/About/AbouttheData/DroughtClassification.aspx)
Dairy operations close
Marijuana growers illegally tap water out of rivers
Fire season lasts year-round; fires occur in typically wet parts of state; burn bans are implemented
Ski and rafting business is low, mountain communities suffer
Orchard removal and well drilling company business increase; panning for gold increases
Low river levels impede fish migration and cause lower survival rates
Wildlife encroach on developed areas; little native food and water is available for bears, which hibernate less
Water sanitation is a concern, reservoir levels drop significantly, surface water is nearly dry, flows are very low; water theft occurs
Wells and aquifer levels decrease; homeowners drill new wells
Water conservation rebate programs increase; water use restrictions are implemented; water transfers increase
Water is inadequate for agriculture, wildlife, and urban needs; reservoirs are extremely low; hydropower is restricted
Fields are left fallow; orchards are removed; vegetable yields are low; honey harvest is small
Fire season is very costly; number of fires and area burned are extensive
Many recreational activities are affected
Fish rescue and relocation begins; pine beetle infestation occurs; forest mortality is high; wetlands dry up; survival of native plants and animals is low; fewer wildflowers bloom; wildlife death is widespread; algae blooms appear
Policy change; agriculture unemployment is high, food aid is needed
Poor air quality affects health; greenhouse gas emissions increase as hydropower production decreases; West Nile Virus outbreaks rise
Water shortages are widespread; surface water is depleted; federal irrigation water deliveries are extremely low; junior water rights are curtailed; water prices are extremely high; wells are dry, more and deeper wells are drilled; water quality is poor;

History of the Hazard
Historically, drought has been so prevalent in California that its presence is almost ubiquitous and consistently recurring, including those communities connected to the
CSU 23-campus footprint. According to the National Drought Mitigation Center, over 3,500 reports and publications covering 370 drought-related events took place across the state (many of which were statewide events) between 2000-2020. In addition, the National Center for Environmental Information (NCEI) reports more than 500 events statewide during this same period. These events produced a comprehensive range of impacts to water supply, regulations and allocations to businesses and municipalities, budgets and resources for firefighting, water law and policy, and physical impacts to built and natural environments. As such, data records of previous occurrences can be viewed as separate time and event demarcations for a hazard almost continuously in effect across the state with cascading impact potential.

According to the Department of Water Resources, droughts exceeding three years are relatively common in Southern California, but relatively rare in Northern California - the region is the geographic source of much of the state’s developed water supply. The 1929-34 drought established the criteria commonly used in designing storage capacity and yield of large Northern California reservoirs. 43

According to the US Drought Monitor’s time series data, from 2000-2021 (with the exception of a 2-3 month period in 2000 and 2011), some degree of drought conditions have been continuously in effect somewhere in California. In fact, 80% - 100% of the state has been subjected to drought conditions for 12 of the last 20 years, with the most severe drought being the 100% state-wide event from 2012-2017. Please refer to each campus Annex for the Figure showing historical periods of drought for the county connected to each campus. Each Figure provides the county-level data corresponding to the state-level data in Figure 3-5 (below).

Figure 3-5: Periods of Drought in State of California, 2001 – 202144


Given the ubiquitous nature of the drought risk in California, the following drought event was selected as an exemplar due to its broad and significant impacts on the state and on the communities surrounding the CSU 23 campus planning area:

2012 – 2017 – Drought produced severe impacts to water wells throughout the state of California, with a high number of wells running dry. Land subsidence due to increased groundwater pumping also occurred in numerous areas of the state such as the San Joaquin and Central Valleys. Crop damage was widespread as well. Water allotments were drastically reduced in many towns and water agencies, with extremely high costs for procuring water. In addition, job loss occurred with many families requiring food supply assistance, and water supply assistance provided to homeowners with dry wells. According to a report released by UC Davis Center for Watershed Sciences, the 2014=2017 period of the California drought cost the state’s agriculture industry about $1 billion in lost revenue, with a total statewide economic cost of the drought calculated to be $2.2 billion. The report says, “it is responsible for the greatest water loss ever seen in California agriculture - about one third less than normal”. The report calls the groundwater situation in California "a slow-moving train wreck." Spring snowpack at Donner Summit reached record low levels in 2014, exceeded in 2015 by a remarkable April 1 snow-water-equivalent value of only 5% of average. Decreased precipitation since contributed to near-record low levels in the Shasta Reservoir. The ongoing drought has contributed to declines in crop values across the state. For example, crops including cotton, corn silage and barley (the field crop category) fell by 42 percent. 45

Potential Impacts of the Hazard

Drought impacts are wide-reaching and may be economic, environmental, and/or societal. This assessment of its impact recognizes that historic occurrences of drought throughout the planning area are a sub-set of larger and inter-connected local and regional droughts, and that the (related) historic impacts provide a sound basis for understanding potential (future) impacts.

The most significant impact associated with drought across the CSU 23 campus planning area is the historic and potential reduction in water availability for the municipal area tied to each campus. Other impacts include crop loss and damage to trees and other natural resources (See Tree Mortality below). The footprint of CSU campuses variably includes these vulnerable resources based on each campus’ landscape (trees) and the existence (and footprint size) of agricultural research crops and field stations.

As a secondary impact of drought, wildfire is directly attributable to dry atmospheric conditions. Wildfires almost always coincide with drought in California, though not

limited to such. However, the wildfire hazard is analyzed separately in this plan. (See X for coverage of the wildfire hazard).

In reviewing the occurrences of drought for CSU campus’ 23 locations (in municipalities and counties), the US Drought Monitor and the National Drought Mitigation Center report that tens of millions of trees died during the (2014-2017) state-wide drought disaster. Though data sources do not provide data for tree mortality specific to the CSU system, the broad geographic extent of the impact makes it likely that tree mortality occurred to some degree on the campuses. Due to the lasting and ongoing effects of drought on the landscape, trees will continue to be impacted within the municipalities, counties and regions wherein lies the CSU campus system as long as drought conditions continue.

Given the absence of data, in order for the CSU Committee to assess the impact of tree mortality, it is useful to view it as a risk sub-set to the probability, location, extent, severity and duration of the drought hazard within each campus-located municipality, county and region. Regarding potential impacts, standing dead trees could fall, posing a risk to people, buildings, power lines, roads and other infrastructure. In addition, drought-impacted trees become susceptible to diseases and insect infestations (bark beetle) further adding to the risk of tree mortality and related potential impacts. No data is currently available for tree mortality on-campus; however, the CSU Planning Team will pursue data on this issue in the future.

As a potential tertiary impact, prolonged and repeated drought conditions over time can produce land subsidence and the risk of damage to building foundations and infrastructure on campus resulting from ground instability and collapse. Land subsidence is defined as the vertical sinking of the land over manmade or natural underground voids. Subsidence is often the direct result of groundwater over-extraction in response to drought conditions, as well as oil and gas extraction. Weight can accelerate the process of subsidence resulting from surface development and infrastructure such as roads and buildings, vibrations from construction blasting and heavy truck or train traffic. For example, the State Water Project’s 444-mile-long California Aqueduct has required repairs such as the raising of canal linings, bridges, and water control structures on the Aqueduct – in the Central Valley a five-mile reach of the Eastside Bypass was impacted by subsidence, and the Department of Water Resources estimated that it may cost in the range of $250 million to acquire flowage easements and levee improvements to restore the design capacity of the subsided area.

At present, drought related damage to campus buildings and infrastructure has not been reported, but the potential for such impacts is possible.

With regard to overall potential impact, water supply/availability for CSU campuses is ultimately tied to broader inter-dependent, and more intensive modes of water use at local and regional scales such as agriculture and ranching, wildfire protection, larger metropolitan/municipal usage, manufacturing and commerce, tourism, recreation, and wildlife preservation. During drought periods, the State of California’s regulated water allocations are modified and often reduced, which can result in reduced water availability for all usage contexts, including CSU campuses. A reduction of electric power generation and water quality deterioration are also potential impact factors.

Table 3-16: Summary of Drought Impacts on Water Resources\(^{48}\)

<table>
<thead>
<tr>
<th>Resource</th>
<th>Type of Impact</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sea Level</td>
<td>Direct</td>
<td>Sea level is rising and will likely impact coastal areas</td>
</tr>
<tr>
<td>Soil Moisture</td>
<td>Direct</td>
<td>Prolonged dry seasons can lead to decreases in soil moisture; drier vegetation</td>
</tr>
<tr>
<td>Vegetation</td>
<td>Indirect</td>
<td>Longer and more intense fire season with increased extent of area burned</td>
</tr>
<tr>
<td>Stream Conditions</td>
<td>Direct</td>
<td>Increases in water temperature; potential effects on fish</td>
</tr>
<tr>
<td>Snowpack</td>
<td>Indirect</td>
<td>Increases in temperature will lead to decreases in snowpack</td>
</tr>
<tr>
<td>Runoff</td>
<td>Direct</td>
<td>Warmer temperatures are likely to lead to a shift in peak runoff from spring to winter and a likely decrease in summer base flow</td>
</tr>
<tr>
<td>Hydropower</td>
<td>Indirect</td>
<td>Decreased summer flows resulting from earlier snowmelt and a shift in peak runoff could affect hydropower generation during summer months</td>
</tr>
<tr>
<td>Precipitation</td>
<td>Direct</td>
<td>Warmer winter temperatures will result in a greater percentage of precipitation falling as rain rather than as snow</td>
</tr>
</tbody>
</table>

Groundwater

Indirect

Reduction in snowpack and extended periods of drought are likely to increase dependency on groundwater

Probability of Future Occurrence of the Hazard

**Highly Likely** — The US Drought Monitor’s time series data (2000-2020) indicates that some degree of drought has nearly a 100% probability of occurrence somewhere in the state in any given year. Given that the CSU planning area covers 23 campuses spread throughout the state, it is prudent to extend this likelihood of occurrence to the planning area.

Vulnerability to the Hazard

In California, rising temperatures are projected to increase the average lowest elevation at which snow falls, reducing water storage in the snowpack, particularly at those lower mountain elevations which are now on the margins of reliable snowpack accumulation. Higher spring temperatures will also result in earlier melting of the snowpack. The shift in snow melt to earlier in the season is critical for California’s water supply because flood control rules require that water be allowed to flow downstream and that water cannot be stored in reservoirs for use in the dry season. Given that state-level drought location, extent and potential impact frame these same factors at the level of the CSU campus system, these same state-level conditions apply to the vulnerability of the CSU system as well.

Moreover, climate change will likely adversely impact the vulnerability of watersheds and ecosystems in their ability to deliver important ecosystem services. These changes may limit the natural capacity of healthy forests to capture water and regulate stream flows. Sierra Nevada mountain winters and springs are warming, and on average, precipitation as snowfall relative to rain is decreasing. A warming climate with reduced snowpack will result in earlier snowmelt and will subsequently reduce downstream water availability during summer and early fall.

As such, the state and CSU planning area stakeholders potentially have less capacity to address future drought risks due to projected temperature increases and shortages in water; ground-water withdrawals have been occurring at a deficit rate of one-to-two-million-acre feet per year, where the impacts of drought include decreased availability of water for agriculture and environmental uses. 49 In forested and other vegetated areas, prolonged drought decreases the moisture content of forest fuels and increases the risk of high severity wildfires.

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It should be pointed out that California is the single most productive agricultural state and its agricultural industry relies heavily on reservoir water supplied by snowmelt and rainfall runoff. Yearly variations in snowpack depths have implications for water availability as snowmelt from the winter snowpack feeds a network of reservoirs. Spring snowpack at Donner Summit reached record low levels in 2014, exceeded in 2015 by a remarkable April 1 snow-water-equivalent value of only 5% of average. Decreased precipitation since 2011 has contributed to near-record low levels in the Shasta Reservoir.

Vulnerability of Populations

The historical and potential impacts of drought on California’s population include agricultural sector job loss, secondary economic losses to local businesses and public recreational resources, increased cost to local and state government for large-scale water acquisition and delivery, and water rationing and water wells running dry for individuals and families. As drought is often accompanied by prolonged periods of extreme heat, negative health impacts such as dehydration can also occur, where children and elderly are most susceptible. Air quality often declines in times of drought which can affect those with respiratory ailments. These same vulnerability measures apply to the students, faculty and staff of the CSU 23-campus system.

Property Vulnerability

The historical and potential impacts of drought on property include crop loss, injury and death of livestock and pets, and damage to infrastructure, homes and other buildings resulting from the secondary drought impact of land subsidence. The related drought impacts of tree mortality and land subsidence pose risks to vulnerable critical infrastructure and property. These same vulnerability measures apply to the properties of the CSU 23-campus system.

Natural Environment Vulnerability

The historical and potential impacts of drought on the natural environment are widespread throughout public and private lands within the state, including tree mortality, impacts to all flora and fauna, and destabilization (subsidence) of land along streams and rivers, and within watersheds.

The core issue shaping the impact of drought throughout California is water supply and demand. Several factors play into the issue including groundwater basins, surface water run-off, public and agricultural demand, and surface water storage water sheds. A USGS led analysis was first conducted in 2010 through the Forest and Rangeland Assessment and ongoing through the USGS Forest and Rangeland Ecosystem Science Center to identify threats and assets where water supply would benefit from environmental

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management designed to protect or enhance water resources, the key effort which, in part, both defines and mitigates the severity of drought risk and vulnerabilities.

With regard to overall threat and asset findings shaping the potential severity of drought, the watersheds in the Sierra region contribute most greatly to the state’s water supply, but are under threat from climate change, wildfire and development. In addition, groundwater basins in the San Joaquin Valley and Sacramento Valley bioregions are an abundant resource that is heavily threatened by over pumping.

**Critical Facilities Vulnerabilities**

Drought impacts to state and CSU critical facilities include water shortfalls for facility operations and critical functions, and potential structural destabilization and damage resulting from land subsidence.

**Estimate of Potential Losses**

An estimate of potential losses from drought has not been calculated for the CSU system as a whole. However, drought related losses to the cities, counties and regions surrounding each campus such as crop loss and cost increases for water resources have re-occurred over time. Please consult city and county level government, and/or state agricultural agencies for data on the financial impacts from drought.

**Vulnerability Assessment Conclusions**

The CSU Planning Committee understands that the high degree of vulnerability posed by drought will be exacerbated by greater climate variation in the future and therefore greater variation and uncertainty regarding the availability of water supplies which are already under tremendous stress. In response to such vulnerability, state legislation passed in 2014 requires local governments to regulate pumping and recharge to better manage groundwater supplies, and groundwater-dependent regions are required to halt overdraft and bring basins into sustainable levels of pumping and recharge by the early 2040s. That said, the Committee will continue to work with local, regional and state partners and stakeholders to explore solutions for mitigating the drought hazard on its campuses by accessing the best available data and resources on climate change and its relationship to drought.

**Identified Data Limitations**

Data is limited concerning campus-related agricultural assets as well as data on campus tree mortality. CSU leadership may acquire or produce such data sets in the future.
**Earthquake**

Description of the Hazard

An earthquake is a sudden motion or shaking caused by the release of pressure accumulated along the edge of tectonic plates covering the earth. These huge plates are constantly moving and move ever so slowly under, over, or by passing one another. This movement is gradual however the plates may lock together accumulating enormous amounts of energy. When this energy builds, stress develops, and the adjoining plates will eventually break free and result in ground shaking – an earthquake.

Large earthquakes may result in fissuring, ground settlement, and/or vertical or horizontal displacement. Earthquakes occur without warning and can result in extensive damages and human casualties. Damages associated to earthquake generated ground shaking is normally confined to a narrow area along fault trend from the earthquake epicenter. However, seismic waves may generate ground shaking resulting in damages in areas outside of the fault trend.

**Fault Rupture** - The rupture of faults is the differential movement of the two sides of the earth’s plates at the point of the fault. Horizontal or vertical displacement may be significant and occur over great distances. The movement and energy that occurs along a fault is released in waves resulting in ground shaking. The intensity of ground shaking varies based on the magnitude of the earthquake, the proximity to the earthquake epicenter, the composition of the ground sediment or rock the waves travel through, and the depth of the earthquake.

**Liquefaction** - As seismic waves travel through saturated granular soil; the soil begins to liquefy and act as a fluid. Soil strength and stability is lost causing the effects of ground shaking to intensify and for ground deformation to occur. These water saturated soils when shaken quickly lose the ability to support buildings, bridges, utilities, and other structures. The greater the magnitude of an earthquake and longer duration of strong ground shaking will result in an enhanced potential for liquefaction to occur.

The severity of earthquake damage is expressed in terms of magnitude and intensity. The amount of energy released during an earthquake is normally conveyed as a magnitude measured from a seismogram. Magnitude is expressed in numbers and decimals representing the physical size of the earthquake. The strength and effect of the shaking on the surface of the earth is classified as the intensity. Intensity is further defined from the effects the earthquake has on people, structures, and the natural environment. The intensity of an earthquake in terms of measuring magnitude and evaluating its effects is generally expressed using the Modified Mercalli (MM) Intensity Scale. (See Mercali Scales under Extent of the Hazard section below).

**Location of the Hazard**

The State of California is particularly vulnerable to earthquake activity due to California’s location residing between two large tectonic plates. California has a chronic and destructive earthquake history with widespread vulnerability, as indicated by California
Geological Survey (CGS) mapping of potential earthquake shaking intensity zones. Many of these zones are commonly located near populated areas.
The state- and federal-declared earthquake disasters by county (representing 26 of California’s 58 counties) are:

- Los Angeles County – 6
- Imperial County – 5
- Humboldt, Napa, and Solano Counties – 3 in each county
- Orange, Riverside, San Bernardino, Santa Barbara, and Santa Clara Counties – 2 in each county
- Alameda, Butte, Contra Costa, Fresno, Marin, Modoc, Mono, Monterey, Sacramento, San Benito, San Francisco, San Joaquin, San Luis Obispo, San Mateo, Santa Cruz, Sonoma, and Ventura Counties – 1 in each county

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51 2018 State Hazard Mitigation Plan/original map from USGS, CGS National Atlas, ESRI
The following map shows the numbers of historical occurrences of earthquake events described as MMI Scale VII or greater from 1800 to 2017. Events have been concentrated along the San Andreas Fault system, particularly in the San Francisco Bay, Monterey Bay, and Humboldt County areas. A significant earthquake is expected in Southern CA in the near future.

Figure 3-7: Areas Damaged by Earthquakes

Source: California Geologic Survey

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52 CA Geologic Survey/2018 CA SHMP
The above map shows the distribution within California of state-proclaimed and federally declared earthquake disasters from 1950 to 2017. The distribution of disasters can be generally related to potential future earthquake shaking hazards levels in California.

**Extent of the Hazard**

Please consult each campus annex for those factors and conditions shaping the extent of the earthquake hazard, along with a corresponding extent ranking. Given a wide-range of extent factors and rankings across the CSU system, the system-wide planning committee ranks the extent of the hazard for the system as a whole as **Moderate**.
The Richter magnitude scale was developed in 1935 by Charles F. Richter of the California Institute of Technology as a mathematical device to compare the size of earthquakes. The Richter Scale is the best-known scale for measuring the extent or magnitude of earthquakes. The magnitude value is proportional to the logarithm of the amplitude of the strongest wave during an earthquake. A recording of 7, for example, indicates a disturbance with ground motion 10 times as large as a recording of 6. The energy released by an earthquake increases by a factor of 31 for every unit increase in the Richter scale.

Table 3-17: Earthquake Intensity/Frequency Comparisons

<table>
<thead>
<tr>
<th>Magnitude</th>
<th>Mercalli Intensity</th>
<th>Potential Damage</th>
<th>Global Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 2.0</td>
<td>I</td>
<td>None</td>
<td>Continually</td>
</tr>
<tr>
<td>2.0 - 2.9</td>
<td>I to II</td>
<td>None</td>
<td>&gt; IM per year</td>
</tr>
<tr>
<td>3.0 - 3.9</td>
<td>II to IV</td>
<td>Light</td>
<td>&gt; 100,000 per year</td>
</tr>
<tr>
<td>4.0 - 4.9</td>
<td>IV to VII</td>
<td>Light</td>
<td>10K to 15 K per year</td>
</tr>
<tr>
<td>5.0 - 5.9</td>
<td>VI to VII</td>
<td>Moderate</td>
<td>1K to 1,500 per year</td>
</tr>
<tr>
<td>6.0 - 6.9</td>
<td>VII to X</td>
<td>Heavy</td>
<td>100 to 150 per year</td>
</tr>
<tr>
<td>7.0 - 7.9</td>
<td>VII &lt;</td>
<td>Very Heavy</td>
<td>10 - 20 per year</td>
</tr>
<tr>
<td>8.0 - 8.9</td>
<td>VII &lt;</td>
<td></td>
<td>1 per year</td>
</tr>
<tr>
<td>&gt; 9.0</td>
<td>VII &lt;</td>
<td></td>
<td>1 per 10-50 years</td>
</tr>
</tbody>
</table>

The Modified Mercalli Intensity Scale provides descriptive values of earthquake intensity that may provide greater meaning to the broader population as the description of intensity refers to the effects actually experienced. This scale uses an arbitrary ranking based on observed earthquake effects. The scale is composed of increasing levels of intensity ranging from shaking that is not recognizable to intense shaking resulting in catastrophic damages and casualties. The Modified Mercalli Intensity Scale is demonstrated below:

Table 3-18: Modified Mercalli Intensity Scale

<table>
<thead>
<tr>
<th>Intensity</th>
<th>Shaking</th>
<th>Description / Damage</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Not felt</td>
<td>Not felt except by a very few under especially favorable conditions.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Level</th>
<th>Intensity</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>II</td>
<td>Weak</td>
<td>Felt only by a few persons at rest, especially on upper floors of buildings.</td>
</tr>
<tr>
<td>III</td>
<td>Weak</td>
<td>Felt quite noticeably by persons indoors, especially on upper floors of buildings. Many people do not recognize it as an earthquake. Standing motor cars may rock slightly. Vibrations similar to the passing of a truck. Duration estimated.</td>
</tr>
<tr>
<td>IV</td>
<td>Light</td>
<td>Felt indoors by many, outdoors by few during the day. At night, some awakened. Dishes, windows, doors disturbed; walls make cracking sound. Sensation like heavy truck striking building. Standing motor cars rocked noticeably.</td>
</tr>
<tr>
<td>V</td>
<td>Moderate</td>
<td>Felt by nearly everyone; many awakened. Some dishes, windows broken. Unstable objects overturned. Pendulum clocks may stop.</td>
</tr>
<tr>
<td>VI</td>
<td>Strong</td>
<td>Felt by all, many frightened. Some heavy furniture moved; a few instances of fallen plaster. Damage slight.</td>
</tr>
<tr>
<td>VII</td>
<td>Very strong</td>
<td>Damage negligible in buildings of good design and construction; slight to moderate in well-built ordinary structures; considerable damage in poorly built or badly designed structures; some chimneys broken.</td>
</tr>
<tr>
<td>VIII</td>
<td>Severe</td>
<td>Damage slight in specially designed structures; considerable damage in ordinary substantial buildings with partial collapse. Damage great in poorly built structures. Fall of chimneys, factory stacks, columns, monuments, walls. Heavy furniture overturned.</td>
</tr>
<tr>
<td>IX</td>
<td>Violent</td>
<td>Damage considerable in specially designed structures; well-designed frame structures thrown out of plumb. Damage great in substantial buildings, with partial collapse. Buildings shifted off foundations.</td>
</tr>
<tr>
<td>X</td>
<td>Extreme</td>
<td>Some well-built wooden structures destroyed; most masonry and frame structures destroyed with foundations. Rails bent.</td>
</tr>
</tbody>
</table>
History of the Hazard

California has a chronic and destructive earthquake history with widespread vulnerability, as indicated by California Geological Survey (CGS) mapping of potential earthquake shaking intensity zones. Many of these zones are commonly located near populated areas. Earthquakes large enough to cause moderate damage to structures—those around Magnitude 5.5—occur three to four times a year in California. Strong earthquakes of Magnitude 6 to 6.9 strike California on an average of once every two to three years. An earthquake of magnitude 6 to 6.9 strike California on an average of once every two to three years, such as the 1994 Northridge Earthquake (Magnitude 6.7) or the 1983 Coalinga Earthquake (Magnitude 6.7), is capable of causing major damage, if the epicenter is near a densely populated area. Major earthquakes (Magnitude 7 to 7.9) occur in California about once every 10 years. It is well established that earthquake monitoring and data gathering instruments detect earthquakes regularly in many of the communities connected to CSU campuses, and events “felt” by the population in these communities are not uncommon and occasionally occur. That said, the 1989 Loma Prieta earthquake in San Francisco and the 1994 Northridge earthquake are the two most notably catastrophic events.

Potential Impacts of the Hazard

Earthquakes represent the most destructive source of hazards, risk, and vulnerability, both in terms of recent state history and the probability of future destruction of greater magnitudes than previously recorded. Earthquakes are a significant concern for California. In addition to shaking, buildings are also vulnerable to ground displacements associated with primary fault rupture, liquefaction, differential settlement, and landslides. Inundations from tsunamis, seiches, and dam failures can also be major sources of loss to buildings and infrastructure. Most injuries resulting from earthquakes are from collapsing walls, flying glass, or other objects moved by ground shaking. The lack of warning allows individuals minimal time to react and find areas of safety.

The 1994 Northridge Earthquake (Magnitude 6.7) which caused over $40 billion of disaster losses, 57 deaths, and 11,846 injuries. After the Northridge earthquake, all the buildings at California State University, Northridge were closed. Through the dedication of the administration the campus reopened for classes one month later—using 450 trailers and other temporary buildings spread around on available campus space.54

During an earthquake event, CSU campuses impacted may experience closures of different kinds of campus spaces, including classrooms, laboratories, libraries and offices. In addition to the potential loss of life, buildings and infrastructure, there are a wide range of additional value losses, including equipment, building contents, and scholarly and

scientific research. The trauma associated with experiencing a large earthquake often requires mental health assistance to victims.

The impacts of a major earthquake would be felt beyond any given campus and would have long reaching effects. The risk of casualties and damages would likely extend to the homes and workplaces of members of the campus community including students, staff, and faculty. The effects on the regional economy may be negatively altered as commercial and industrial facilities may not be functional due to damaged goods and/or facilities. The cessation of businesses would result in job losses and greater needs among members of the community. Ability to rebuild will be influenced by the disrupted supply chain and contractor resources, affecting the continuity of operations on the campus and impacting the educational productivity and return of students whose education is disrupted. Short-term closures will impact the retention of the students, and potential recruitment of faculty.

Please note that the (above) earthquake impacts might be aggravated by collateral incidents such as fire, flooding, hazardous material spills, dam/levee compromises, and other cascading events.

In summary, potential impacts to CSU campuses from an earthquake could include:

- Potential hazardous material releases on and off campus
- Infrastructure damage to State Route 99
- Damages to rail lines and rail cars ½ mile to east and west of campus
- Structural damage to bridges over waterways and flood control channels
- Potential isolation of campus from community
- Potential isolation among on-campus residents
- Structural damage to flood control levees
- Structural damage to campus academic and support buildings
- Structural damage to residence halls resulting in displaced student populations
- Structural damage to nearby residences and businesses
- Community members arriving on campus for refuge from damaged homes
- Damaged university communications, computer systems, and networks
- Considerable stress and fear among community
- Closure or reduction of service to campus operations
- Reduction of campus revenue

Probability of Future Occurrence of the Hazard

For the state’s two most densely populated metropolitan areas, based on the most recent earthquake forecast model for California, the USGS and other scientists estimate a 72-
percent probability that at least one earthquake of Magnitude 6.7 or greater, capable of causing widespread damage, will strike the San Francisco Bay Area before 2044. For the Los Angeles region, the same model forecasts a 60-percent probability that an earthquake of Magnitude 6.7 or greater will occur before 2044.

The map below depicts probabilities of various magnitude earthquakes greater than Magnitude 6.7 occurring in 30 years in various regions of the state. These probabilities include greater than 99 percent for a Magnitude 6.7 event, 93 percent for a Magnitude 7.0 event, 48 percent for a Magnitude 7.5 event, and 7 percent for a Magnitude 8.0 event. Given the location of CSU campuses in relation to the fault lines described in each campus annex along with their locations in relation to the magnitude/probability map (below), the system-wide planning committee ranks the probability of occurrence for the system as a whole as Possible to Likely.
Vulnerability to the Hazard

The CSU campuses located in areas identified as earthquake intensity zones are susceptible to earthquake impacts. The degree of earthquake resilience will be based on the conditions of the individual buildings, the level of seismic strengthening (structural and non-structural retrofitting) and the number of buildings that have been designed and built to a higher standard of earthquake safety. The building damage will vary, depending on the campus location in context of the earthquake epicenter and the duration and direction of the ground motions. Observations of damage from California earthquakes have also shown that ground shaking may be locally attenuated but then be amplified farther away due to differential soil conditions and structural response.

In addition to building and population vulnerabilities, campuses may be vulnerable to an earthquake due to local and regional impacts on the following infrastructure:

- Electrical utilities
- Pipeline networks: oil and natural gas
- Petrochemical facilities: oil refineries and liquefied natural gas facilities
- Localized water and wastewater pipelines and treatment facilities
- Statewide water system: aqueducts, canals, levees, dams, and reservoirs
- Solid waste disposal systems
- Transportation systems
- Ports and harbors
- Communication systems
- Hospital and Heath Care facilities

**Estimate of Potential Losses**

Estimates of potential losses for each campus will be influenced by a variety of factors. The intensity of the earthquake will determine what scale of damages affecting campus infrastructure, equipment, and other impacted features. Losses will be generated by the physical damages, the loss of revenue, loss of academic research, loss of building contents, and community wide economic reductions. The CSU leadership may consider conducting an advanced analysis of quantitative/dollar loss impacts to each campus and for the system as a whole in the future.

**Vulnerability Assessment Conclusions**

It is difficult to predict the severity of casualties, property, and cascading impacts generated by future seismic events affecting the CSU campuses. Each of the earthquake generated effects will vary widely based on the intensity of the earthquake, location of the epicenter, proximity to people and development, time of day and year, the soil composition under the impacted structures, building construction, among others. For campuses at risk, the potential for a major earthquake exists affecting the campus and causing extensive challenges to the CSU campus and community.

In the event that a major earthquake was to strike along the fault systems, the effects could be significant to the campus community and campus operations.

Compared to other earthquake vulnerabilities, CSU buildings pose the largest risk to life, injury, property, and economic welfare. The buildings built to earlier standards may have inadequate earthquake performance. Observations after earthquakes indicate that building safety is most often compromised by poor quality in design and construction, inadequate maintenance, lack of code enforcement at the time of original construction, and improper alterations to the original building.

A less common cause of damage is the poor performance of older buildings built to earlier seismic codes. Explicit requirements for earthquakes first began to be incorporated into building codes in 1933 and the state first required local governments to create building departments and issue permits. The Structural Engineers Association of California’s first statewide consensus on recommended earthquake provisions were published in 1960. In the mid- to late-1970s significant improvements to lateral force requirements began to be enforced throughout the state. California did not have uniform adoption of the same edition of model codes in every jurisdiction until the early 1990s.

Nonstructural building components on CSU properties can also become vulnerable to damage during earthquakes. Ceilings, air conditioning equipment, plumbing and water heaters, windows, chimneys, appliances, and stone veneer are examples of non-
structural components that may become damaged as a result of earthquake ground shaking.

While ground shaking may be the predominant agent of damage in most earthquakes, fires following earthquakes can also lead to catastrophic damage depending on the combination of building characteristics and density, meteorological conditions, and other factors. Fires following earthquakes may result from multiple causes (e.g., overturned burning candles, electrical sparking from downed power lines, and broken natural gas pipelines). 56

The widespread impacts generated by a major earthquake impacting a CSU campus would extend the effects of casualties, damages, and other impacts to the broader campus region creating large-scale regionwide needs for critical assistance and a heavy demand on limited emergency resources.

Identified Data Limitations

Although we know which factors produce variability in the degree of earthquake risk and potential economic loss from one campus to another, quantifying dollar losses is currently limited and will require an advanced HAZUS analysis or other type of analysis at the campus level and CSU system-wide. The CSU system’s leadership may consider developing such data sets in the future.

Erosion

Description of the Hazard

The US Geological Survey (USGS) defines erosion as “the process whereby materials of the earth’s crust are loosened, dissolved, or worn away and simultaneously moved from one place to another”. 57 Erosion may occur in areas of streams and rivers, along bluffs, around immovable objects (such as buildings or bridge abutments), or as a cascading result of other natural hazards, such as earthquakes or wildfires. When erosion occurs along bodies of water, the removal of material causes the shore to move further landward.

Forces such as sea level rise and changes in sediment supply impact erosion gradually and can be difficult to recognize. In contrast, the impacts of short-term events, such as storms and flooding, can be severe and are immediately recognizable. Along the Pacific coast, rain, wind, and waves can induce significant short-term erosion.

Location of the Hazard

Erosion is a severe hazard in coastal communities, where sea level rise and storms contribute to de-sedimentation and the retreat of coastal cliffs, bluffs, and beaches. While

coastal erosion can happen in any storm, it is more likely during El Nino events, which occur every 5-7 years.

Other incidents of erosion, such as occurs around buildings, is relatively non-spatial and can occur in any locations with conducive soil structure and a source of movement, such as water or wind. An area’s potential for erosion is determined by several factors, including rainfall, topography, soil characteristics, and vegetative cover. For the purpose of a CSU system-wide analysis, the erosion hazard poses a consistent risk across those areas of each campus with erosion-prone characteristics.

Extent of the Hazard

Erosion is occurring along the entire Pacific coastline. The USGS estimates that the state’s shorelines with the highest rates of erosion are in Monterey Bay and San Francisco South, and that, in general, erosion hazards have increased.\(^{58}\) While there is no published scale of severity or extent for this geologic hazard on any individual campus, erosion is likely to occur over the long term if conditions remain favorable. That said, given the historical occurrence of erosion and the presence of erosion-prone characteristics on some campuses and not on others, it is prudent that the planning committee ranks the overall extent of this hazard as **Moderate**.

History of the Hazard

CSU Sacramento, CSU Sonoma, and CSU Chico, while not reporting any past significant incidents of erosion on their campuses, have established mitigation projects in nearby riverways to reduce erosion and sediment loads. Similarly, several coastal campuses – CSU Monterey Bay, CSU Long Beach, and CSU San Francisco - have not reported erosion on campus, but are proximal to shoreline mitigation projects.

CSU campuses in Channel Islands, Dominguez Hills, Fresno, Fullerton, and Humboldt have all experienced past incidents of erosion. These incidents ranged from minor incidents around clogged drainage pipes or construction sites to more severe incidents causing structural damage (CSU Fullerton).

Potential Impacts of the Hazard

Coastal erosion can result in severe impacts to local infrastructure, including the undermining of foundations, exposure of underground infrastructure, and breaches of natural or constructed protections. The latter can expose communities to the destructive forces of floodwaters, surge, and debris impacts. On campus, areas of erosion can create pedestrian and transportation hazards, and structures may become unsafe if erosion is not controlled. Public health and safety, structures, and infrastructure can all be negatively impacted, damaged, or destroyed by the erosion hazard.

Probability of Future Occurrence of the Hazard

Erosion is an on-going and dynamic process that occurs regularly. As climate change

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raises sea levels and induces more frequent and intense weather events, coastal and other erosion may generally become more widespread or severe. These events can cause erosion or exacerbate areas already experiencing erosion. Therefore, given some history of occurrence and the Moderate extent of erosion, the probability of future occurrence across all CSU campuses is **Likely**. However, conditions could emerge in the future which may further increase the probability, precipitated by climate change, changes in land-use or other factors. It is anticipated that CSU leadership will monitor such changes and respond accordingly with viable and cost-effective mitigation efforts.

**Vulnerability to the Hazard**

Topography, soil structure, land use, and precipitation are all factors of erosion. CSU System infrastructure, buildings, and agriculture located on steep slopes, in areas with little vegetation, or in areas with conducive soil types are more vulnerable to erosion. As such, CSU leadership may consider performing a system-wide analysis to identify such at-risk buildings, infrastructure, slopes and soil types on each campus in the future.

In the communities surround CSU campuses, erosion vulnerabilities include agricultural sector jobs, riverine ecosystems and coastlines, and water quality.

**Estimate of Potential Losses**

The historic and potential impacts of erosion on property statewide include reduced agricultural productivity, lower surface water quality, and damaged drainage networks.

Current modeling is not precise enough to allow for an assessment of potential losses to buildings and infrastructure on CSU campuses. CSU leadership may choose to pursue such estimates in the future, should modeling improvements be made.

**Vulnerability Assessment Conclusions**

While the ability to predict future erosion on CSU campuses is limited, the core indicator for monitoring and identifying erosion vulnerability on each campus is the condition of its soil relative to the topography of, building locations, overall campus layout and landscaping. If left unchecked, erosion can cause significant damage to campus infrastructure and the surrounding environment.

**Identified Data Limitations**

The complex interactions between soil erosion factors make predictive modeling, determination of hazard areas, and quantification of loss difficult. Localized data on this hazard is also limited, resulting in more generalized findings.
**Extreme Temperatures (Includes Extreme Cold and Extreme Heat)**

**Extreme Heat**

**Description of the Hazard**

What is considered an excessively hot temperature varies according to the normal climate for that region. However, when temperatures are extremely high, people are at higher risk for heat-related illnesses, such as dehydration, heat exhaustion, heat stroke, and in severe cases, death.59

Hazards from extreme heat are made worse when high temperatures are accompanied by high levels of humidity, which is defined as the amount of moisture in the air.60 As the temperature climbs, the air is able to hold more moisture. High humidity prevents the human body from cooling down naturally, which leads people to perceive that the temperatures “feels” hotter. The combination of temperature and humidity is known as the heat index.61

Heat stroke, the most serious heat-related illness, occurs when the body is unable to control its temperature. Body temperature rises rapidly, the sweating mechanism fails, and the body cannot cool down.62 In extreme causes, heat stroke can cause confusion and unconsciousness, so the victim is unable to seek treatment without assistance.

There are several groups of people who are uniquely vulnerable to the effects of extreme heat, such as infants and children, older adults aged 65 and up, athletes and outdoor workers, low-income households, and individuals with certain chronic medical conditions.63

**Location of the Hazard**

Extreme heat events are non-spatial, and can occur throughout a given campus footprint, and across several CSU campuses at one time, particularly during the summer months.

**Extent of the Hazard**

The CSU campuses experience a wide variance of maximum average temperatures in June through October. Northern campuses and those closer to the ocean see more moderate temperatures, on average, while urban campuses and those closer to the desert are likely to experience higher temperatures and less sea breeze. For example, the monthly average maximum temperatures in Fresno during the summer months of June through September range from 91 – 99° F. In contrast, Rohnert Park, home to Sonoma

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60 National Weather Service. *Discussion on Humidity.* Retrieved 01.22.21 from: [https://www.weather.gov/lmk/humidity](https://www.weather.gov/lmk/humidity)

61 Ibid.


State, typically sees summer high temperatures ranging from 79 – 82°F. Given that 26 heat events spanning 40 days has taken place on CSU campuses from 2006-2021 (15 years), along with the historical and potential impact of the hazard, the system-wide planning committee ranks the extent of the hazard overall as **Moderate**.

The National Weather Service issues a Heat Advisory when the heat index value is expected to reach 100° – 104°F within the next 12 to 24 hours. Excessive Heat Warnings are issued when there is an anticipated heat index of 105°F or greater that will last for two (2) or more hours. Excessive Heat Warnings are issued by the county when any location in the county is expected to reach that criteria. In anticipation of an Excessive Heat Warning, an Excessive Heat Watch may be issued 1 to 2 days in advance, when the Heat Warning criteria is 50 – 79% likely to occur.

The following figure depicts the National Weather Service’s methodology for determining the heat index, using the % humidity and the actual temperature.

Figure 3-10: Methodology for Determining Heat Index.

As the heat index rises, so does the potential danger to people and animals. The following table shows the health hazards associated with extreme heat.

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Table 3-19: Health Risks Associated with Heat Index

<table>
<thead>
<tr>
<th>Category</th>
<th>Heat Index</th>
<th>Health Hazards</th>
</tr>
</thead>
<tbody>
<tr>
<td>Extreme Danger</td>
<td>130° F or higher</td>
<td>Heat stroke / sunstroke is likely with continued exposure.</td>
</tr>
<tr>
<td>Danger</td>
<td>105° – 129° F</td>
<td>Sunstroke, heat cramps, and/or heat exhaustion is likely with prolonged exposure and/or physical activity.</td>
</tr>
<tr>
<td>Extreme Caution</td>
<td>90° – 104° F</td>
<td>Sunstroke, heat cramps, and/or heat exhaustion is possible with prolonged exposure and/or physical activity.</td>
</tr>
<tr>
<td>Caution</td>
<td>80° – 89° F</td>
<td>Fatigue is possible with prolonged exposure and/or physical activity.</td>
</tr>
</tbody>
</table>

History of the Hazard

Based on data gathered from the National Centers for Environmental Information (NCEI) Storm Events Database, excessive heat is a hazard of concern for CSU. In just the last few years, the following extreme heat events have occurred at CSU campuses:

Table 3-20: Notable Extreme Heat Events to Affect CSU Campuses

<table>
<thead>
<tr>
<th>Dates of Extreme Heat Event(s)</th>
<th>Campuses Affected</th>
</tr>
</thead>
<tbody>
<tr>
<td>June 2, 2020</td>
<td>San Diego, San Marcos</td>
</tr>
<tr>
<td>May 26, 2020</td>
<td>Bakersfield, Fresno, San Diego, San Marcos</td>
</tr>
<tr>
<td>May 5, 2020</td>
<td>San Diego, San Marcos</td>
</tr>
<tr>
<td>April 24, 2020</td>
<td>San Diego, San Marcos</td>
</tr>
<tr>
<td>October 21 – 22, 2019</td>
<td>Fullerton, San Diego, San Marcos</td>
</tr>
<tr>
<td>September 13, 2019</td>
<td>Fullerton, San Diego, San Marcos</td>
</tr>
<tr>
<td>August 21, 2019</td>
<td>San Diego, San Marcos</td>
</tr>
<tr>
<td>August 14, 2019</td>
<td>San Diego, San Marcos</td>
</tr>
<tr>
<td>August 2, 2019</td>
<td>San Diego, San Marcos</td>
</tr>
<tr>
<td>June 9 – 10, 2019</td>
<td>Bakersfield, Fresno, San Diego, San Francisco, San Jose, San Marcos</td>
</tr>
<tr>
<td>July 6, 2018</td>
<td>Fullerton, San Diego</td>
</tr>
<tr>
<td>October 23 – 25, 2017</td>
<td>Fullerton, San Diego</td>
</tr>
<tr>
<td>September 1 – 2, 2017</td>
<td>Fresno, Fullerton, San Diego, San Francisco</td>
</tr>
</tbody>
</table>

In addition to these specific excessive heat events, the NCDC database lists hundreds of additional incidents when the temperature has hit 100° F or greater.

**Potential Impacts of the Hazard**

During an excessive heat event, CSU campuses may experience impacts from extreme heat due to cancelled classes or postponed outdoor events in order to protect students, faculty, and staff from the weather.

In addition to the threat extreme heat poses to humans, high temperatures also pose a threat to utility production, which in turn threaten facilities and operations that rely on utilities. As temperatures rise, more people stay indoors, increasing the demand for air conditioning, fans, and other electronics. This puts a strain on the electrical grid, which can cause temporary outages. These outages can impact operations throughout campus, resulting in interruptions and delays in service. Outages may also negatively impact research efforts on campus, as the inability to maintain a steady, constant temperature may impact research specimens and experimental results.

**Probability of Future Occurrence of the Hazard**

Across all CSU campuses, extreme heat events have occurred annually in for the past several years. Given that 26 events have occurred over the past 15 years (1.7 events per year), it is **Highly Likely** that the hazard will occur annually.
Vulnerability to the Hazard

When dealing with an extreme heat event, the most common impacts are those generally felt by the people living in the targeted area. For people in particular, heat can kill when the body is pushed beyond its limits. Most heat disorders occur because the victim has been overexposed to heat. As discussed, the major human risks associated with extreme heat include dehydration, sunburn, fatigue, heat exhaustion, heat stroke, and in severe cases, death.

Some portions of the population are more at risk to the effects of extreme heat. The very young, the elderly, and certain groups with chronic medical conditions (such as asthma or other pulmonary illnesses, heart disease, poor blood circulation, neurological illnesses, and obesity) are generally more vulnerable to the effects of extreme heat and are more likely to suffer illness or death as a result.66 This is especially true if exposure is extended for a period of time and preventative measures are not taken immediately.

The majority of CSU campuses with a serious risk of excessive heat events have precautions in place in case of power outages (e.g., back-up generators) as well as mitigation plans for heat waves, such as cooling centers and safety plans for extremely hot days. While this is a hazard that the university will continue to experience with increasing regularity, most campuses have enough knowledge and familiarity with the hazard to handle the risks and vulnerabilities.

Estimate of Potential Losses

Based on the previous historical occurrences, annualized losses are considered to be negligible. In an extreme heat event, loss of human life or health impacts are a greater concern than is property damage.

Vulnerability Assessment Conclusions

While the ability to predict future heat events at CSU campuses is limited, the effects of climate change may provide some information. Figure 3-11 (below) from the Environmental Protection Agency (EPA) depicts the change in temperature over the last century. Areas of Southern California have warmed as much as 3 – 3.5 degrees. Coupled with less rainfall, this may lead to stronger and more frequent heat events, drought, and an increased risk of wildfires.67 Although CSU leadership maintains sound notification and protective measures for campus populations, it will monitor climate conditions and changes in order to mitigate any increased frequency, intensity and duration of extreme heat events in the future.

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Extreme Cold

Description of the Hazard

What is considered an excessively cold temperature varies according to the normal climate for that region. However, when temperatures are far below normal, with higher wind speeds, heat leaves the human body more rapidly, which increases the possibility of negative effects from these extreme temperatures.68

The greatest danger from extreme cold is to people, as prolonged exposure can cause frostbite or hypothermia, and can become life threatening. When someone is suffering from hypothermia, body temperatures can become so low that they affect the brain, making it difficult for the victim to think clearly or move well. In the case of frostbite, the frozen tissue becomes numb and the victim may be unaware that anything is wrong until someone else notices.69 This makes hazards from extreme cold particularly dangerous, as people may not understand what is happening to them or what to do about it.

The primary hazards from extreme cold are frostbite and hypothermia. Frostbite is caused by freezing of the skin and underly tissue. It causes a loss of feeling and color in the

affected areas of the body, and most often affects the nose, chin, fingers, or toes.\textsuperscript{70} It can be permanently damaging if not treated promptly and can lead to infection, nerve damage, or amputation in severe cases.\textsuperscript{71} The risk of frostbite is increased in people with preexisting conditions, the elderly, people with reduced blood circulation, and people who are not dressed warmly enough for the conditions.

Hypothermia occurs when the body loses heat faster than it can produce heat, causing a dangerously low body temperature. A normal body temperature is around 98.6° F. Hypothermia occurs when your body temperature falls below 95° F.\textsuperscript{72} As this happens, the heart and other essential organs cannot work properly. If hypothermia is not treated, it can lead to heart failure, respiratory failure, and eventually to death.

Excessive or extreme cold can accompany severe winter weather, or it can occur without severe weather. For this reason, extreme cold is a separate hazard from severe winter storms.

**Location of the Hazard**

Extreme cold events are a non-spatial hazard and could occur throughout a given campus and at various CSU campuses simultaneously.

**Extent of the Hazard**

Extreme cold has a wide range of extent and severity markers and characteristics. Average nighttime winter temperatures in Monterey Bay are typically in the mid-40s. According to data from the National Climatic Data Center (NCDC), the lowest daily temperature recorded in Monterey Bay was 20° F on December 22, 1990.

The National Weather Service issues Extreme Cold Warnings when the temperature feels like it is -30° F or colder across a wide area for a period of at least several hours. When possible, these advisories are issued a day or two in advance of the conditions.\textsuperscript{73}

The most common extent/severity marker for extreme cold is the Wind Chill scale. Figure xx (following) depicts the National Weather Service’s methodology for determining the wind chill, using wind speed and actual temperature. Although wind chill is not necessarily related to extreme cold as a single cause, the advisory system that the NWS currently uses relies on wind chill to relay warning and advisory information to the public. Extreme cold severity is a function of wind chill and other factors, such as precipitation amount (rain, sleet, ice, and/or snow). Although CSU maintains sound cold weather notifications and protective measures for campus populations, given that the historic low temperature across CSU-based communities averages about 15 degrees, during a future

\textsuperscript{70} Mayo Clinic. *Frostbite: Overview*. Retrieved 01.29.21 from: https://www.mayoclinic.org/diseases-conditions/frostbite/symptoms-causes/syc-20372656

\textsuperscript{71} Ibid.

\textsuperscript{72} Mayo Clinic. *Hypothermia: Overview*. Retrieved 01.29.21 from https://www.mayoclinic.org/diseases-conditions/hypothermia/symptoms-causes/syc-20352682

re-occurrence, if accompanied by even a 20mph wind, the wind chill could dip below zero
degrees. As such, the planning committee ranks the overall extent of the hazard as
**Moderate.**

Figure 3-12: Methodology for **Determining Wind Chill**

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In 2011, the National Weather Service introduced an experimental program that
issued warnings for extreme cold events, independent of other severe weather warnings.
The test areas included North and South Dakota and Minnesota. However, in 2012, after a
single season of use, the program was abandoned, based on reports of confusion among
test audiences.\(^7^4\)

**History of the Hazard**

Based on data gathered from the National Centers for Environmental Information (NCEI)
Storm Events Database, a few of the CSU campuses have experienced frost/freeze events,
when the temperature has reached below freezing temperatures. However, actual
extreme cold events are rarely, if ever experienced. [Records for extreme cold were first
kept starting in 1996.]

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\(^7^4\) Chiu, C.H., et al. Evaluation of the National Weather Service extreme cold warning experiment in
North Dakota. *American Meteorological Society*, 2014. Retrieved 01.29.21 from:
https://journals.ametsoc.org/view/journals/wcas/6/1/wcas-d-13-00023_1.xml
Potential Impacts of the Hazard

An extreme cold or frost/freeze event, depending on the campus’s level of preparation for cold weather, could lead to cancelled classes.

In addition to the threat posed to humans, extreme cold weather poses a significant threat to utility production, which in turn threatens facilities and operations that rely on utilities, specifically climate stabilization. As temperatures drop and stay low, increased demand for heating places a strain on the electrical grid, which can lead to temporary outages. These outages can impact operations throughout the campus, which can result in interruptions and delays in services. These outages may also negatively impact research efforts throughout the campus, as the inability to maintain a steady, constant temperature may result in unintended effects on research specimens.

Probability of Future Occurrence of the Hazard

As most CSU campuses are located in temperate climates, it is **Unlikely** that this hazard will occur annually.

Vulnerability to the Hazard

When dealing with an extreme cold event, the most common impacts are those generally felt by the people living in the targeted area. For people in particular, extreme cold can kill when the body is pushed beyond its limits. Most danger due to the cold is because the victim has been overexposed to low temperatures. As discussed, the major human risks associated with extreme cold include frostbite, hypothermia, and in severe cases, death.

Some portions of the population are more at risk to the effects of extreme cold. The elderly, those with certain preexisting conditions (hypothyroidism, diabetes, and high blood pressure, just to name a few), those with poor blood circulation, and people who are not dressed warmly enough for the cold are generally more vulnerable and are more likely to suffer illness or death as a result.\(^75\) This is especially true if exposure is extended for a period of time and preventative measures are not taken immediately.

Overall, CSU campuses do not consider extreme cold to be a significant hazard. A few campuses have warning systems in place for frost/freeze events, reminding students and staff to keep building temperatures at a certain level to prevent pipes from freezing and bursting. As this is not a hazard that the university will experience regularly, most campuses have enough knowledge and familiarity with the hazard to handle the risks and vulnerabilities.

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Estimate of Potential Losses

Based on the previous historical occurrences of extreme cold events, annualized losses are considered to be negligible. In an extreme cold event, loss of human life or health impacts are a greater concern than is property damage.

However, it is worth considering that a frost/freeze or extreme cold event could cause substantial losses to the university’s major agricultural programs if the event were prolonged and occurred during the growing season. Campuses with agricultural production programs include:

- Cal Poly San Luis Obispo
- Humboldt State
- Fresno State
- CSU Chico
- Cal Poly Pomona

However, based on the previous historical occurrences of extreme cold events, annualized losses are considered unlikely.

Vulnerability Assessment Conclusions

Although CSU leadership maintains sound notification and protective measures for campus populations, CSU will monitor climate conditions and changes in order to mitigate any increased frequency, intensity and duration of extreme cold events in the future.

Identified Data Limitations

Numerous public and private actors conduct research, acquire data and disseminate meteorological information and forecasting to the general public, including the CSU university system. Currently, it is assumed that, apart from regular access to climate change models on changes to temperature extremes over time, the CSU community maintains sufficient access to the data needed to plan for, respond to, and mitigate the effects of extreme heat and cold.
**Hazardous Materials**

**Description of the Hazard**

A hazardous material is defined in California’s State Hazardous Materials Incident Contingency Plan (1991) as “a substance or combination of substances which, because of quantity, concentration, physical, chemical, or infectious characteristics may: cause, or significantly contribute to an increase in deaths or serious illnesses; and/or pose a substantial present or potential hazard to humans or the environment.”76 Hazardous materials are one or more of the following: flammable, corrosive or an irritant, oxidizing, explosive, toxic (poisonous or infectious), thermally unstable or reactive, or radioactive. Hazardous materials are ubiquitous in modern society and may be found at all stages of production, consumption, and disposal.

Federal and state laws permit the intentional release of some hazardous materials into the environment such that the risk to human health and the environment is thought to be acceptable. However, sometimes releases are unintentional, resulting from leaks, accidents, or natural hazards. This section focuses on such accidental releases and fall into the following key categories:

**Fixed Hazardous Materials Incident:** A fixed hazardous materials incident is the accidental release of chemical substances or mixtures during production or handling at a fixed facility.

**Transportation Hazardous Materials Incident:** A transportation hazardous materials incident is the accidental release of chemical substances or mixtures during highway, waterway or air transport. Populations, built and natural environments are potentially impacted.

**Pipeline Incident:** A pipeline transportation incident occurs when a break in a pipeline creates the potential for an explosion or leak of a dangerous substance (oil, gas, etc.) possibly requiring evacuation. An underground pipeline incident can be caused by environmental disruption, accidental damage, or sabotage. Incidents can range from a small, slow leak to a large rupture where an explosion is possible. Inspection and maintenance of the pipeline system along with marked gas line locations and an early warning and response procedure can lessen the risk to those near the pipelines.

Hazardous materials can also be classified according to worker safety and health.77 Information provided by California Division of Safety and Health includes guidelines related to:

- **Safety hazards**: fire and fire byproducts, electricity, flammable gases, unstable structures, demolition, sharp or flying objects, excavations)
- **Health hazards**: carbon monoxide ash, soot and dust; asbestos; hazardous liquids; other hazardous substances; heat illness)

**Natural-Technological Incidents (Natechs)**: During the past two decades, increasing attention has been given to hazardous materials releases resulting from Natechs or a natural disaster event that triggers a technological hazard event. Natechs are of particular concern for the following reasons:
- They can produce a simultaneous effect on many industrial facilities
- Can overwhelm response capacity
- Containment systems may fail
- May produce cascading disasters
- Response may be hindered by a disaster’s impact on the physical environment

**Location of the Hazard**

Hazardous materials and infrastructure such as fuel, chemicals, hazardous waste sites and/or gas pipelines are located to varying degrees on each campus. Refer to each campus Annex for maps identifying the location of hazardous materials on each campus. At larger scales (beyond the campus planning area) hazardous materials are located throughout cities and counties and reflect different types, configurations and scales dispersed across these geographic areas.

**Extent of the Hazard**

There is no comprehensive statewide vulnerability assessment available at this time. As such, the true extent of the hazardous materials risk in California and its communities is not known, meaning no overarching conclusions have been reached which have been able to integrate all qualitative and quantitative risk factors to produce a comprehensive measure of the extent of the hazard. That said, in essence, the extent of the risk is primarily driven by human error and/or equipment/containment failure which itself is driven by inadequate maintenance in some cases. For the CSU planning committee, while some historical events have been severe in some CSU-based communities, the vast majority of events on and off campus are minor and localized. As such, it is prudent to rank the extent of the hazard for the CSU 23 campus system as **Moderate** and to consider worst case scenarios as the main driver of policy in order to fully mitigate all possible hazardous materials event outcomes.

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Moreover, according to the 2018 CA State Hazard Mitigation Plan, 400 hazardous materials problems are tied to 32 past earthquakes, including over 150 problems from the Loma Prieta Earthquake alone. 81 Finally, it should be noted that the plan indicates that it is likely that many such hazardous materials releases have received little attention in the past because public authorities, the media, and the public have overlooked them in the rush to address and recover from immediate disaster threats, and that responsible parties may have an incentive to understate the extent of releases or not to report them at all.

History of the Hazard

According to the CA Governor’s Office of Emergency Services’ Hazardous Materials Spill Report, the state experiences from 10 to 30 spill events daily. As of April 20th, 2021 already 2096 spill events had occurred. Such events have occurred in all the cities and/or counties where CSU campuses are located. 82

According to the 2018 CA State Hazard Mitigation Plan, with regard to natural-technological hazard events (Natechs), 400 hazardous materials events are tied to 32 past earthquakes, including over 150 Natech events from the Loma Prieta Earthquake alone.

For more details on specific hazmat events, please refer to the local, county and/or multi-jurisdictional hazard mitigation plans where CSU campuses are located at: https://www.caloes.ca.gov/cal-oes-divisions/hazard-mitigation/hazard-mitigation-planning/local-hazard-mitigation-program

With regard to hazmat incidents at CSU campuses, Chico State, CSU - Bakersfield, CSU - East Bay, Humboldt State, CSU - Long Beach, CSU - Los Angeles, CSU - Monterey Bay (gas leak), San Francisco State, and San Jose State have experienced minor, isolated chemical spills mostly in science labs. In 5 of these 9 cases, building evacuation was required. For example, following the 1994 Northridge Earthquake, California State University (CSU) Northridge laboratories and chemical storage rooms experienced multiple chemical spills.

Potential Impacts of the Hazard

A large hazardous materials release could affect an entire community or city under certain conditions related to direction of air flow (air-based chemical release) and population density or the contamination of a community’s main water supply. Either type of release could necessitate large scale evacuation. By contrast, in the rural unincorporated areas where population densities are low, even in the event of a large release, the number of homes that may need to be evacuated would be significantly lower than in an urban environment. The occurrence of a hazmat incident can also result

in the shut-down of transportation corridors which can last for hours at a time while the impacted area is stabilized.

The release of some toxic gases may cause immediate death, disablement, or sickness if absorbed through the skin, injected, ingested, or inhaled. Contaminated water resources become unsafe and unusable, depending on the amount of contaminant. Some chemicals cause painful and damaging burns if they come in direct contact with skin. Prolonged and concentrated exposure to such chemicals can produce severe long-term impacts to respiratory, endocrine and nervous systems, heart and brain health.

With regard to the natural environment, contamination of air, ground, or water may result in harm to fish, wildlife, livestock, and crops. The release of hazardous materials into the environment may cause debilitation, disease, or birth defects over a long period of time. Loss of livestock and crops may lead to economic hardships within the community.

Recent California examples include the 2016 Aliso Canyon methane gas leak, which caused evacuation of nearby residents, many of whom experienced temporary health problems such as difficulty breathing and eye irritation; and the 2016 Fruitland metal recycle plant fire in Maywood, which released heavy metals such as lead, magnesium, copper, aluminum, antimony, calcium, iron, sulfur, tin, potassium, and zinc which pose severe risks to public health. Health effects from exposure to these metals included short-term symptoms such as irritation to the eyes, nose, throat, and lungs. 83

Potential Impacts of the Hazard

Natural disasters, including earthquake, flood, and fire also pose risks to public health and the environment. For example, following the Northridge Earthquake, California State University (CSU) Northridge laboratories and chemical storage rooms experienced multiple chemical spills. Such incidents, triggered by a natural disaster, pose a significant risk to students, faculty, staff, and first responders. Any educational institution with a science lab might be at risk for a chemical spill leading to adverse health outcomes.

In a severe flood event, floodwaters are often contaminated with hazardous materials posing a threat to public and animal health, groundwater, and other parts of the environment. These hazardous materials may be released from damaged or flooded underground tank sites (e.g., gas stations or chemical storage facilities), propane tanks, manure or human waste handling facilities, fertilizer and pesticide storage, agricultural sites, and household hazardous waste.

In a fire event, (such as the October 2017 Northern California firestorms which destroyed approximately 6,000 residences) entire neighborhoods can be burned to the ground. Hazardous material release creates public health concerns which can delay the initial steps of fire recovery, including reopening burned areas to residents and initiating debris removal activities. The post-fire “toxic sweep” poses a risk of coming into contact with toxic substances due to the presence of synthetic and hazardous materials.

83 2018 California State Hazard Mitigation Plan, section 9.2.
Probability of Future Occurrence

The probability of occurrence for a hazmat release on campus can be viewed in two different ways: first, is that the history of occurrence serves as a sound predictor of future probability assuming current risk and vulnerability factors remain somewhat constant. For the purposes of the current estimate, no current data clearly indicates otherwise. As such, 9 of 23 campuses have experienced at least 1 hazmat event from approximately 2015 – present. At a minimum, this equates to at least 1 hazmat event at 40% of CSU campuses over the past 6 years or a 6.5% chance of occurrence per year for each campus across the 23-campus system. Of course, changes in risk and vulnerability factors such as materials oversight and handling practices or changes in the amount of chemicals or exposure may affect future probability.

Assessment of Vulnerability

Hazardous materials pose ubiquitous risk to the state and to the communities encompass each of CSU’s 23 campuses. Although campus planning committees identified different types, degrees, and combinations of campus-level hazmat risks, and that students, staff, critical facilities, water and natural resources in close proximity to hazardous substances are most vulnerable, it is quite difficult to produce a quantitative measure of vulnerability because of the variable nature of a hazardous materials spill. For example, the release of a toxic airborne chemical in a populated area has severe impact potential, whereas the impact potential of a small chemical spill in a remote or rural area is most likely limited to remediation of soil. And, in both cases, (unlike natural hazards) the probability of occurrence is dependent on human error, which itself is variable based upon a fluctuating set of interrelated factors, some of which lack prediction or control.

Therefore, given the complexity of how all natural and built environments and hazmat risks factors interrelate at the local level, and the related difficulty in predicting future events and their primary and secondary impacts, it is prudent to assume for planning purposes that each vulnerability is a sub-set of the larger community’s vulnerability, and that all CSU campuses and their communities are vulnerable as a whole or single system. As such, CSU leadership maintains an equal degree of vigilance to mitigate the vulnerability of each campus because its leadership approaches vulnerability at the system-wide level. And, the starting point for the CSU planning committee’s assessment of vulnerability is that students, staff, critical facilities, water and natural resources in close proximity to hazardous substances are most vulnerable.

Estimate of Potential Losses

As discussed previously, it is difficult if not impossible to produce an accurate quantitative measure of vulnerability because of the variable nature of a hazardous materials spill. For example, the release of a toxic airborne chemical in a populated area has severe impact potential, whereas the impact potential of a small chemical spill in a remote or rural area is most likely limited to remediation of soil. And, in both cases, the
probability of occurrence is dependent on human error, which itself is variable based upon a fluctuating set of interrelated factors, some of which lack prediction or control. In all cases, different types and amounts of hazardous materials interact with fluctuating combinations of human error to produce different event outcomes with variable impact costs.

**Vulnerability Assessment Conclusions**

It is well understood that with regards to hazmat vulnerability, each CSU-based community and county operates through a complex and dynamic interaction between industrial and commercial inputs and outputs and the natural and built environment. Such activity produces hazardous materials that move through the environment along both convergent and divergent routes and across all levels of land-use from site to campus to city and county and beyond. It is also clear from a review of local mitigation plans and Cal OES’ records of hazardous material spills, that such events occur with great frequency and varying degrees of severity across jurisdictions statewide. As such, in assessing the vulnerability of the CSU system as a whole and of the individual campus, while campus-level risks and vulnerabilities vary, in many cases they are not discreet or isolated, but are exacerbated or augmented through connections to broader community-level hazmat risks and vulnerabilities.

Finally, in order to draw final conclusions on vulnerability, it should be noted that any identified vulnerabilities at the campus level and/or community level are circumscribed and potentially reduced by targeted policy and program interventions. Numerous policies and programs have been established in recent years in response to California’s widespread and complex and integrated hazardous materials risks - California established the Unified Program which consolidates and integrates the administrative requirements, permits, inspections, and enforcement activities of the following environmental and emergency response programs: the Aboveground Petroleum Storage Act (APSA) Program, Area Plans for Hazardous Materials Emergencies, the California Accidental Release Prevention (CalARP) Program, the Hazardous Materials Release Response Plans and Inventories (Business Plans), Hazardous Material Management Plan (HMMP) and Hazardous Material Inventory Statement (HMIS) requirements (California Fire Code), the Hazardous Waste Generator and Onsite Hazardous Waste Treatment (tiered permitting) Programs, and the Underground Storage Tank Program.

**Identified Data Limitations**

Campus planning committees have provided information on campus-level hazmat materials and risks. Data limitations pertain to a comprehensive understanding of human activity and error related to materials control over the long term.
Landslide

Description of the Hazard

A landslide is a down-slope movement of soil, rock, or other debris, and can also be referred to as a mass movement or slope failure. These geological hazards can range in size from a few feet to over a mile in length and width and, when heavy and rapidly moving, can cause serious damage and loss of life.

Landslides are classified based on the type of material and type of movement involved. They can range from slow-moving earth flows to fast-moving debris flows, though many large slope failures involve more than one type of movement. The primary natural triggers of slope failures are water, seismic activity, and volcanic activity. Slope saturation by water can occur from intense rainfall, snowmelt, changes in ground-water levels, and surface-water level changes along coastlines. In winter months, El Nino storms or other high rainfall events may saturate soils and trigger slope failure.

Deep-Seated Landslides

Deep-seated landslides, ranging in depth from ten to several hundred feet, occur as a result of geologic and hydraulic changes, such as earthquakes or increased levels of groundwater. These landslides can move slowly or quickly and can cause extensive property damage, but rarely result in loss of life.

Debris Flows Related to Shallow Landslides

Shallow landslides may mobilize into rapidly moving debris flows and typically occur after sudden saturation of the ground. These types of debris flows are typically more dangerous because they move rapidly, causing both property damage and loss of life.

Debris flows may also occur as a result of post-fire conditions, where wildfires have left barren ground exposed to heavy rainfall. Intense rainfall, generally greater than .5 inch per hour, has the potential to trigger a post-fire debris flow. These landslides may impact lives and properties within the deposition zone and can result in downstream flooding. Post-fire debris flows often occur during the fall and winter following major summer fires.

Location of the Hazard

The susceptibility of an area to landslides depends on several variables, including magnitude of slope gradients, water content, ground cover, presence of erosion, and slope material and structure. However, landslides are most prevalent in terrain with weak material and steep slopes, and the highest risk is found in areas with high rainfall or high earthquake potential. Slope failures are also most likely to occur in areas where they have

occurred in the past. In California, the most landslide-prone areas are found along the coast and in the northern Franciscan Formation as identified in Figure 3-13 below.

With regard to landslide locations at CSU campuses, ten (10) are not located within or near a landslide susceptibility zone, two (2) campuses are located somewhat near Moderate susceptibility zones, one (1) is located somewhat near a High susceptibility zone, six (6) are adjacent or connected to Moderate susceptibility zones, and four (4) are adjacent or connected to High landslide susceptibility zones. Please refer to the landslide susceptibility map within each campus Annex for details.

Figure 3-13: Deep-Seated Landslide Susceptibility in California

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Extent of the Hazard

CSU System campuses are susceptible to seismic activity, wildfires, and intense rainfall

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that can lead to landslides. The ten campuses identified as connected to Moderate and High Landslide Susceptibility Zones are most at risk of direct impacts. That said, the history of landslides impacting a CSU campus is limited to one event at Cal Poly San Luis Obispo. However, landslide events have occurred near other campuses and within the broader communities. At a minimum, the indirect impacts of landslides may cover a larger geographical extent than that of indirect impacts. As such, the planning committee ranks the overall extent of the hazard as **Moderate**.

**History of the Hazard**

Based on data gathered from the National Centers for Environmental Information (NCEI) Storm Events Database, landslides are a hazard of concern for the CSU System. Since 1971, the following severe landslides have occurred proximal to CSU campuses. In addition, in 2017, a dormitory on the Cal Poly SLO campus was evacuated and closed as a result of encroaching landslide debris on a hillside east of the dormitory. The Hall remains closed.

Table 3-21: Historical Landslide Events Near CSU Campuses

<table>
<thead>
<tr>
<th>Location</th>
<th>Year</th>
<th>Impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>Camarillo Springs</td>
<td>2014</td>
<td>Post-Springs Fire debris flows. 10 homes destroyed; 6 homes damaged.</td>
</tr>
<tr>
<td>La Canada</td>
<td>2009-2010</td>
<td>Post-Station Fire debris flows with early damage claims at $58 million and Los Angeles County cleanup costs at over $30 million (2009 dollars).</td>
</tr>
<tr>
<td>Pacifica</td>
<td>2007</td>
<td>Devil’s Slide: bypass construction of $325 million</td>
</tr>
<tr>
<td>San Bernardino</td>
<td>2003</td>
<td>Post-Grand Prix/Old Fire debris flows on Christmas Day. 16 fatalities, 52 homes, and 32 trailers damaged; more than $100 million in damages.</td>
</tr>
<tr>
<td>Mission Peak</td>
<td>1998</td>
<td>-</td>
</tr>
<tr>
<td>El Dorado County Hwy 50</td>
<td>1997</td>
<td>Destroyed Highway 50; $32 million in repair and economic losses.</td>
</tr>
<tr>
<td>Anaheim Hills</td>
<td>1993</td>
<td>30 homes destroyed, 200 homes damaged. Cost: $12 million</td>
</tr>
</tbody>
</table>
San Fernando | 1971 | Cost: $354 million

Potential Impacts of the Hazard

Landslides can result in physical damage to buildings and property and have the potential to significantly affect infrastructure. As a landslide moves, it distresses structural foundations by settlement, cracking, and tilting. Fast-moving flows can remove entire structures in one instance, while other types of flows can cause damage gradually.

Transportation and utility infrastructure are particularly vulnerable to landslides, since the failure of any component can disrupt service over a large area. The loss of power and communication and disruption of transportation can have cascading effects throughout an area, including impaired disposal of sewage, contamination of water supplies, and the release of flammable fuels. Transportation routes are also often expensive to clean up, and prolonged obstruction can disrupt the movement of people and goods for long periods of time.

Probability of Future Occurrence of the Hazard

Slope failures are often triggered by other natural hazards, such as earthquakes and heavy rainfall, so landslide frequency is often related to the frequency of these other hazards. As climate change impacts the frequency and intensity of triggers such as rain events and fires, landslides will likely occur more often. The USGS estimates that climate change-induced shifts in weather will increase the frequency of post-wildfire landslides, which are expected to occur almost every year in California. Although the location of the majority of campuses is outside the landslide risk zones, the planning committee ranks the probability of the landslide hazard for the campuses as a whole as Possible. In addition, the probability of a given campus experiencing secondary effects of a landslide occurring beyond the campus footprint resulting in on-campus loss of power or transportation disruption is Possible.

Vulnerability to the Hazard

The vulnerability of the built environment to landslides depends on exposure and is more likely to incur damage as a result of proximity, rather than inferior structural design. The structures most vulnerable to landslides are buildings and utility/transportation lifelines, which can be impacted by either impact or ground deformation. Utilities and transportation infrastructure are particularly vulnerable, due to their geographic extent and susceptibility to physical distress. Any population proximal to a landslide when it occurs is vulnerable to its impacts. As identified in the Location section, vulnerable CSU assets and populations include
the six campuses connected to moderate landslide zones (Channel Islands, East Bay, Monterey Bay, San Diego, San Francisco, San Marcos) and most vulnerable are the four campuses located within high risk landslide zones (Humboldt, Pomona, San Bernardino, San Luis Obispo).

**Estimate of Potential Losses**

Due to data, cost and time limitations, the current planning effort does not include models for estimating potential losses from a landslide directly impacting the campus. That said, if relevant data and modeling becomes available, the planning committee may consider their use in the future.

Although the economic impact of landslide damage can exceed that of the direct repair costs, the current planning effort does not include methods for estimating indirect costs related to CSU System campuses. That said, given that the vast majority of campuses lies outside of landslide susceptibility zones, it may be the case that potential economic losses will be weighted toward secondary losses that may potentially far outweigh the costs of any direct impacts possible at only a small minority of campuses.

**Vulnerability Assessment Conclusions**

Community exposure to landslides varies depending on their physical locations – whether in flat plains or on steep hillsides – and on their dependence on critical infrastructure located in landslide hazard zones.

Landslides could impact CSU System campuses in a variety of ways, primarily related to indirect impacts to transportation and utilities. Utility outages can impact health, particularly for vulnerable populations, and can cause interruptions in operations. Interruptions may impact student and employees’ ability to travel to campus and the delivery of classes and events.

**Identified Data Limitations**

The ability to predict the location of future landslides is limited. However, if relevant data and modeling becomes available, the planning committee may consider their use in the future.

However, the USGS estimates that climate change-induced shifts in weather will increase the frequency of post-wildfire landslides, which are expected to occur almost every year in California.

**Power Outage**

**Description of the Hazard**

In the event of a power outage, most aspects of modern life will be disrupted. Almost all aspects of urban life, rely on the availability of reliable utilities, such as electricity, water, and natural gas. An interruption in the supply or distribution of a commodity like power can affect the campus in various ways like forcing campus closures to limiting campus
operations. These interruptions can be cascading effects from other hazards, such as the result of major windstorms, winter storms and wildfire, which can prompt an intentional disruption or Public Safety Power Shut Off (PSPS).

A power outage event can interrupt day-to-day operations of CSU campuses, like in-person classes, impede, or limit digital, telephonic or radio communications, create traffic jams around the busy avenues and boulevards surrounding the campus, close the student health center and close restaurants around campus and outside the campus. Additionally, thousands of CSU student residents in on-campus housing would also be affected by a power outage on campus.

Additionally, a severe outage in the surrounding cities, counties or neighboring communities would also directly affect campuses and their communities.

An electric power disruptions and outages fall into two categories: intentional and unintentional.

The four types of **intentional** disruptions:

- Planned: Some disruptions are intentional and can be scheduled based on maintenance or upgrading needs.
- Unscheduled: Some intentional disruptions must be done "on the spot" in response to an emergency.
- Demand-Side Management: Some customers (i.e., on the demand side) have entered into an agreement with their utility provider to curtail their demand for electricity during periods of peak system loads.
- Load Shedding: When the power system is under extreme stress due to heavy demand and/or failure of critical components, it is sometimes necessary to intentionally interrupt the service to selected customers to prevent the entire system from collapsing. These intentional interruptions result in rolling blackouts.

**Unintentional** or unplanned disruptions are outages that come with essentially no advance notice or warning. This type of disruption is the most problematic. The following are categories of unplanned disruptions:

- Accident by the utility, utility contractor, or others.
- Malfunction or equipment failure.
- Equipment overload (utility company or customer).
- Reduced capability (equipment that cannot operate within its design criteria).
- Tree contact other than from storms.
- Vandalism or intentional damage.
- Weather, including lightning, wind, earthquake, flood, and broken tree limbs taking down power lines.
- Wildfire that damages transmission lines.

Other classifications of power outages include the following:
- Repair Outages: An outage caused by unexpected circumstances, such as traffic accidents or severe weather. Energy utility agencies work to repair these outages quickly to restore power to the affected areas.
- Maintenance Outage: A scheduled outage that occurs when we turn the power off for equipment upgrades. Energy utility agencies notify business and resident customers in advance if they will be affected by a maintenance outage.
- Rotating Outage “Rolling Blackouts: A strategic and controlled power outage enact as a last resort when there is a statewide Stage 3 Emergency declared. Sometimes called a “rolling blackout.”
- Public Safety Power Shutoff (PSPS) Events energy utility companies proactively turn off power to help reduce the risk of wildfires. These events will primarily be called during extreme and potentially dangerous weather conditions. Turning off power is a critical decision, and a number of factors are considered before that decision is made. Utility agencies aim to advise affected areas approximately 48 hours in advance of a potential PSPS event and will attempt notification again approximately 24 hours before power is shut off. Additional notifications will be made throughout the outage when power has been shut off and when it has been restored. Some situations prevent agencies from providing advance notice due to weather conditions and other circumstances beyond the agency’s span of control.

**Location of the Hazard**

The power outage hazard poses an equal risk to all areas of a given CSU campus and to all areas within the CSU campus system. At the local level, if a CSU-based city or county is experiencing a power outage, it is likely that the particular campus is also experiencing a power outage.

Regarding the location of electrical utility infrastructure, the image below highlights the expansive system of electrical power utility companies spanning throughout the State of California. Some providers are large utility corporations, while others are small municipal agencies sourcing their energy from the larger corporations creating a tremendous demand from few resources, intensifying the need during extreme temperature periods of the year.
Historically, the most consistent reason causing power outages are falling trees. In Southern California Santa Ana Winds can cause destruction due to its extremely strong winds. Windstorms with 45 mph+ winds can cause flying debris and downed utility lines. Even minor windstorm can create damage when tree limbs break off and bring down power lines, potentially causing fatal accidents through electrocution along with blackouts. In addition, extremely wet weather conditions can saturate soils weakening the
tree foundations and enabling trees to fall during high wind winter storms in northern and high-altitude parts of the state.

In order to anticipate outage conditions and reduce impacts, campus facility managers and others keep track of conditions and data provided by the media, municipal utilities and the California Independent System Operator (CAISO), which is tasked with managing the power distribution grid that supplies most of California, except in areas served by municipal utilities. CAISO is thus the entity that coordinates statewide flow of electrical supply. CAISO uses a series of “stage alerts” to the media based on system conditions. The alerts are as follows:

- Stage 1 - reserve margin falls below 7 percent.
- Stage 2 - reserve margin falls below 5 percent.
- Stage 3 - reserve margin falls below 1.5 percent.

Rotating blackouts become a possibility when Stage 3 is reached. Utility agencies aim to advise affected areas approximately 48 hours in advance of a potential PSPS event and will attempt notification again approximately 24 hours before power is shut off. Campus staff respond accordingly.

Given the prevalence of rolling blackouts and other causes of power outages in California, CSU campuses maintain safety precautions, situational awareness, access to emergency power generators and other protocols for managing campus power outages. Based on these factors, and the fact that recorded outages have taken place on CSU campuses, the campus-wide planning committee ranks the overall extent of the power outage hazard as Moderate.

History of the Hazard

The State of California has experienced power outages over time and every summer the state consistently experiences a high demand for electrical energy. The state’s electric utility providers, like the Los Angeles Department of Water and Power (LADWP), Power Gas & Electric (PG&E) and southern California Edison (SCE), to name a few, have taken mitigation efforts to reduce outages and blackouts whenever possible. In the last few years, California has exercised planned outages by implementing PSPS strategies to reduce the affects and hazards related to extreme weather event disasters, like wildfires. Also, major crimes (fraud) have led to power crises resulting in major power outages affecting residents and commerce.

- 2019 California power shutoffs, a series of PSPS, or "Public Safety Power Shutoff" events, that occurred in several California counties in October 2019 to prevent the risk of catastrophic wildfires caused by power lines.
- California electricity crisis, blackouts affecting California in 2000 and 2001, due to an energy shortage caused by market manipulation.
- 1996 Western North America blackouts, two blackouts affecting California and other areas in 1996.
- 2011 Southwest blackout, a blackout affecting Arizona, Southern California, and Mexico in 2011

**Note:** Based on interview data as part of the current planning effort, approximately half of all CSU’s 23 campuses have experienced at least one power outage. For more information, please refer to the History of the Hazard section in each campus annex.

### Potential Impacts of the Hazard

The California State University System infrastructure relies on electricity for basic business and educational operations. During a widespread power failure, it may take anywhere from several hours to days to restore operations if a significant event occurs. Electrical power may be the only cooling source for many individuals on the campuses and their communities, and long-term outages can potentially put people’s health and life at risk. Disruptions in the supply of heating fuel may put people and property at risk during extremely cold weather if it relies on electric generation or heating mechanisms instead of gas. Additionally, many medical devices, communications devices, and security rely on power to maintain their functions.

Although CSU campuses have specific power outage protocols it can impact the operations of the universities depending on the severity of the outage. During daytime hours, the University may remain open and business and instructional operations will remain on-going to the maximum extent possible. It will be expected that the areas surrounding the campus, including streetlights, will also experience a blackout.

For example, crises created by droughts, delays in approval of new power plants, and market manipulation decrease power supplies to California’s constituency. An extreme or unexpected increase cause an incredibly high increase in wholesale prices during hotter months. In addition, rolling blackouts adversely affect many businesses dependent upon a reliable supply of electricity, and inconvenienced many retail consumers. Additionally, residents affected by blackouts and brownouts may face health hazards and economic losses due to power failure.

Finally, flood events present potential issues involving power outages if any facilities inundated with floodwaters create disruptions at nearby electrical grids. Disruptions involving floodwater can create significant and lengthy power outages with challenging issues preventing immediate remedies for repair. Additionally, power outages create caveats in emergency personnel reaching crisis events due to possible traffic build up due to streetlights and traffic lights also malfunctioning.

### Potential Impact and the Effect of Climate Change

Climate change is expected to bring more frequent and intense natural disasters. Over the years, what was once a disaster uncharacteristic to landscape is now occurring outside of historical areas. These changes have created a variability at a rate that makes historical data a poor predictor of future climate. For example, the warmest years on record in California occurred in 2014, 2015, and 2016.
Changes in temperatures, precipitation patterns, extreme events, and sea-level rise have the potential to decrease the efficiency of thermal power plants and substations, decrease the capacity of transmission lines, render hydropower less reliable, spur an increase in electricity demand, and put energy infrastructure at risk of flooding.

With climate warming, higher costs from increased demand for cooling in the summer are expected to outweigh the decreases in heating costs in the cooler seasons. Hotter temperatures in California will mean more energy (typically measured in “cooling-degree days”) needed to cool homes and businesses both during heat waves and on a daily basis, during the daytime peak of the diurnal temperature cycle. During future heat waves, historically cooler coastal cities (e.g., San Francisco and Los Angeles) are projected to experience greater relative increases in temperature, such that areas that never before relied on air conditioning will experience new cooling demands.

Secondary impacts of energy shortages are most often felt by vulnerable populations. For example, those who rely on electric power for life-saving medical equipment, such as respirators, are extremely vulnerable to power outages. Also, during periods of extreme heat emergencies, the elderly and the very young are more vulnerable to the loss of cooling systems requiring power sources.

**Probability of Future Occurrence of the Hazard**

Along with storm and wind related falling trees, other factors contribute to both intentional and unintentional outages, such as wildfire and extreme heat, and climate change further exacerbates these power outage factors throughout California, including the CSU System. It is important to decipher the frequency and intensity of extreme temperatures throughout the year in California, especially in the widespread areas covered by the state’s largest provider coverage areas, Power, Gas & Electric and Southern California Edison. The probability of California experiencing an extreme temperature can be difficult to quantify but is considered a hazard that occurs yearly during the same seasonal periods throughout the calendar year. Climate models suggest summer global temperatures are likely to increase while changes between temperature extremes would be more pronounced. The length of days above 100 degrees may also increase severely and has already done so in the last 20 years, especially in southern-most and northern-most regions of California. Additionally, future years are projected to see a continuation or worsening of fire events across California increasing the need for Public Safety Power Shut-Offs (intentional power outages). More than half of the CSU System campuses fall within a Public Safety Power Shut Off (PSPS) affected location. Based on the above factors, the planning committee ranks the probability of future occurrence as **Likely**.

**Vulnerability to the Hazard**

When an energy shortage creates power disruptions it can have a major effect on the entire state or different regions individually or in synchronicity. Different regions on opposite ends of the state may be enduring separate heatwaves creating a high demand for power causing an unintended power outage or a combination of extreme heat and
wind events prompt the need for intended power outages or Public Safety Power Shut-off (PSPS) events.

Based on the data available, and in consideration of the increasing effects of climate change, the probability of future occurrences prompting intentional outages or creating unintentional power outages, the CSU system’s overall vulnerability to the hazard is high. Nonetheless, it would serve the campus well to be able to mitigate and cope with an interruption to electrical power.

As such, in an effort to expand resilience, the state of California’s energy infrastructure has been designed to cope with the state’s highly variable conditions and frequent disruptions from wildfires, storms, and floods. As a result, power outages caused by these events are short-term and limited to regional impacts, which, in turn, reduces the vulnerability of the California State University System. Moreover, CSU leadership works to reduce vulnerabilities through consistent use of safety and operational protocols and emergency power sources to ensure it is able to mitigate an interruption to electrical power.

Estimate of Potential Losses

California’s energy infrastructure is designed to cope with the state’s highly variable conditions and frequent disruptions from wildfires, storms, and floods. Generally, power outages caused by these events are short-term and limited to regional impacts. Of more concern are system-wide outages or shortages caused by a major disruption in supply or transmission. No data on power outage related dollar losses to CSU campuses is currently available. The system-wide planning committee may pursue such data in the future.

For information related to each campus’s loss assessment, each campus hazard profile indicates that although the economic impact of power outage damage can exceed that of the direct repair costs, there are currently no applicable methods for estimating indirect costs related to the CSU system.

Vulnerability Assessment Conclusions

The primary concern for CSU System leadership is that a loss of power can lead to potential hazards to students, faculty, and staff at any campus. In response, safety and operations protocols center on the following “direct impact” set of concerns:

Elevators, entry ways, air filtration systems and lighting provide campus communities with the necessary infrastructure and systems to function and navigate through each campus and to maintain a safe campus environment and visibility during nighttime hours. The vulnerable population (especially students with physical disabilities) may be the most heavily affected by loss of power as they rely on elevators, entry ways with automatic doors, and locks and lights may impede on a disabled student’s ability to travel and utilize the campus and its structures safely.

The use of communication devices, billing, records, and electrical tools may also become unusable due to a loss of electricity. Many records and billing items may have to revert to
“by-hand” procedures and paper copies may be needed for continuity of operations. Additionally, classrooms may not be usable if lighting equipment is not functioning impacting a semester or quarter’s progress for the academic year.

In order to reduce such vulnerabilities, CSU leadership works to reduce vulnerabilities through consistent use of safety and operational protocols and emergency power sources to ensure it is able to mitigate an interruption to electrical power.

**Identified Data Limitations**

Although it is recognized that PSPS events impact campuses across the state, mitigation efforts are necessary to manage the power outage hazard on a yearly basis, regardless of whether hard data on campus level dollar losses is available.

Potential economic impacts (regardless of whether or not data or modeling on such losses is available), are most closely tied to continuity of campus operations, and campus operating costs are already built into campus budgets. Therefore, the ability to quantify potential losses is, practically speaking, secondary to the cost expenditures which will necessarily be approved by CSU leadership for campus operations recovery in the event of an outage. Nevertheless, CSU leadership will continue expanding the use of energy efficiency standards for equipment and infrastructure to help reduce or eliminate power outage response and recovery costs. For example, California utilities energy efficiency programs since the 1970s offer some of the lowest-cost energy resource options to help meet California’s and the CSU System’s energy and climate policy objectives consistently across all CSU campuses and sites.
**Tsunami**

Description of the Hazard

A tsunami is a wave triggered by any form of land displacement along the edge or bottom of an ocean or lake. Land displacement can be in the form of submarine landslides or submarine dip-slip faults. These types of faults cause ruptures that result in seafloor uplift or down-drop. This mass movement translates to a tsunami or gravity wave within the overlying water at the surface.

Tsunamis travel radially outward from the area of initiation. The size of a tsunami is proportional to the mass that moved to generate the tsunami. As a tsunami approaches the shore and the depth of the water column decreases, the energy in the wave pushes the wave crest above the water surface resulting in a larger wave height. Wave runup is the elevation above mean sea level on dry land that a tsunami reaches. Run-up is what causes inundation of coastal areas that are below the run-up height.

There are two types of source regions for tsunamis—resulting in local and distant source tsunamis as viewed from the affected shoreline. Local tsunamis are typically more threatening because they afford at-risk populations only a few minutes to find safety. California is vulnerable to, and must consider, both types. Identifying tsunami hazards requires 1) evaluating the potential for submarine mass movement both locally and at great ocean distances, and 2) identifying coastal regions within the direct or indirect path of a potential tsunami wave that are below the run-up height.

Tsunamis can travel at speeds of over 600 miles per hour in the open ocean and can grow to over 50 feet in height when they approach a shallow shoreline, potentially causing severe damage to coastal development. At the shoreline, tsunamis may take the form of a fast-rising tide, a cresting wave, or a bore (a large, turbulent wall-like wave). The bore phenomenon resembles a step-like change in the water level that advances rapidly (from 10 to 60 miles per hour). The first wave is usually followed by several larger and more destructive waves.

Location of the Hazard:

According to the 2018 CA State Hazard Mitigation Plan, tsunami locations span 94 incorporated communities and 83 unincorporated areas across 20 coastal counties.

For CSU campus locations, the CSU – Chancellor’s Office campus (below) is located within a mapped tsunami zone, and based on current mapping, it appears that the Humboldt State campus is located within, or very close to within the inundation zone. As such, the tsunami hazard will be fully profiled for these 2 campuses.

- Humboldt State University (City of Arcata, Humboldt County)
- CSU - Chancellor’s Office (City of Long Beach, Los Angeles County)
Figure 3-15: Tsunami Inundation Area Near Chancellor’s Office
In order to highlight the relationship between universities and the broader community, although just two campuses (above) are located in a tsunami inundation zone, the campuses (below), although not located in a mapped tsunami zone, are located in a municipality and/or county with some coastal areas at risk of tsunami impacts. In two cases, university resources are utilized for emergency response and/or post-disaster recovery:

According to the Ventura County Emergency Operations Plan, CSU – Channel Islands is identified as an evacuation point for displaced people due to its high-ground location; and, according to the CSU – Monterey Bay planning team, the campus maintains an Emergency Operations Center and displaced persons evacuation point also due to its high-ground location.

Note: The tsunami hazard will not be profiled for the campuses listed (below), as the tsunami inundation maps in each campus’ annex indicates that the main campus location is outside of the tsunami inundation zone. Where noted, some schools maintain assets or
satellite facilities within the inundation zone. The extent, probability and potential impact of a tsunami discussed below are applicable to those satellite/coastal facilities or assets.

- CSU – Channel Islands (Ventura County) **
- CSU – East Bay (Alameda County)****
- CSU – Dominguez Hills (Los Angeles County)
- CSU – Fullerton (Los Angeles County)
- CSU – Long Beach \textit{(Long Beach State; Los Angeles County)} ***
- CSU – Los Angeles (Los Angeles County)
- CSU – Maritime Academy (Solano County) *
- CSU – Monterey Bay (Monterey County) **
- CSU – Northridge (Los Angeles County)
- CSU – Pomona \textit{(Cal Poly Pomona; Los Angeles County)}
- CSU – San Jose \textit{(San Jose State; Santa Clara County)} *
- CSU – San Marcos (San Diego County)
- CSU – San Diego \textit{(San Diego State; San Diego County)}
- CSU – San Francisco \textit{(San Francisco State; San Francisco County)} *
- CSU – San Luis Obispo \textit{(Cal Poly SLO; San Luis Obispo County)}

* Main campus is not in a mapped tsunami zone but has assets on waterfront inundation zone such as docks, boats and buildings.

** Not in a mapped tsunami zone; campuses maintain EOC related functions for tsunami.

*** CSU – Long Beach campus is not located in a tsunami inundation zone, and the tsunami hazard does not pose a risk to campus buildings or infrastructure as identified. However, according to the campus planning committee, the university leases a building that it believes lies in the tsunami inundation zone. Although not mapped, the university may verify and map the property’s location in the future, only with the permission of the property owner.

**** Main campus is not in zone but has assets in downtown Oakland – inundation zone borders part of downtown; need to identify downtown asset location relative to the inundation zone.

All remaining CSU campuses identified (below) are neither located in a tsunami zone nor located within a municipality or county at risk to tsunami.

- CSU Bakersfield
- CSU – Chico (Butte County)
- CSU – Fresno (Fresno County)
- CSU – Sacramento (Sacramento County)
- CSU – San Bernardino (San Bernardino County)
- CSU – Sonoma (Sonoma County)
- CSU – Stanislaus (Stanislaus County)
Extent of the Hazard:

The factors shaping the extent or severity of the hazard are a combination of geophysical forces (the amount of vertical and horizontal motion of the sea floor, the area over which it occurs, and the efficiency with which energy is transferred from the earth’s crust to the ocean water) and the geographic range of coastal development to be impacted.

More specifically, as a tsunami approaches the shore, wave run-up is the elevation above mean sea level on dry land that a tsunami reaches. A tsunami’s potential severity can be forecasted as a function of the wave’s mass along with the difference between the wave’s run-up height and the ground elevation of the affected coastal location.

There are two types of source regions for tsunamis—resulting in local and distant source tsunamis as viewed from the affected shoreline. Local tsunamis are typically more threatening because they afford at-risk populations only a few minutes to find safety. California is vulnerable to, and must consider, both types. Identifying tsunami hazards requires 1) evaluating the potential for submarine mass movement both locally and at great ocean distances, and 2) identifying coastal regions within the direct or indirect path of a potential tsunami wave that are below the run-up height. 87

With regard to the aforementioned CSU main campuses or off-campus assets located within the tsunami inundation area, given no history of tsunami impacts,

History of the Hazard:

The California Seismic Safety Commission report, the Tsunami Threat to California Findings and Recommendations on Tsunami Hazards Risks, published in December 2005, indicates that over 80 tsunamis have been observed or recorded along the coast of California in the past 150 years. That said, no tsunamis have impacted CSU campus locations.

According to the National Centers for Environmental Information (NCEI), have been eight tsunamis have caused damage to ports and harbors or coastal inundation in California since 1946. The most significant events are as follows:

- In 1964, a tsunami caused by a Magnitude 9.2 earthquake offshore from Alaska resulted in 13 deaths in California and destroyed portions of downtown Crescent City.
- A 2006 tsunami (originating in the Kuril Islands region north of Japan) caused approximately $20 million in damage to Crescent City harbor.
- A 2010 tsunami (originating offshore from Chile) caused millions of dollars in damage to ports and harbors in the state.
- A tsunami in 2011 (caused by a Magnitude 9.0 earthquake offshore of Japan) killed one person at the mouth of the Klamath River and caused up to $100 million of damage to 27 ports, harbors, and marinas throughout the State. 169

87 NOAA. About Tsunami. Retrieved 03.31.2021 from:
http://www.prh.noaa.gov/itic/library/about_tsu/faqs.html#1
damage occurred in Crescent City, Santa Cruz and Moss Landing harbors and a federal disaster was declared in Del Norte, Santa Cruz, and Monterey Counties. Both Crescent City and Santa Cruz harbors sustained damage to all docks, and oil spills and water/sediment contamination that resulted from sunk or damaged boats. Because recovery efforts in these two harbors took several years to complete, both harbors incurred business/economic losses that have been difficult to recapture.

Summary of Tsunamis Along the California Coast Since 1946

- March 11, 2011, Offshore Japan Earthquake 9.0, $100 million (1 death)
- February 27, 2010 Offshore Chile Earthquake 8.8 $3 million (No deaths)
- November 15, 2006 Kuril Islands Region Earthquake 8.3 $20 million (No deaths)
- March 28, 1964 Offshore Alaska Earthquake 9.2 $20 million (13 deaths)
- May 22, 1960 Chile Earthquake 9.5 $1 million (2 deaths)
- March 9, 1957 Aleutian Islands Earthquake 8.6 <$1 million (No deaths)
- November 4, 1952 Kamchatka Earthquake 9.0 <$1 million (No deaths)
- April 1, 1946 Aleutian Islands Earthquake 8.8 <$1 million (2 deaths)

Additionally, the Worldwide Tsunami Database provides information on tsunami run-up levels and earthquake magnitude factors. Although data for the most recent events is not available, additional (earlier) tsunami events are recorded.

Table 3-22: Tsunami Events in California 1930-2013

<table>
<thead>
<tr>
<th>Date</th>
<th>Location</th>
<th>Maximum Run-up (m)</th>
<th>Earthquake Magnitude</th>
</tr>
</thead>
<tbody>
<tr>
<td>08/31/1930</td>
<td>Redondo Beach</td>
<td>6.1</td>
<td>5.2</td>
</tr>
<tr>
<td>08/31/1930</td>
<td>Santa Monica</td>
<td>6.1</td>
<td>5.2</td>
</tr>
<tr>
<td>08/31/1930</td>
<td>Venice</td>
<td>6.1</td>
<td>5.2</td>
</tr>
<tr>
<td>03/11/1933</td>
<td>La Jolla</td>
<td>0.1</td>
<td>6.3</td>
</tr>
<tr>
<td>03/11/1933</td>
<td>Long Beach *</td>
<td>0.1</td>
<td>6.3</td>
</tr>
<tr>
<td>08/21/1934</td>
<td>Newport Beach</td>
<td>12.0</td>
<td>Unknown</td>
</tr>
<tr>
<td>02/09/1941</td>
<td>San Diego</td>
<td>Unknown</td>
<td>6.6</td>
</tr>
<tr>
<td>10/18/1989</td>
<td>Monterey</td>
<td>0.4</td>
<td>7.1</td>
</tr>
<tr>
<td>10/18/1989</td>
<td>Moss Landing</td>
<td>1.0</td>
<td>7.1</td>
</tr>
<tr>
<td>10/18/1989</td>
<td>Santa Cruz</td>
<td>0.1</td>
<td>7.1</td>
</tr>
<tr>
<td>04/25/1992</td>
<td>Arena Cove</td>
<td>0.1</td>
<td>7.1</td>
</tr>
<tr>
<td>04/25/1992</td>
<td>Monterey</td>
<td>0.1</td>
<td>7.1</td>
</tr>
</tbody>
</table>

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<table>
<thead>
<tr>
<th>Date</th>
<th>Location</th>
<th>Run-up Height</th>
<th>Magnitude</th>
</tr>
</thead>
<tbody>
<tr>
<td>09/01/1994</td>
<td>Crescent City</td>
<td>0.1</td>
<td>7.1</td>
</tr>
<tr>
<td>11/04/2000</td>
<td>Point Arguello</td>
<td>5.0</td>
<td>Unknown</td>
</tr>
<tr>
<td>06/15/2005</td>
<td>N. California</td>
<td>0.1</td>
<td>7.2</td>
</tr>
</tbody>
</table>

* The City of Long Beach has not been impacted by a tsunami previously, according to the 2016 City of Long Beach Hazard Mitigation Plan. That said, a tsunami event is recorded (above) in 1933, though the run-up height of 0.1 meters or 4 inches, so it is understandable that no event was observed on the ground.
Table 3-23: Tsunamis That Have Affected North Coast California

<table>
<thead>
<tr>
<th>Date</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>03/20/1855</td>
<td>▪ M 6.0 Earthquake; Humboldt Bay; wave height/feet (0.0)</td>
</tr>
<tr>
<td>11/24/1885</td>
<td>▪ Meteorological Event Eureka; wave height/feet (0.0)</td>
</tr>
<tr>
<td>04/01/1946</td>
<td>▪ M 8.6 Earthquake, Unimak Island, AK Humboldt Bay; wave height/feet (0.0)</td>
</tr>
<tr>
<td>03/28/1964</td>
<td>▪ M 9.2 Earthquake, Prince William Sound, AK Trinidad; wave height/feet (8.9)</td>
</tr>
<tr>
<td></td>
<td>▪ King Salmon Slough, Humboldt Bay; wave height/feet (4.5)</td>
</tr>
<tr>
<td></td>
<td>▪ Humboldt Bay; wave height/feet (6.2)</td>
</tr>
<tr>
<td></td>
<td>▪ North Spit, Humboldt Bay; wave height/feet (3.1)</td>
</tr>
<tr>
<td></td>
<td>▪ Municipal Marina, Eureka; wave height/feet (5.1)</td>
</tr>
<tr>
<td></td>
<td>▪ Pacific Gas &amp; Elec., Humboldt Bay; wave height/feet (3.8)</td>
</tr>
<tr>
<td>06/15/2005</td>
<td>▪ M 7.2 Earthquake, N. California North Spit, Humboldt Bay; wave height/feet (0.1)</td>
</tr>
<tr>
<td>11/17/2003</td>
<td>▪ M 7.8 Earthquake, Rat Islands, AK North Spit, Humboldt Bay; wave height/feet (0.2)</td>
</tr>
</tbody>
</table>

Potential Impact of the Hazard:

Tsunamis can travel at speeds of over 600 miles per hour in the open ocean and can grow to over 50 feet in height when they approach a shallow shoreline, potentially causing total devastation to coastal development. Potential impacts to at risk CSU campuses or other assets include destruction of campus buildings and infrastructure, destruction of the natural environment, destruction of boats and coastal development, and loss of life in the area surrounding the campuses. Tsunamis that impact both harbors and communities also can produce free-floating debris hazards and environmental contamination from chemical spills.

89 Global Historical Tsunami Database, National Center for Environmental Information, 2019
The configuration of the coastline, the shape of the ocean floor, and the characteristics of advancing waves play important roles in the destructiveness of the waves. Bays, sounds, inlets, rivers, streams, offshore canyons, islands, and flood control channels may cause various effects that alter the level of damage. Offshore canyons can focus tsunami wave energy, and islands can filter the energy. It has been estimated that a tsunami wave entering a flood control channel could reach a mile or more inland, especially if it enters at high tide. The orientation of the coastline determines whether the waves strike head-on or are refracted from other parts of the coastline.

**Probability of Future Occurrence of the Hazard:**

The California Seismic Safety Commission report, the Tsunami Threat to California Findings and Recommendations on Tsunami Hazards Risks, published in December 2005, indicates that over 80 tsunamis have been observed or recorded along the coast of California in the past 150 years. If we consider historical occurrence as one data set for estimating future events, the average rate of occurrence over the past 150 years is 1 tsunami every 1.9 years.

The rate of future occurrence may change, and the California State Tsunami Program is trying to refine the accuracy of the data. In doing so, the State Tsunami Program is completing a set of Probabilistic Tsunami Hazard Analysis (PTHA) maps representing risk levels from 100-year to 3000-year average return periods. Analysis using these probabilistically based products will allow for a more common platform for comparison to other seismic and flood probabilistic analyses.90

**Vulnerability to the Hazard:**

For the purpose of this section, the discussion will center on the two Main campuses located in the inundation zone: Chancellor’s Office and Humboldt State University. It should be pointed out, however, that the discussion of main campus vulnerability (below) also applies to the satellite/coastal assets owned by San Francisco State, San Jose State and Maritime Academy. Long Beach State and CSU-East Bay may also have vulnerable coastal assets (to be determined). See the Location of the Hazard section (above) for more information.

Population and asset vulnerabilities are a function of “maximum run-up” projections modeled by the University of Southern California and distributed by the California Office of Emergency Services. The tsunami model was the result of a combination of inundation modeling and onsite surveys and determined the maximum projected inundation levels from tsunamis along the entire coast of Los Angeles County.

The most notably vulnerable campus is the Chancellor’s Office located in an inundation zone with a maximum run-up of approximately 42 feet. This means that based on the worst-case scenario tsunami, the displaced water level would be approximately 42 feet above the normal tide for that day and time. As such, given that the Chancellor’s Office is

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located on the oceanfront, it is clearly vulnerable to catastrophic loss, as are any staff or
visitors unable to evacuate with proper lead-time.91

With regard to Humboldt State University’s vulnerabilities, the campus planning
committee indicates that the California Geologic Survey datasets will be utilized in the
near future to analyze critical assets on campus that fall within zones of vulnerability. That
said, the planning committee indicates that the Aquatic Center and the Coral Sea
(research and classroom vessel) are located in the tsunami zone along with campus
access and egress routes. A tsunami could create isolated islands of people due to the
inundation, and no evacuation or access to hospital services. In fact, according to the
2018 State Hazard Mitigation Plan, Humboldt county’s population is among the most
vulnerable to tsunami related injury and life safety issues due to its close proximity to the
Cascadia Subduction Zone.92

Population Vulnerabilities
The populations most vulnerable to the tsunami hazard are the elderly, disabled and very
young who reside near beaches, low-lying coastal areas, tidal flats and river deltas that
empty into ocean going waters. In the event of a local tsunami generated near the coast,
little warning time would exist, so more of the population would be vulnerable, and to
some extent, this vulnerability pertains to the Humboldt State University planning area
and the Chancellor’s Office location in Long Beach. Though no data is currently available
for Long Beach, it is densely populated which creates a high degree of vulnerability. For
Humboldt County, HAZUS analysis of the inundation area indicates that a tsunami event
could displace 1,441 people, with up to 96 people needing short-term shelter assistance.

Property Vulnerabilities
The impact of tsunami waves and the scouring associated with debris that may be carried
in the water could be damaging to all structures along beaches, low-lying coastal areas,
tidal flats and river deltas. The most vulnerable structures are those in the front line of
tsunami impact and those that are structurally unsound. According to the 2018 State of
California Hazard Mitigation Plan, Long Beach exhibits among the state’s highest number
of businesses located in the tsunami zone.

Critical Facilities and Infrastructure
The following infrastructure is vulnerable to damage in Long Beach, CA and Humboldt
County, CA:

- Water Proximate Infrastructure—Breakwaters and piers collapse, sometimes
  because of scouring actions that sweep away their foundation material and
  sometimes because of the sheer impact of the tsunami waves.

91 2016 City of Long Beach Hazard Mitigation Plan.
92 2019 Humboldt County Operational Area Hazard Mitigation Plan
- Flood Control Systems—Floodwaters can back up drainage systems, causing localized flooding. Culverts can be blocked by debris from tsunami events, also causing localized urban flooding.
- Utility Systems—Floodwaters can get into drinking water supplies, causing contamination. Sewer systems can be backed up, causing waste to spill into homes, neighborhoods, rivers and streams. Tsunami waves can knock down power lines and radio/cellular communication towers. Power generation facilities can be severely impacted by wave action and by inundation from floodwater.
- Fuels— Destruction of fueling infrastructure and related environmental and potable water contamination can occur. In Humboldt County, the Chevron terminal is located in the tsunami inundation zone on Humboldt Bay and receives most of the vehicle fuel for the county by barge.

Estimate of Potential Losses

Estimates of potential losses specific to CSU campuses have not been conducted yet. In addition, no estimated loss data is currently available for the City of Long Beach, although the local mitigation plan indicates concern for losses related to fires from damaged ships in ports or from ruptured coastal oil storage tanks and refinery facilities in the port area. That said, according to the State plan, technological Improvements have been made in the ability to estimate losses from tsunami impacts which can be brought to bear on loss estimation for CSU campuses in the future.

For Humboldt County, the HAZUS analysis indicated that 49 percent of the county’s exposed structures (997 structures) would be impacted by the modeled scenario event with a damage estimate of $448M dollars (buildings, contents). The estimated damage value is associated with the tsunami wave only; it does not include additional damage as a result of debris battering structures or losses to from boats, bridges or utility lines. Moreover, HAZUS estimates of damage to critical facilities and infrastructure in the county show an estimated 141 facilities impacted with 66 facilities showing a light to moderate degree of damage (10% - 49% structural damage).

Vulnerability Assessment Conclusions

According to the 2018 State of California Hazard Mitigation Plan, community exposure to tsunamis in California varies considerably—some communities may experience great losses that reflect only a small part of their community and others may experience relatively small losses that devastate them. Among the 94 incorporated communities and 83 unincorporated areas of the 20 coastal counties, the communities of Alameda, Oakland, Long Beach, Los Angeles, Huntington Beach, and San Diego have the highest number of people and businesses in the tsunami inundation zone, and the communities that are most vulnerable to injury and life safety issues exist within Del Norte and Humboldt counties due their close proximity to the Cascadia Subduction Zone. As discussed, the Chancellor’s Office (Long Beach), Humboldt State University, San Francisco State, San Jose State, Maritime Academy (and potentially Long Beach State and CSU-East Bay) overlap with these highly vulnerable areas.
For improving assessments of vulnerability, FEMA has developed a new tsunami loss estimation module for HAZUS using existing numerical model results for tsunami inundation, flow depth, velocity, and force. This HAZUS module allows new capability for estimation of economic losses, and site-specific analysis of content losses, casualties, infrastructure damage, and evacuation time. The module calibrates losses based on safe zones and community preparedness levels.

Along with new probability-based tsunami maps, the HAZUS module will improve the ability to compare tsunami impacts to those of other hazards. Moreover, the probability mapping will be used for numerous applications including identifying potential tsunami hazard “zones of required investigation” under the Seismic Hazards Mapping Act and will assist state and local agencies in making land use planning decisions. They will also help regional and state planners understand the flood potential from tsunamis representing different risk levels.93

**Note:** To download the Community Exposure to Tsunami Hazards in California report visit the USGS website: [http://pubs.usgs.gov/sir/2012/5222/](http://pubs.usgs.gov/sir/2012/5222/).

**Identified Data Limitations:**

As identified in the Vulnerability Summary (above), with regard to the current planning effort, the primary data limitations for assessing the tsunami hazard for CSU campuses (Chancellor’s Office and Humboldt State University) are asset valuations lying within the tsunami inundation zone, and the need to apply FEMA’s new probability mapping techniques and tsunami loss estimation module to the footprint of each campus. That said, CSU leadership and planning teams intends to pursue such data in the future.

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**Volcano (Associated Air Quality)**

**Description of the Hazard**

The US Geological Service defines volcanoes as “openings or vents where lava, tephra (small rocks), and steam erupt on to the Earth’s surface. Through a series of cracks within and beneath the volcano, the vent connects to one or more linked storage areas of molten or partially molten rock (magma). This connection to fresh magma allows the volcano to erupt over and over again in the same location.”94

A volcanic eruption occurs when magma, lighter than surrounding rock, is driven upwards by its buoyancy and by pressure from the dissolved gases contained within it. Gases are released from magma as it reaches the surface and pressure decreases. Magma can be erupted in several ways and violent eruptions typically cause tiny pieces of tephra (ash) to be carried away by the wind. This ash is hard, does not dissolve in

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water, is extremely abrasive and mildly corrosive, and conducts electricity when wet. The gases released in an eruption include carbon dioxide, sulfur dioxide, hydrogen sulfide, and hydrogen halides. Depending on their concentration, these are potentially hazardous to people, animals, agriculture, and property.

**Location of the Hazard**

There are eight volcanic areas located throughout California. Seven of these - Medicine Lake Volcano, Mount Shasta, Lassen Volcanic Center, Clear Lake Volcanic Field, Long Valley Volcanic Region, Coso Volcanic Field, and Salton Buttes – are considered active volcanoes. Chico State and Fresno State are located in counties partially within the Lassen Volcanic Center and Long Valley Volcanic Region hazard zones, but the campuses themselves are not. No CSU campuses are located in a volcano hazard zone.

**Extent of the Hazard**

Volcanic hazards are most severe within a few miles of the volcano vent and the severity generally decreases with distance. Ash impact zones can range from tens to hundreds of miles from the vent source. The US Geological Survey has estimated zones surrounding active volcanoes wherein 2 inches or more of ashfall following an eruption is possible. While no CSU campuses fall within these estimated zones, lighter dustings of ash outside of those areas may directly or indirectly impact a CSU campus.

**History of the Hazard**

Over the last 1,000 years, there have been at least 12 eruptions in California. The most recent volcanic eruption in California occurred at Lassen Peak about 100 years ago, when a major explosion delivered windborne ash over 275 miles away.

**Potential Impacts of the Hazard**

The specific impacts vary widely and depend on which type of volcano erupts, the style of explosion, the volume of lava, the eruption duration, and the local water conditions. As no CSU campus is proximal to an active volcano, only the potential impacts of ashfall and gases have been detailed. While both these hazards can be widespread, their most severe impacts are generally seen closer to the volcanic source.

Although ashfall is typically a nonlethal volcanic hazard, it is the most widespread and disruptive. Falling ash can damage crops, electronics, and machinery. It can also impact human health by irritating the respiratory tract, eyes, and skin. The particles may enter drinking water and structures and may cause structure failure if it is thick and heavy enough. Even a fine layer of ash can disrupt utilities. A portion of California’s major

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96 https://www.usgs.gov/observatories/california-volcano-observatory/california-has-active-and-hazardous-volcanoes#:~:text=At%20least%20seven%20California%20volcanoes,they%20will%20erupt%20again%20in%202021
electric transmission lines, aerial telecommunication lifelines, transportation corridors, and water storage and conveyance lie within the state’s volcano hazard zones. Impacts to any of these can impact operations on a CSU campus.

The potential impacts of gases released during volcanic eruptions are as follows:

- Carbon dioxide typically becomes diluted very quickly and is not life threatening. However, it can become trapped in higher concentrations in low-lying areas and has the potential to be fatal.
- Sulfur dioxide can cause acid rain and air pollution downwind of a volcano.
- Hydrogen sulfide can cause irritation of the upper respiratory tract. At high concentrations it can cause unconsciousness and death.
- Hydrogen halides can coat ash particles and once deposited, poison drinking water, agricultural crops, and grazing land.

Probability of Future Occurrence of the Hazard

The US Geological Survey, based on the record of volcanic activity in California, estimates that the probability of another small- to moderate-sized eruption in the next thirty years is about 16 percent. The USGS has estimated the probability of future eruption of five of the seven active volcanoes in California:

- Coso Volcanic Field: .5 percent chance in the next 30 years
- Lassen Volcanic Center: .5 - 2 percent chance in the next 30 years
- Long Valley Volcanic Region: 2.5 percent chance in the next 10 years
- Medicine Lake Volcano: 1 percent chance in the next 30 years
- Mount Shasta: 3.5 percent chance in the next 30 years

Vulnerability to the Hazard

Populations living near volcanoes are the most vulnerable to eruptions and lava flows. However, volcanic ash can travel and affect populations miles away. The location and thickness of ash in any given area is a function of the severity of the eruption and wind speed and direction. For CSU campuses, there is low vulnerability to the immediate impacts of volcanic eruptions due to the limited area affected and remote potential of an eruption. In the event of a widespread ashfall event, the elderly, infants, and populations with existing respiratory disease will be at higher risk.

Estimate of Potential Losses

Impacts to critical infrastructure, agriculture, and property from ashfall have the potential to cause widespread disruption, damage, and economic loss throughout the state. In the event of a widespread ashfall event, impacts will be immediate.

Current modeling is not precise enough to allow for an assessment of potential losses from ashfall to structures or infrastructure on or surrounding the campus.

Vulnerability Assessment Conclusions
CSU campuses are unlikely to experience the direct impacts of a volcanic event. While any campus may be indirectly impacted by ashfall elsewhere in the state, direct ashfall impacts are generally unlikely but possible in a widespread event. However, the likelihood of any volcanic eruption in the state impacting CSU campuses is very low.

**Identified Data Limitations**

Not all active volcanoes in California have been zoned for hazards by the US Geological Survey. This fact, together with the infrequent occurrence of volcanic explosions and the variety and complexity of factors determining type and extent of impacts, make the quantification of potential loss difficult.

**Wildfire**

**Description of the Hazard**

While wildfires are a natural part of California’s ecosystem, wildfires in California represent a hazard that presents one of the greatest probabilities of destruction along with a demonstrated history of catastrophic fire events in recent years. In general, a wildfire is defined as any free-burning vegetative fire that initiates from an unplanned ignition, whether natural (e.g., lightning) or human-caused (e.g., powerlines, mechanical equipment, escaped prescribed fires), where the management objective is full suppression. While wildfires can potentially lead to benefits to an ecosystem if within the range of natural variability for a given ecotype and geographical area, they can also lead to deleterious effects to both the natural and built environment.

In California, the combination of complex terrain, Mediterranean climate that annually facilitates several monthlong rain-free periods, productive natural plant communities that provide ample fuels, and ample natural and anthropogenic ignition sources, has created a land forged in fire. A century of fire exclusion has led to a significant buildup of fuels in many mixed-conifer forests, which historically experienced frequent, low-intensity surface fires.

The behavior of wildfires in California is significantly influenced by three distinct geographic factors. These factors will help shape the size, direction of spread, rate of combustion, fire intensity, and ability to pre-heat fuels. The physical factors contributing to wildfire behavior include:

- **Topography** – The rate in which wildfires spread increases with greater slopes in topography. The greater the slope will result in more pre-heating of fuel above the advancing fire. The direction that a slope faces will also influence fire behavior as south facing slopes receive greater solar radiation and thus drier vegetation that is more susceptible to combustion. Ridgetops often denote the end of fire spread as fire has greater difficulty spreading downhill.

- **Weather** – Weather factors substantially in influencing the behavior of wildfires. Wind, temperature, humidity, lightning, and lack of precipitation all contribute to a fire’s ability or inability to spread and intensify. California routinely experiences conditions in which these factors are in alignment to contribute to extreme fire
behavior during the summer and fall seasons. High winds, low humidity, and high temperatures provide an environment promoting extreme fire activity.

- **Fuels** – Certain types of vegetation are increasingly prone to igniting and promote more intense burning. Areas with greater “fuel loading” (amount of fuel present in terms of weight of fuel per unit of area) increases the amount of fuel to fuel a fire. Greater volumes of dead or dry vegetation compared to live plants is a critical factor. Vegetation during drought conditions will experience decrease in moisture content increasing the conditions for combustion. Fuels close proximity to one another allows for rapid spread through contact or radiant exposures.

A risk assessment for wildfires should be implemented within a geospatial context focusing on the specific location features and incorporates the three components of the wildfire risk triangle – likelihood, intensity, and susceptibility.

Fire science distinguishes between two types of wildfires: “wildland” fires, which burn predominately in undeveloped areas, and “wildland-urban Interface” (WUI) fires. This distinction is important because mitigation, damage, and actions related to the two types may differ significantly.

Wildland fires that burn in natural settings with little or no development are part of a natural ecological cycle and may be beneficial to the landscape if they burn within the historic range of variability for fire size and intensity. Many species are adapted to California’s natural fire regimes and flourish after a low or mixed severity burn. These fires also enhance ecosystem function by creating landscapes that have more variation, are more resilient to other disturbances, and are better able to withstand extremes in precipitation. The wildland fire may result in secondary negative impacts in the form of air pollution, soil erosion (resulting in siltation of streams and lakes), or mudslides, though these impacts tend to be far less than would occur following high severity fires in areas of historic fire suppression. However, unless these fires or their related secondary impacts occur in or near developed areas (see Map 8.C), they are rarely classified as disasters because they do not affect people or the built environment. Wildland fires, regardless of size, that burn primarily on federally managed lands are only rarely classified as disasters.

The WUI is characterized by the intersection of the natural and the built environments and has been defined as “the area or zone where structures and other human development meet or intermingle with undeveloped wildland or vegetative fuels” (Society of American Foresters). The WUI can be configured in many ways including a classic “interface” (e.g., a community that abuts a National Forest at a distinct boundary), an “intermix” (e.g., vegetative fuels distributed between buildings throughout a subdivision between buildings), or an “occlusion” (e.g., a community that completely surrounds a designated open space area).

**Location of the Hazard**

The potential for destructive wildfires exists throughout the state. Historic fire perimeters indicate a pattern that many wildfires occur in the foothills of both coastal and interior
mountain ranges, especially in mountainous regions near populated areas of Southern California. Some areas in California are prone to burn with higher regularity than other areas and therefore have a heightened exposure to loss. This is of special concern in the South and Central Coast bioregions, which show the highest frequencies. These bioregions have significant amounts of shrubland plant communities where wildfires typically occur as high- intensity, stand-replacement fires.

While higher fire frequency has historically occurred in mixed-conifer forests, those fires were commonly low- intensity surface fires. However, given fuel buildup following a century of fire exclusion, a lengthened fire season predicted by many climate-change models, forest management practices which removed many of the older, larger trees, and massive tree die-off following epidemic bark beetle infestations, fires in mixed-conifer forests are likely to continue to grow in both size and intensity. 97

Substantial portions of the State of California are exceptionally vulnerable to wildfire activity or reside in a wildland-urban interface (WUI) area due to the vast open spaces, rangelands, forests and other lands with high susceptibility to fire occurring throughout the state. Many WUI fires occur in areas that have a historical pattern of wildland fires that burn under extreme conditions. The most common extreme fire behavior factor is high, dry, warm foëhn winds, such as Santa Ana or Diablo winds, that occur in a predictable location and seasonal pattern. The pattern of increased damages is directly related to increased urban spread into areas that have historically had wildfire as part of the natural ecosystem.

While most counties have experienced a state or federally declared fire disaster, the majority of those declarations have occurred in Southern California, due to a large population base located in areas that commonly have volatile shrublands, steep slopes, and annually occurring Santa Ana winds. However, there are growing concerns regarding increased wildfire frequency and severity in Northern California shown in climate change models. Recent catastrophic fire events throughout Northern California, in counties including Butte, Sonoma, Napa, Solano, Shasta, Mendocino, Lake, Glenn, and Colusa Counties, substantiated this concern.

With respect to CSU campuses, according to current mapping, eight (8) out of 23 campuses (roughly one-third) are located in or extremely close to a Fire Hazard Severity Zone (FHSZ). Of those, 4 campuses (Channel Islands, Pomona, San Bernardino and San Marcos campuses) are located in a Very High hazard zone, while CSU – Sacramento is located in a High severity zone, and CSU – Monterey, CSU – Northridge, and San Diego State are located in a Moderate severity zone.

**Extent of the Hazard**

Among California’s three primary hazards, wildfire, and particularly wildland-urban interface (WUI) fire, has represented the third greatest source of hazard to California, both in terms of recent state history as well as the probability of future destruction of greater
magnitudes than previously recorded. With the more recently catastrophic wildfire events starting in 2017, fire has emerged as an annual threat roughly comparable to floods. (Fire and flood fire hazards are surpassed only by high magnitude earthquake hazards.)

The National Fire Danger Rating System (NFDRS) is the current system in use for rating and classifying the potential danger of fire. The NFDRS tracks the effects of previous weather events on both dead and live fuel loads and adjusts accordingly based on future or predicted weather conditions. These complex relationships and equations are computed, and the outputs are expressed in terms that users can quickly and easily understand. The current NFDRS is used by all federal and most state agencies to assess fire danger conditions.

The following table depicts the National Fire Danger Rating System (NFDRS), from the US Forest Service’s Wildland Fire Assessment System.

Table 3-24: National Fire Danger Rating System

<table>
<thead>
<tr>
<th>Rating</th>
<th>Basic Description</th>
<th>Detailed Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>CLASS 1: Low Danger</td>
<td>Fires not easily started</td>
<td>Fuels do not ignite readily from small firebrands. Fires in open or cured grassland may burn freely a few hours after rain, but wood fires spread slowly by creeping or smoldering and burn in irregular fingers. There is little danger of spotting.</td>
</tr>
<tr>
<td>COLOR CODE: Green</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CLASS 2: Moderate</td>
<td>Fires start easily and spread at a</td>
<td>Fires can start from most accidental causes. Fires in open cured grassland will burn briskly and spread rapidly on windy days. Woods fires spread slowly to moderately fast. The average fire is of moderate intensity, although heavy concentrations of fuel -- especially draped fuel -- may burn hot. Short-distance spotting may occur but is not persistent. Fires are not likely to become serious and control is relatively easy.</td>
</tr>
<tr>
<td>Danger (M)</td>
<td>a moderate rate</td>
<td></td>
</tr>
<tr>
<td>COLOR CODE: Blue</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CLASS 3: High Danger</td>
<td>Fires start easily and spread at a</td>
<td>All fine dead fuels ignite readily, and fires start easily from most causes. Unattended brush and campfires are likely to escape. Fires spread rapidly and short-distance spotting is common. High intensity burning may develop on slopes or in concentrations of fine fuel. Fires may become serious and their control difficult, unless they are hit hard and fast while small.</td>
</tr>
<tr>
<td>(H)</td>
<td>a rapid rate</td>
<td></td>
</tr>
<tr>
<td>COLOR CODE: Yellow</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Wildfire is a hazard with a somewhat unpredictable nature. While it is at least somewhat possible to determine the areas that may be subject to experiencing wildfire, it is not possible to determine in advance how or where a wildfire will begin. Only the conditions for a wildfire can be predicted with any accuracy.

Some areas in California are prone to burn with higher regularity than other areas and therefore have a heightened exposure to loss. This is of special concern in the South and Central Coast bioregions, which show the highest frequencies. These bioregions have significant amounts of shrubland plant communities where wildfires typically occur as high-intensity, stand-replacement fires. While higher fire frequency has historically occurred in mixed-conifer forests, those fires were commonly low-intensity surface fires. However, given fuel buildup following a century of fire exclusion, a lengthened fire season predicted by many climate change models, forest management practices which removed many of the older, larger trees, and massive tree die-off following epidemic bark beetle infestations, fires in mixed-conifer forests are likely to continue to grow in both size and intensity.
Given the identified locations of 8 campuses in FHSZ’s along with the increased prevalence and severity of the wildfire hazard state-wide, (including students, staff and faculty having lost homes to wildfire), the CSU system-wide planning committee ranks the overall extent of the hazard across all CSU campuses as **Moderate**.

**History of the Hazard**

The State of California has a long history of chronic and destructive wildfires throughout the state. 8,300 wildfires have burned 928,245 acres across the state over the 20-year period between 2000 and 2020. While California has long been recognized as one of the most fire-prone natural landscapes in the world, WUI fires represent an increasingly significant concern for the State of California. While the number of acres burned
fluctuates from year to year, a trend over the last 30 years that has remained constant is the rise in wildfire-related losses. In 2018, most local governments that had submitted Local Hazard Mitigation Plans (LHMPs) identified fire and WUI fires as specific hazards. 2020 was the worst wildfire season in California history, consuming more than 4.2 million acres. California has a chronic and destructive WUI fire history with significant losses of life, structures, infrastructure, agriculture, and businesses.

Driven by worsening drought conditions and above-normal temperatures, California has passed new legislation investing millions of dollars towards hiring additional fire personnel, buying mechanical equipment, building defensible spaces and developing vegetation-management projects that will control and slow down the fires. In 2020, state wildfires consumed more that 4.2 million acres. In April 2021, state officials approved the allocation of more than $80 million in emergency funds to elevate forest management and wildfire response efforts. The funding will specifically promote 1,399 additional firefighters within CAL FIRE and will allow training of fire crews ahead of peak fire season, which occurs between July through October.99

Wildfire has not occurred directly on the footprint of CSU campuses, although CSU – San Marcos did have a wildfire reach the edge of campus in 2014 which required evacuation and campus closure for a week. Also, students, faculty and staff are frequently affected by smoke and poor air quality produced by wildfires. Some members of these populations have also lost homes to wildfire.

Potential Impacts of the Hazard

Wildfire poses significant risk to the people of California and their homes. According to California’s Forests and Rangelands 2017 Assessment, development patterns around the state have resulted in construction of approximately 3 million housing units within Fire Hazard Severity Zones (FHSZ) that are potentially at risk from wildfire. Of those housing units, close to 2.2 million are within the Wildland Urban Interface (WUI), 83 percent of which are in “dense interface” and 17 percent of which are in “intermix”.

Even relatively small-acreage WUI fires may result in disastrous damage. Most WUI fires are suppressed before they exceed 10 acres. The remainder usually occur during episodes of hot, windy conditions that exceed initial attack capabilities and, therefore, are more likely to cause heightened losses to the built environment. Dense interface WUI can be described as a fully developed residential area that terminates at the edge of a wildland area, while intermix WUI, as the name indicates, occurs where residential units are intermittently scattered through a wildland area. Fires that originate in the WUI from structures or other improvements can cause damage to wildland resources. The challenge is in how to reduce wildfire losses within a framework of California’s diversity of natural and built environments.

While some of the standing timber value can be salvaged following a wildfire, many of California’s timber assets are exposed to significant risk from wildland fire. initial

changes in the post-fire environment may cause temporary habitat loss and species dislocation. In the short term, the presence of partially burnt vegetation reduces recreational and open space values. Fires can also destroy campgrounds, trails, bridges, and other recreational facilities within the area. Wildfires can have significant adverse effects on watershed lands, watercourses, and water quality. Fire and the subsequent removal of vegetative cover increase the potential rate of soil erosion and new sediment sources. Potentially affect water quality through increased sedimentation and increased turbidity and through increases in nutrient loadings.

Probability of Future Occurrence of the Hazard

In California, 8,300 wildfires have burned 928,245 acres over the 20-year period between 2000 and 2020. This translates to an average of 415 fires annually with an average of 112 acres burned per wildfire event. Given a fairly consistent distribution of High and Very High severity zones from the north to the south of the state, it is reasonable to rank the annual probability of a wildfire occurrence within a CSU-based community as Possible. Also, because roughly one third of CSU campuses are located in Fire Hazard Severity Zones, and that such zones exist within all the broader communities and counties where CSU campuses are located, it is prudent to rank the annual probability of a wildfire occurrence on a CSU campus also as Possible.

In general, large, destructive wildfires are increasingly becoming the “new normal” in California, even with increased firefighting personnel, equipment, technology, and training. While wildfires are a natural part of California’s landscape, the fire season in California and across the West is starting earlier and ending later each year. The length of fire season is estimated to have increased by 75 days across the Sierras and seems to correspond with an increase in the extent of forest fires across the state.100 Climate change is considered a key driver shaping greater wildfire probability of occurrence, extent and severity. These increases are expected to be greatest in the mixed-conifer forests of the Sierra Nevada and Northern California; less impact is expected for fires in chaparral shrublands, which are expected to be more driven by increases in human-caused ignitions. In general, future years are projected to see a continuation or worsening of fire events across California related to the following:

- Increased fuel loading following a century of fire exclusion policies
- More human-caused ignitions
- Climate change, which is influencing drought
- Greater silvicultural insect and disease impacts
- Increased tree mortality
- Lengthening of the “fire season,” or annual time frame during which vegetative fuels are receptive to combustion.

While ignition sources for urban conflagrations within developed areas have been reduced via improvements in community design, construction materials, and building fire

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100 https://www.fire.ca.gov/incidents/2021/
protection systems, continued development in fire-prone areas subsequently increases the potential for an urban conflagration via WUI fires, especially in high-density developments that are adjacent to wildland areas that are prone to seasonably strong, dry winds (e.g., Diablo winds in the Bay Area or Santa Ana winds in Southern California).

Vulnerability to the Hazard

While structures burn every year, most damaging fires have occurred when ignitions coincided with severe weather that included critically high temperatures, low relative humidity, and perhaps most importantly, high winds. Once thought of as a seasonal hazard, wildfires are an almost everyday occurrence in California. California has widespread WUI fire vulnerability due to an increasing pattern of projected development encroaching into previously wildland area resulting in increased WUI zones.

Of those, 4 campuses (Channel Islands, Pomona, San Bernardino and San Marcos campuses) are located in a Very High hazard zone, while CSU – Sacramento is located in a High severity zone, and CSU – Monterey, CSU – Northridge, and San Diego State are located in a Moderate severity zone. CSU campuses not located in a fire hazard severity zone are not directly vulnerable to fire damage, but are still vulnerable to the effects of wildfire smoke and its air quality impacts to campus populations and operations.

Figure 3-18: California’s Projection of Development
California has widespread WUI fire vulnerability, as indicated on the map, based on CAL FIRE FRAP data. The map depicts an increasing pattern of projected development encroaching into previously wildland area resulting in increased WUI zones.

According to California’s Forests and Rangelands 2017 Assessment, development patterns around the state have resulted in construction of approximately 3 million housing units within Fire Hazard Severity Zones (FHSZ) that are potentially at risk from wildfire. Of those housing units, close to 2.2 million are within the Wildland Urban Interface (WUI), 83 percent of which are in “dense interface” and 17 percent of which are in “intermix”. Dense interface WUI can be described as a fully developed residential area
that terminates at the edge of a wildland area, while intermix WUI, as the name indicates, occurs where residential units are intermittently scattered through a wildland area.

The degree of vulnerability for CSU campuses is greater or less depending on their location within (Low to Very High) wildfire hazard severity zones, along with the natural fuels and incendiary materials on campus in closest proximity to such severity zones. Of those, 4 campuses (Channel Islands, Pomona, San Bernardino and San Marcos campuses) are located in a Very High hazard zone, while CSU – Sacramento is located in a High severity zone, and CSU – Monterey, CSU – Northridge, and San Diego State are located in a Moderate severity zone. CSU campuses not located in a fire hazard severity zone are not directly vulnerable to fire damage but are still vulnerable to the effects of wildfire smoke and its air quality impacts to campus populations and operations. In response, the SOP’s and other wildfire monitoring and fuel maintenance protocols are in place on each campus. Protocols include air quality warnings and evacuation procedures reduce the vulnerability of campus populations, assets and operations.

Estimate of Potential Losses

Currently, a dollar loss estimate of direct and indirect impacts from wildfire has not been calculated for CSU campuses as whole or individually. CSU leadership may pursue such data in the future.

Vulnerability Assessment Conclusions

Wildfires are the most frequent source of declared disasters and account for the third highest combined losses. Most Local Hazard Mitigation Plan reviewed in 2017 in Southern California and San Francisco Bay Area counties, some Central Valley counties, and many North Coast and Sierra Mountain counties rated wildfires high in their hazard rankings. For CSU campuses, the degree of vulnerability is greater or less depending on their location within (Low to Very High) wildfire hazard severity zones, along with the natural fuels and incendiary materials on campus in closest proximity to such severity zones.

Identified Data Limitations

As indicated above, data on direct and indirect losses form wildfire are not currently available. In addition, a comprehensive assessment and tracking of wildfire-prone campus assets and incendiary potential of natural fuels within and around CSU campuses has not been conducted. CSU leadership may pursue such data in the future.

Severe Weather (Wind, Tornado, Hail, Lightning)

Description of the Hazard

Severe weather can be described as a variety of weather or climate events that are beyond or near the ends of the range of observed weather patterns and behavior. These events can include high or extreme winds, storms, lightning, hail, tornadoes, heat waves,
unusually cold temperatures, extreme rainfall, and flooding. According to the Intergovernmental Panel on Climate Change (IPCC), to be classified as severe (or extreme), the occurrence of each value of a climate or weather variable (e.g., wind, hail, lightning, tornado, etc.) must be “above (or below) a threshold value near the upper (or lower) ends of the range of observed values of the variable.”

Severe weather in California can be generated by local, regional, and/or global weather and climate influences. From the individual thunderstorm to the Santa Ana wind event to the strong El Niño, damaging weather elements that are produced by and accompany severe weather and climate phenomena (e.g., damaging winds, hail, lightning, and tornadoes) occur throughout California and the California State University (CSU) system.

**Global Scale Influences on Severe Weather in California: El Niño, La Niña, and ENSO**

The El Niño-Southern Oscillation (ENSO) is a recurring climate pattern involving changes in the temperature of waters in the central and eastern tropical Pacific Ocean. On periods ranging from about three (3) to seven (7) years, the surface waters across a large swath of the tropical Pacific Ocean warm or cool by anywhere from 1°C to 3°C, compared to normal. This oscillating warming and cooling pattern, referred to as the ENSO cycle, directly affects rainfall distribution in the tropics and can have a strong influence on weather across the United States and other parts of the world.

El Niño and La Niña are extreme phases of the ENSO cycle, with a third phase occurring between them called the Neutral phase. The El Niño phase is characterized by unusually warm ocean temperatures and weaker-than-normal east winds in the Equatorial Pacific, while the La Niña phase is characterized by unusually cold ocean temperatures and stronger-than-normal east winds in the Equatorial Pacific. Both extreme ENSO phases lead to significant differences from the average ocean temperatures, winds, surface pressure, and rainfall across parts of the tropical Pacific. The Neutral phase indicates that conditions are near their long-term average.

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103 Retrieved on 07.18.2021 from [https://www.weather.gov/mhx/ensowhat](https://www.weather.gov/mhx/ensowhat)


105 Retrieved on 07.17.2021 from [https://www.climate.gov/news-features/understanding-climate/el-ni%C3%B1o-and-la-ni%C3%B1a-frequently-asked-questions](https://www.climate.gov/news-features/understanding-climate/el-ni%C3%B1o-and-la-ni%C3%B1a-frequently-asked-questions)
The extreme ENSO phases affect the frequency and intensity of weather events across the world, including in California. On average, areas across California experience exceptionally stormy winters with increased precipitation under El Niño conditions, but experience less stormy and drier winters under La Niña conditions. This variability in storminess and precipitation brought on by El Niño and La Niña events affects the both the frequency and intensity of severe weather conditions experienced by all CSU campuses.

**Regional Climate Influences on Severe Weather across California**

Most of the weather in California is influenced by the wet-winter/dry-summer Mediterranean climate pattern. In the summer months, Pacific storm tracks are deflected north due to the position of the Pacific High (i.e., a large-scale atmospheric circulation over the Northeast Pacific Ocean), preventing Pacific storms from reaching California. As a result, most summer storms are generated due to the incursion of moist air from the Gulf of Mexico or the Gulf of California, and occur as scattered, locally heavy showers in the desert and mountain regions of the state. In the winter months, the Pacific High decreases in intensity and moves south, permitting powerful Pacific storms to move into and across the state; these storms can produce extreme winds, heavy rains (including “atmospheric river” events), and widespread coastal and inland flooding. (Please see the Flood Hazard profile in this document for information on Floods.) As a result, storm events accompanied by precipitation in California are far more frequent in the winter months than they are in the summer months.

While the Mediterranean climate pattern influences the seasonal frequency, intensity, geographic spread, and type of some severe weather events that CSU campuses systemwide experience, other severe weather phenomena may occur in California at any time of the year. For example, near the coast and over the Central Valley, there appears to be no defined seasonality to thunderstorms, and these storms are usually light and infrequent. Thunderstorms are more intense and more frequent in the intermediate and higher elevations of the Sierra Nevada, and occur with greater frequency during the summer months.

**Types of Storms in California**

The 2018 California State Hazard Mitigation Plan (SHMP) defines a storm as a violent atmospheric disturbance occurring over land and/or water that is distinguished by its strength, characteristics, and the scale of the resulting damage. The SHMP also lists the following types of storms that produce hazardous conditions and potential damage

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106 Retrieved on 07.16.2021 from https://www.pmel.noaa.gov/elnino/what-is-el-nino
throughout the state of California.111 These storms affect (in varying degrees) all CSU campuses.

- **Thunderstorm**: A rain-bearing cloud that also produces lightning. Thunderstorms can produce some of nature’s most destructive and deadly weather including tornadoes, hail, strong winds, lightning and flooding.112 Thunderstorms are caused by an atmospheric imbalance from warm unstable air rising rapidly into the atmosphere. Lightning, which occurs during all thunderstorms, can strike anywhere.113 Thunderstorms can produce some of nature’s most destructive and deadly weather including tornadoes, hail, strong winds, lightning and flooding.114 *Severe thunderstorms* are more intense, violent, and dangerous thunderstorms. The National Oceanic and Atmospheric Administration (NOAA) defines a severe thunderstorm as any storm that produces one or more of the following elements: Damaging winds or speeds of 58 mph (50 knots) or greater, hail 1 inch in diameter or larger, and/or a tornado.115 116

- **Hailstorm**: a type of storm that precipitates round chunks of ice. Hailstorms usually occur during regular thunderstorms.117

- **Wind storm**: marked by high wind with little or no precipitation.118

- **Winter storm**: A storm that can produce a combination of freezing rain, sleet, heavy snow, and/or strong winds.119

- **Coastal storm**: large wind-driven waves and/or storm surge that strike the coastal zone.120

- **Ice storm**: Ice storms are one of the most dangerous forms of winter storms. When surface temperatures are below freezing, but a thick layer of above-freezing air

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115 Retrieved on 07.15.2021 from https://www.noaa.gov/explainers/severe-storms
116 Retrieved on 07.15.2021 from https://www.weather.gov/safety/thunderstorm
remains aloft, rain can fall into the freezing layer and freeze upon impact into a glaze of ice. In general, 8 millimeters (0.31 inch) of accumulation is all that is required, especially in combination with breezy conditions, to start downing power lines as well as tree limbs. Ice storms also make unheated road surfaces too slick to drive on. Ice storms can vary in time range from hours to days and can cripple small towns and large urban centers alike.121

- **Snowstorm**: A heavy fall of snow accumulating at a rate of more than 5 centimeters (2 inches) per hour that lasts several hours. Snowstorms, especially ones with a high liquid equivalent and breezy conditions, can down tree limbs, cut off power, and paralyze travel over a large region.122

**Severe Weather Hazard Elements: Wind Hazards, Hail, and Lightning**

This hazard profile concentrates on the following types of severe weather hazards: wind hazards (including tornadoes), hail, and lightning. These hazards are produced by a variety of weather phenomena, including thunderstorms, coastal storms, winter storms, and topographically enhanced downslope winds. While storm and downslope wind hazards are responsible for severe weather events across the CSU system, only the wind, tornado, hail, and lightning elements generated by these hazards are covered in this profile. (Storm-related hazards such as flooding and extreme temperatures are covered in other sections of this document.)

**Wind Hazards**

Wind is the horizontal movement of air past any given point. Wind begins with differences in air pressures; pressure that is higher at one point than another sets up a force, pushing the high towards the low pressure.123 Wind gusts are defined as “rapid fluctuations in the wind speed with a variation of 10 knots or more between peaks and lulls.” 124

Wind hazards in California take several forms: High Wind, Strong Winds, Thunderstorm Winds, Mountain-Valley (Downslope) Winds, and Tornadoes. These hazards are encountered across California and have the potential to cause harm to or loss of life and/or property throughout California and the CSU system.

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High Winds, Strong Winds, and Thunderstorm Winds

The National Weather Service reports three (3) types of wind events that occur areas over land: High Winds, Strong Winds, and Thunderstorm Winds. Collectively, these reports are used to determine the frequency with which wind hazard events have affected areas across the U.S., including California.

High Winds

High winds are defined as sustained non-convective winds of 35 knots (40 mph) or greater lasting for 1 hour or longer, or gusts of 50 knots (58 mph) or greater for any duration (or otherwise locally/regionally defined). In some mountainous areas, the above numerical values are 43 knots (50 mph) and 65 knots (75 mph), respectively.125

Strong Winds

Strong winds are defined as non-convective winds gusting less than 50 knots (58 mph), or sustained winds less than 35 knots (40 mph), resulting in a fatality, injury, or damage.126

Thunderstorm Winds

Thunderstorm winds are winds that arise from thunderstorm convection (occurring within 30 minutes of lightning being observed or detected), with speeds of at least 50 knots (58 mph). They can also be winds of any speed (non-severe thunderstorm winds below 50 knots (58 mph)) producing a fatality, injury, or damage.127

Please note: Straight-line wind is a term used to define any thunderstorm wind that is not associated with rotation. It is used mainly to differentiate from the rotational winds found in tornado-producing storms.128 However, it is not a term used in the NCEI Storm Events Database, and therefore cannot be used to determine severe weather history of or potential impacts to CSU campuses.

Tornadoes

A tornado is an extreme severe weather wind hazard. A tornado is a rapidly rotating column of air extending from a thunderstorm to the surface of the Earth.129 This column extends between cloud and the Earth’s surface. The damage from tornadoes comes from the strong winds they contain and the flying debris they create. It is generally believed that rotational wind speeds can be as high as 300 mph in the most violent tornadoes.130

On a local scale, tornadoes are the most violent and most destructive of all atmospheric phenomena.\textsuperscript{131}

**Mountain-Valley (Downslope) Wind Systems: Santa Ana, Diablo, and Sundowner Winds.**

*Santa Ana Winds*. A type of wind hazard that is peculiar to Southern California is called a *Santa Ana Wind*. Santa Ana winds are strong, topographically-enhanced, extremely dry downslope winds that originate inland and affect coastal southern California and northern Baja California (Mexico).\textsuperscript{132} They occur when air from a region of high pressure over the dry, desert region of the southwestern U.S. flows westward towards low pressure located off the California coast. This creates dry winds that flow east to west through the mountain passages in Southern California. These winds have a strong seasonal component; they are most common during the cooler months of the year, occurring from September through May. Santa Ana winds typically feel warm (or even hot) because as the cool desert air moves down the side of the mountain, it is compressed, which causes the temperature of the air to rise. If strong enough, Santa Ana winds can cause major property damage, and may present difficulties for airborne and seagoing transportation. They also may increase wildfire risk because of the dryness of the winds and the speed at which they can spread a flame across the landscape.\textsuperscript{133} (Note: The Wildfire hazard is profiled elsewhere in this document.)

Figure below illustrates the mechanisms involved in the generation of Santa Ana winds across Southern California.

\textsuperscript{131} Retrieved on 07.15.2021 from https://www.weather.gov/bgm/severedefinitions


\textsuperscript{133} Retrieved on 07.13.2021 from https://www.weather.gov/safety/wind-mountain-valley
**Diablo Winds.** The Diablo wind is another type of topographically-enhanced downslope wind phenomenon that occurs in the North-Central areas of California. Diablo winds are offshore wind events that flow northeasterly over Northern California’s Coast Ranges, often creating high wind speeds downwind of major canyons and over ridges, and extreme fire danger for the San Francisco Bay Area. Diablo winds are driven by a surface pressure gradient that forms in response to an inverted pressure trough that develops over California.  

**Sundowner Winds.** Sundowner winds are significant and potentially damaging downslope wind and warming events that periodically occur along a short segment of the southern California coast in the vicinity of Santa Barbara, CA. The unique topography of this coastal region promotes the development of Sundowner wind events: over a length of about 100 km, the coastline is oriented approximately west–east, with the adjoining

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narrow coastal plain bounded by a steeply rising (to elevations greater than 1200 m) and coast-parallel mountain range. Called Sundowner winds because they often begin in the late afternoon or early evening, their onset is typically associated with a rapid rise in temperature and decrease in relative humidity, and the winds tend to blow from the north from the Santa Ynez Mountains to the coast of Santa Barbara County, California. During the more intense Sundowner wind events, wind speeds can be of gale force 39-54 miles per hour) or higher, and can even reach hurricane force (≥ 74 miles per hour) in the most extreme cases. Temperatures over the coastal plain, and even at the coast itself, can rise significantly above 37.8°C (100°F). Seasonally, Sundowner winds peak in March, April, and May, with a minimum during summer and a secondary peak in winter that often corresponds with Santa Ana winds. In addition to causing a dramatic change from the more typical marine-influenced local weather conditions, Sundowner wind episodes have produced significant wind-related property and agricultural damage, as well as conditions of extreme fire danger.136 137 138

**Hail**

Hail is a form of precipitation consisting of solid ice that forms inside thunderstorm updrafts.139 It is roughly round in shape and at least 0.2’ in diameter. Hail develops in the upper atmosphere as ice crystals that are bounced about by high velocity updraft winds; the ice crystals accumulate frozen droplets and fall after developing enough weight. The size of hailstones varies and is a direct consequence of the severity and size of the storm that produces them – the higher the temperatures at the Earth’s surface, the greater the strength of the updrafts and the amount of time hailstones are suspended, and therefore the greater the size of the hailstone.140

**Lightning**

Lightning is an electrical discharge produced by a thunderstorm. Lightning rapidly heats the air in its immediate vicinity to about 50,000°F - about five times the temperature of the surface of the sun. This compresses the surrounding air and creates a supersonic shock wave, which decays to an acoustic wave that is heard as thunder.141

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The discharge may occur within or between clouds, between the cloud and air, between a cloud and the ground, or between the ground and a cloud.\textsuperscript{142} Lightning that is produced from thunderstorms in which precipitation evaporates before reaching the ground is called “dry lightning.”

**Location of the Hazard**

Severe weather is a non-spatial hazard, and can occur anywhere in the CSU system, and at all main campuses, satellite campuses, research facilities, conference centers, and other CSU-owned facilities and properties. For each CSU campus – and for each campus’ surrounding community – no one area is subject to experiencing severe weather more than any other area.

There is geographic variability among the different types of mountain-valley wind events (as a sub-category of the severe weather hazard). Santa Ana winds occur in Southern California, Diablo winds occur in North-Central California, and Sundowner winds occur almost exclusively in Santa Barbara County, California.

**Extent of the Hazard**

Severe weather hazards are non-spatial hazards that potentially affect all CSU system campus areas equally. However, the smallest geographic unit of measurement for almost all official severe weather event data is county-level. Because the severe weather data used do not exist at the campus level, it is assumed that the same (or similar) severe weather risks to each CSU campus reflect those of the campus’ surrounding community and County. As a result, all assets and people at all CSU campuses are at risk from the effects of severe weather and can expect to experience at least some (or the complete range of) endemic severe weather hazards.

In consideration of the campus’ design, layout, and operations, the severe weather history and degree of severity in the area, and the history and degree of severity of each severe weather sub-type identified by the extent scales (below), the campus planning committee ranks the overall extent of the Severe Weather hazard for the CSU system as **MODERATE**. See each sub-hazard below for the planning committee’s sub-type extent ranking for the CSU system.

**Wind Hazard: Non-Rotational**

The Beaufort Scale (Table 3-XX) is an empirical measure that relates wind speed to observed conditions at sea or on land. Its full name is the Beaufort wind force scale.\textsuperscript{143} First developed in 1805, it is still used today to estimate wind strengths.\textsuperscript{144}

\textsuperscript{143} Retrieved on 07.15.2021 from https://www.rmets.org/resource/beaufort-scale
\textsuperscript{144} Retrieved on 07.15.2021 from https://www.weather.gov/mfl/beaufort
Table 3-25: Beaufort Wind Force Scale\textsuperscript{145}

<table>
<thead>
<tr>
<th>Force</th>
<th>Speed (mph)</th>
<th>Speed (knots)</th>
<th>Description</th>
<th>Specifications for use at sea</th>
<th>Specifications for use on land</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0-1</td>
<td>0-1</td>
<td>Calm</td>
<td>Sea like a mirror.</td>
<td>Calm; smoke rises vertically.</td>
</tr>
<tr>
<td>1</td>
<td>1-3</td>
<td>1-3</td>
<td>Light Air</td>
<td>Ripples with the appearance of scales are formed, but without foam crests.</td>
<td>Direction of wind shown by smoke drift, but not by wind vanes.</td>
</tr>
<tr>
<td>2</td>
<td>4-7</td>
<td>4-6</td>
<td>Light Breeze</td>
<td>Small wavelets, still short, but more pronounced. Crests have a glassy appearance and do not break.</td>
<td>Wind felt on face; leaves rustle; ordinary vanes moved by wind.</td>
</tr>
<tr>
<td>3</td>
<td>8-12</td>
<td>7-10</td>
<td>Gentle Breeze</td>
<td>Large wavelets. Crests begin to break. Foam of glassy appearance. Perhaps scattered white horses.</td>
<td>Leaves and small twigs in constant motion; wind extends light flag.</td>
</tr>
<tr>
<td>4</td>
<td>13-18</td>
<td>11-16</td>
<td>Moderate Breeze</td>
<td>Small waves, becoming larger; fairly frequent white horses.</td>
<td>Raises dust and loose paper; small branches are moved.</td>
</tr>
<tr>
<td>5</td>
<td>19-24</td>
<td>17-21</td>
<td>Fresh Breeze</td>
<td>Moderate waves, taking a more pronounced long form; many white horses are formed.</td>
<td>Small trees in leaf begin to sway; crested wavelets form on inland waters.</td>
</tr>
<tr>
<td>6</td>
<td>25-31</td>
<td>22-27</td>
<td>Strong Breeze</td>
<td>Large waves begin to form; the white foam crests are more extensive everywhere.</td>
<td>Large branches in motion; whistling heard in telegraph wires; umbrellas used with difficulty.</td>
</tr>
<tr>
<td>7</td>
<td>32-38</td>
<td>28-33</td>
<td>Near Gale</td>
<td>Sea heaps up and white foam from breaking waves begins to be blown in streaks along the direction of the wind.</td>
<td>Whole trees in motion; inconvenience felt when walking against the wind.</td>
</tr>
</tbody>
</table>

\textsuperscript{145} Retrieved on 07.15.2021 from https://www.weather.gov/mfl/beaufort
<p>| | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>8</td>
<td>39-46</td>
<td>34-40</td>
<td>Gale</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Moderately high waves of greater length; edges of crests begin to break into spindrift. The foam is blown in well-marked streaks along the direction of the wind.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Breaks twigs off trees; generally impedes progress.</td>
</tr>
<tr>
<td>9</td>
<td>47-54</td>
<td>41-47</td>
<td>Severe Gale</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>High waves. Dense streaks of foam along the direction of the wind. Crests of waves begin to topple, tumble and roll over. Spray may affect visibility</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Slight structural damage occurs (chimney-pots and slates removed)</td>
</tr>
<tr>
<td>10</td>
<td>55-63</td>
<td>48-55</td>
<td>Storm</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Very high waves with long overhanging crests. The resulting foam, in great patches, is blown in dense white streaks along the direction of the wind. On the whole the surface of the sea takes on a white appearance. The tumbling of the sea becomes heavy and shock-like. Visibility affected.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Seldom experienced inland; trees uprooted; considerable structural damage occurs.</td>
</tr>
<tr>
<td>11</td>
<td>64-72</td>
<td>56-63</td>
<td>Violent Storm</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Exceptionally high waves (small and medium-size ships might be for a time lost to view behind the waves). The sea is completely covered with long white patches of foam lying along the direction of the wind. Everywhere the edges of the wave crests are blown into froth. Visibility affected.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Very rarely experienced; accompanied by widespread damage.</td>
</tr>
<tr>
<td>12</td>
<td>73+</td>
<td>64+</td>
<td>Hurricane</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>The air is filled with foam and spray. Sea completely white with driving spray; visibility very seriously affected.</td>
</tr>
</tbody>
</table>

Based on those extent ranking factors identified (above), the planning committee ranks the extent of non-rotational wind hazards as **MODERATE** for the CSU system.
Extent: Tornado

Tornadoes have their own severity/extent scale. Until 2007, tornadoes were measured and described according to the Fujita Scale.\textsuperscript{146}

In February 2007, use of the Fujita Scale was discontinued. In its place, the Enhanced Fujita (EF) Scale is used. The Enhanced Fujita scale considers how most structures are designed and is thought to be a much more accurate representation of the surface wind speeds in the most violent tornadoes. Like the original Fujita scale, the Enhanced Fujita scale is a set of wind estimates (not measurements) based on damage.

It is important to note the date that a tornado occurred. Tornadoes that occurred prior to February, 2007 are classified using the original Fujita scale and will not be converted to the Enhanced Fujita Scale.

Table below illustrates the Fujita Scale in use prior to February 2007.

Table 3-26: Fujita Tornado Scale (Pre-February 2007) \textsuperscript{147}

<table>
<thead>
<tr>
<th>F-Scale Number</th>
<th>Intensity Phrase</th>
<th>Wind Speed</th>
<th>Type of Damage</th>
</tr>
</thead>
<tbody>
<tr>
<td>F0</td>
<td>Gale tornado</td>
<td>40-72 mph</td>
<td>Some damage to chimneys; breaks branches off trees; pushes over shallow-rooted trees; damages sign boards.</td>
</tr>
<tr>
<td>F1</td>
<td>Moderate tornado</td>
<td>73-112 mph</td>
<td>The lower limit is the beginning of hurricane wind speed; peels surface off roofs; mobile homes pushed off foundations or overturned; moving autos pushed off the roads; attached garages may be destroyed.</td>
</tr>
<tr>
<td>F2</td>
<td>Significant tornado</td>
<td>113-157 mph</td>
<td>Considerable damage. Roofs torn off frame houses; mobile homes demolished; boxcars pushed over; large trees snapped or uprooted; light object missiles generated.</td>
</tr>
<tr>
<td>F3</td>
<td>Severe tornado</td>
<td>158-206 mph</td>
<td>Roof and some walls torn off well-constructed houses; trains overturned; most trees in forest uprooted.</td>
</tr>
</tbody>
</table>

\textsuperscript{146} Retrieved on 07.19.2021 from https://www.weather.gov/tae/ef_scale
<table>
<thead>
<tr>
<th></th>
<th>Devastating tornado</th>
<th>Well-constructed houses leveled; structures with weak foundations blown off some distance; cars thrown and large missiles generated.</th>
</tr>
</thead>
<tbody>
<tr>
<td>F4</td>
<td>207-260 mph</td>
<td>Strong frame houses lifted off foundations and carried considerable distances to disintegrate; automobile sized missiles fly through the air in excess of 100 meters; trees debarked; steel reinforced concrete structures badly damaged.</td>
</tr>
<tr>
<td>F5</td>
<td>Incredible tornado</td>
<td>These winds are very unlikely. The small area of damage they might produce would probably not be recognizable along with the mess produced by F4 and F5 wind that would surround the F6 winds. Missiles, such as cars and refrigerators would do serious secondary damage that could not be directly identified as F6 damage. If this level is ever achieved, evidence for it might only be found in some manner of ground swirl pattern, for it may never be identifiable through engineering studies.</td>
</tr>
<tr>
<td>F6</td>
<td>Inconceivable tornado</td>
<td>319-379 mph</td>
</tr>
</tbody>
</table>
Table 3-27: Enhanced Fujita Scale (February 2007 and Later) 148

<table>
<thead>
<tr>
<th>Enhanced Fujita Category</th>
<th>Wind Speed</th>
<th>Potential Damage</th>
</tr>
</thead>
<tbody>
<tr>
<td>EF0</td>
<td>65-85 mph</td>
<td>Light damage. Peels surface off some roofs; some damage to gutters or siding; branches broken off trees; shallow-rooted trees pushed over.</td>
</tr>
<tr>
<td>EF1</td>
<td>86-110 mph</td>
<td>Moderate damage. Roofs severely stripped; mobile homes overturned or badly damaged; loss of exterior doors; windows and other glass broken.</td>
</tr>
<tr>
<td>EF2</td>
<td>111-135 mph</td>
<td>Considerable damage. Roofs torn off well-constructed houses; foundations of frame homes shifted; mobile homes completely destroyed; large trees snapped or uprooted; light-object missiles generated; cars lifted off ground.</td>
</tr>
<tr>
<td>EF3</td>
<td>136-165 mph</td>
<td>Severe damage. Entire stories of well-constructed houses destroyed; severe damage to large buildings such as shopping malls; trains overturned; trees debarked; heavy cars lifted off the ground and thrown; structures with weak foundations blown away some distance.</td>
</tr>
<tr>
<td>EF4</td>
<td>166-200 mph</td>
<td>Devastating damage. Well-constructed houses and whole frame houses completely leveled; cars thrown and small missiles generated.</td>
</tr>
<tr>
<td>EF5</td>
<td>&gt;200 mph</td>
<td>Incredible damage. Strong frame houses leveled off foundations and swept away; automobile-sized missiles fly through the air in excess of 100 m (107 yd); high-rise buildings have significant structural deformation; incredible phenomena will occur.</td>
</tr>
</tbody>
</table>

Based on the extent ranking factors identified (above), the planning committee ranks the extent of tornadoes as **LOW** for the CSU system.

**Extent: Hail**

The National Oceanic and Atmospheric Administration and the Tornado and Storm Research Organization (TORRO) have combined efforts to create the Hailstorm Intensity Scale. Table below provides details of this scale.

Table 3-28: Combined NOAA/TORRO Hailstorm Intensity Scale\(^{149}\)

<table>
<thead>
<tr>
<th>Size Code</th>
<th>Intensity Category</th>
<th>Typical Hail Diameter</th>
<th>Approximate Size</th>
<th>Typical Damage Impacts</th>
</tr>
</thead>
<tbody>
<tr>
<td>H0</td>
<td>Hard Hail</td>
<td>Up to 0.33”</td>
<td>Pea</td>
<td>No damage</td>
</tr>
<tr>
<td>H1</td>
<td>Potentially Damaging</td>
<td>0.33” – 0.60”</td>
<td>Marble or Mothball</td>
<td>Slight damage to plants and crops</td>
</tr>
<tr>
<td>H2</td>
<td>Potentially Damaging</td>
<td>0.60” – 0.80”</td>
<td>Dime or grape</td>
<td>Significant damage to fruit, crops, and vegetation</td>
</tr>
<tr>
<td>H3</td>
<td>Severe</td>
<td>0.80” – 1.20”</td>
<td>Nickel to Quarter</td>
<td>Severe damage to fruit and crops, damage to glass and plastic structures, paint and wood scored</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Extent</th>
<th>Ranking</th>
<th>Size</th>
<th>Object</th>
<th>Damage Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>H4</td>
<td>Severe</td>
<td>1.20” – 1.60”</td>
<td>Half Dollar to Ping Pong Ball</td>
<td>Widespread glass damage, vehicle body damage</td>
</tr>
<tr>
<td>H5</td>
<td>Destructive</td>
<td>1.60” – 2.0”</td>
<td>Silver Dollar to Golf Ball</td>
<td>Wholesale destruction of glass, damage to tiled roofs, significant risk of injuries</td>
</tr>
<tr>
<td>H6</td>
<td>Destructive</td>
<td>2.0” – 2.4”</td>
<td>Lime or Egg</td>
<td>Aircraft body dented; brick walls pitted</td>
</tr>
<tr>
<td>H7</td>
<td>Very Destructive</td>
<td>2.4” – 3.0”</td>
<td>Tennis Ball</td>
<td>Severe roof damage, risk of serious injuries</td>
</tr>
<tr>
<td>H8</td>
<td>Very Destructive</td>
<td>3.0” – 3.5”</td>
<td>Baseball to Orange</td>
<td>Severe damage to aircraft body</td>
</tr>
<tr>
<td>H9</td>
<td>Super Hailstorms</td>
<td>3.5” – 4.0”</td>
<td>Grapefruit</td>
<td>Extensive structural damage, risk of severe or fatal injuries to persons caught in the open</td>
</tr>
</tbody>
</table>

Based on those extent ranking factors identified (above), the planning committee ranks the extent of the hail hazard as **LOW** for the CSU system.
**Extent: Lightning**

The National Weather Service (NWS) uses a Lightning Activity Level (LAL) scale to indicate the frequency and character of cloud-to-ground (C/G) lightning. The scale uses a range of 1 – 6, with 6 being the high end of the scale. Table below provides details of the LAL scale.

Table 29: Lightning Activity Level (LAL) Scale\(^{150}\)

<table>
<thead>
<tr>
<th>Rank</th>
<th>Cloud and Storm Development</th>
<th>Areal Coverage</th>
<th>Counts C/G per 5 Minutes</th>
<th>Counts C/G per 15 Minutes</th>
<th>Average C/G per Minute</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>No Thunderstorms</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>2</td>
<td>Cumulus clouds are common but only a few reaches the towering stage. A single thunderstorm must be confirmed in the rating area. The clouds mostly produce virga, but light rain will occasionally reach ground. Lightning is very infrequent.</td>
<td>&lt;15%</td>
<td>1-5</td>
<td>1-8</td>
<td>&lt;1</td>
</tr>
<tr>
<td>3</td>
<td>Cumulus clouds are common. Swelling and towering cumulus cover less than 2/10 of the sky. Thunderstorms are few, but 2 to 3 occur within the observation area. Light to moderate rain will reach the ground, and lightning is infrequent.</td>
<td>15% to 24%</td>
<td>6-10</td>
<td>9-15</td>
<td>1-2</td>
</tr>
</tbody>
</table>

\(^{150}\) Retrieved on 07.19.2021 from [https://graphical.weather.gov/definitions/defineLAL.html](https://graphical.weather.gov/definitions/defineLAL.html)
### Lightning Activity Level Scale

<table>
<thead>
<tr>
<th>Rank</th>
<th>Cloud and Storm Development</th>
<th>Areal Coverage</th>
<th>Counts C/G per 5 Minutes</th>
<th>Counts C/G per 15 Minutes</th>
<th>Average C/G per Minute</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>Swelling cumulus and towering cumulus cover 2-3/10 of the sky. Thunderstorms are scattered but more than three must occur within the observation area. Moderate rain is commonly produced, and lightning is frequent.</td>
<td>25% to 50%</td>
<td>11-15</td>
<td>16-25</td>
<td>2-3</td>
</tr>
<tr>
<td>5</td>
<td>Towering cumulus and thunderstorms are numerous. They cover more than 3/10 and occasionally obscure the sky. Rain is moderate to heavy, and lightning is frequent and intense.</td>
<td>&gt;50%</td>
<td>&gt;15</td>
<td>&gt;25</td>
<td>&gt;3</td>
</tr>
<tr>
<td>6</td>
<td>Dry lightning outbreak. (LAL of 3 or greater with majority of storms producing little or no rainfall.)</td>
<td>&gt;15%</td>
<td>None</td>
<td>None</td>
<td>None</td>
</tr>
</tbody>
</table>

Based on those extent ranking factors identified (above), the planning committee ranks the extent of the lightning hazard as **LOW** for the CSU system.

**Extent: Thunderstorms that Generate Wind, Tornado, Hail, and Lightning Hazard Events**

Thunderstorms are not explicitly identified as a severe weather category for this hazard profile. However, they are responsible for most tornado, lightning, and hail hazard events – as well as a significant number of wind hazard events – across California and the CSU system. While individual thunderstorms affect relatively small areas, there are many instances in which thunderstorms can cluster together and/or travel in a line over long distances, producing significant damage over large geographic areas.

A thunderstorm is classified as “severe” when certain meteorological parameters within the thunderstorm are reached (i.e., damaging winds or speeds of 58 mph (50 knots) or greater, hail 1 inch in diameter or larger, and/or a tornado). However, there is currently no
established, objective severity scale for thunderstorms.\textsuperscript{151} \textsuperscript{152} That said, according to the \textit{Glossary of Meteorology} published by the American Meteorological Society (AMS), a thunderstorm is reported as \textit{light, medium, or heavy} according to following five (5) characteristics:

- the nature of the lightning and thunder;
- the type and intensity of the precipitation, if any;
- the speed and gustiness of the wind;
- the appearance of the clouds; and
- the effect upon surface temperature.\textsuperscript{153}

A thunderstorm may also be classified by the nature of the overall weather situation in which the thunderstorm is produced, including:

- \textbf{Airmass Thunderstorm}: A thunderstorm produced by local convection within an unstable air mass;\textsuperscript{154}
- \textbf{Frontal Thunderstorm}: An individual thunderstorm the initiation of which results from rising motion associated with a front, or a thunderstorm within a convective system generated and organized by frontal rising motion;\textsuperscript{155} or
- \textbf{Squall-line Thunderstorm}: An individual thunderstorm included within a squall line (i.e., a continuous or broken line of active deep moist convection frequently associated with thunder).\textsuperscript{156} \textsuperscript{157}

Based on the extent ranking factors identified (above) in relation to campus layout and operations, and past event low degree of severity, the planning committee ranks the extent of the thunderstorm hazard as \textbf{LOW} for the CSU system.

**History of the Hazard**

Severe weather hazards have been an annual occurrence in across the CSU system. Historical data for these hazards are presented below.

\textsuperscript{151} Retrieved on 07.15.2021 from https://www.noaa.gov/explainers/severe-storms
\textsuperscript{152} Retrieved on 07.15.2021 from https://www.weather.gov/safety/thunderstorm
Historical Storm Data Collection: NCEI Storm Events Database Searches for Wind, Tornado, Hail, and Lightning Hazard Events

Historical information regarding severe weather hazards can be found using The National Centers for Environmental Information (NCEI) Storm Events Database. The Storm Events Database contains searchable, archived National Weather Service (NWS) storm data from January 1950 to April 2021, as entered by NOAA’s National Weather Service (NWS). Due to changes in the data collection and processing procedures over time, there are unique periods of record available depending on the event type.\footnote{ Retrieved on 07.19.2021 from \url{https://www.ncdc.noaa.gov/stormevents/details.jsp}} For example, from 1950 through 1954, only tornado events were recorded; from 1955 through 1995, only tornado, thunderstorm wind, and hail events were introduced into the database; from 1996 to present, 45 additional event types are recorded, including high wind, strong wind, and lightning events.\footnote{ Dos Santos, Renato. (2016). Some Comments on the Reliability of NOAA’s Storm Events Database. \textit{SSRN Electronic Journal}. DOI: \url{10.2139/ssrn.2799273}. Retrieved 07.19.2021 from \url{https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2799273}} To obtain the most accurate portrayal of severe weather event frequency, searches of the Storm Events Database are conducted using data collected from January 1, 1996 through April 30, 2021. As a reminder, all official severe weather event data is at the county level. Severe weather data do not exist at the campus level. That said, it may be the case that the campus to some degree experiences the severe weather events reported for the surrounding community and County.

Average Number of Annual Hazard Event Occurrences

Information obtained from the NCEI Storm Event Database shows the number of events (or occurrences) of hazard events in California Counties from January 1, 1996 through April 30, 2021. Average historical frequencies of occurrence are then calculated by dividing the number of events for each hazard by the number of years of records analyzed (i.e., 25½ years). (Please note that wind hazard events include all “High Wind,” “Strong Wind,” and “Thunderstorm Wind” storm reports.) More detailed campus-level results, including historical severe weather hazard losses, can be found in the CSU Campus Annex sections of this document.

Historical Data Collection for Wind Hazards Not Included in NCEI Storm Events Database

Santa Ana Winds

Santa Ana wind events occur at least twice per month from October through April.\footnote{ Retrieved on 07.14.2021 from \url{https://agupubs.onlinelibrary.wiley.com/doi/epdf/10.1002/2016GL067887}} From 1948 to 2012, total of 2056 events on the 65-year record were recorded in the Southern California region, yielding an average of \textbf{32 occurrences per year}. Typical Santa Ana wind events last 1–2 days and represent 27% of the occurrences, with events lasting
up to 6 days accounting for 90% of all occurrences. The remaining 10% are made up almost entirely of events lasting between 7 and 12 days.\textsuperscript{161} \textsuperscript{162}

Figure below shows the mean monthly frequency per season of Santa Ana Wind events detected from 1948 to 2012. Extreme Santa Ana wind events are shown in dark red and are defined as those events that are above the 90th percentile of all events on record.

Figure 3-20: Mean Annual Frequency of Santa Ana Wind events (1948-2012)\textsuperscript{163} \textsuperscript{164}

**Diablo Winds**

Diablo wind events occur approximately **2.5 events per year**. These events are most frequent during the fall and early winter seasons, with the highest frequency of events occurring in October. As a result, the highest risk of Diablo-wind-related damage is in the fall and early winter.\(^{165}\)

Figure below shows the monthly frequency of Diablo winds (along with average live fuel moisture content). The Diablo Wind data are derived from a 17-year climatology of San Francisco Bay Area regional surface weather stations.\(^ {166}\)

Figure 3-21: Monthly Frequency of Diablo Winds and Average Live Fuel Moisture Content (Dashed Line)\(^{167}\)

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**Sundowner Winds**

Strong sundowner wind events occur approximately **2-3 times per year**. These events can create sharp temperature rises, local gale force winds, and significant weather-related problems. Rare, “explosive” types of sundowner wind events occur about 6 times per

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\(^{166}\) Retrieved on 07.15.2021 from [https://www.fireweather.org/diablo-winds](https://www.fireweather.org/diablo-winds)

\(^{167}\) Retrieved on 07.13.2021 from [https://www.fireweather.org/diablo-winds](https://www.fireweather.org/diablo-winds)
century that present dangerous weather situations, generating extremely strong and hot winds that can reach gale force or higher speeds.¹⁶⁸

**Historical Severe Weather Event Data Collection Results: NCEI and non-NCEI Sources**

Table below shows the average annual frequencies of wind, tornado, hail, and lightning hazard events in counties in which CSU campuses are located. Information regarding the presence of regional mountain-valley wind hazards is also included in Table 3-XX.

Table 2-30: Average Annual Frequency of Severe Weather Hazard Events for all CSU Campuses (01/01/1996 to 04/30/2021)¹⁶⁹

<table>
<thead>
<tr>
<th>CSU School</th>
<th>Campus</th>
<th>County</th>
<th>Average Annual Frequency of Severe Weather Hazard Events</th>
<th>*Regional Wind Hazards</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bakersfield</td>
<td>Main</td>
<td>Kern</td>
<td>54.28 0.39 1.38 1.58 SA</td>
<td></td>
</tr>
<tr>
<td>Bakersfield</td>
<td>Antelope Valley</td>
<td>Los Angeles</td>
<td>16.86 0.47 0.71 0.36 SA</td>
<td></td>
</tr>
<tr>
<td>Channel Islands</td>
<td>Main</td>
<td>Ventura</td>
<td>9.47 0.2 0.12 0.08 SA</td>
<td></td>
</tr>
<tr>
<td>Channel Islands</td>
<td>Extended University</td>
<td>Santa Barbara</td>
<td>6.51 0.12 0.20 0 SA, SU</td>
<td></td>
</tr>
<tr>
<td>Chico</td>
<td>Main</td>
<td>Butte</td>
<td>2.21 0.28 0.32 0.16 D</td>
<td>D</td>
</tr>
<tr>
<td>Dominguez Hills</td>
<td>Main</td>
<td>Los Angeles</td>
<td>16.86 0.47 0.71 0.36 SA</td>
<td></td>
</tr>
<tr>
<td>East Bay</td>
<td>Main</td>
<td>Alameda</td>
<td>13.54 0 0.75 0.08 D</td>
<td>D</td>
</tr>
<tr>
<td>East Bay</td>
<td>Concord</td>
<td>Contra Costa</td>
<td>13.50 0.12 0.47 0 D</td>
<td>D</td>
</tr>
<tr>
<td>Fresno</td>
<td>Main</td>
<td>Fresno</td>
<td>13.54 0.67 3.08 1.34 SA</td>
<td>SA</td>
</tr>
<tr>
<td>Fullerton</td>
<td>Main</td>
<td>Orange</td>
<td>8.64 0.28 0.43 0.16 SA</td>
<td>SA</td>
</tr>
<tr>
<td>Humboldt</td>
<td>Main</td>
<td>Humboldt</td>
<td>5.21 0.04 0.83 0.04 None</td>
<td>None</td>
</tr>
<tr>
<td>Long Beach</td>
<td>Main</td>
<td>Los Angeles</td>
<td>16.86 0.47 0.71 0.36 SA</td>
<td>SA</td>
</tr>
<tr>
<td>Los Angeles</td>
<td>Main</td>
<td>Los Angeles</td>
<td>16.86 0.47 0.71 0.36 SA</td>
<td>SA</td>
</tr>
<tr>
<td>Maritime</td>
<td>Main</td>
<td>Solano</td>
<td>2.84 0.12 0.16 0 D</td>
<td>D</td>
</tr>
</tbody>
</table>


<table>
<thead>
<tr>
<th>Location</th>
<th>Type</th>
<th>City</th>
<th>Distance</th>
<th>Duration</th>
<th>Distance</th>
<th>Duration</th>
<th>Distance</th>
<th>Duration</th>
<th>Distance</th>
<th>Duration</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>Monterey Bay</td>
<td>Main</td>
<td>Monterey</td>
<td>6.63</td>
<td>0.04</td>
<td>0.79</td>
<td>0.04</td>
<td>SA</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Northridge</td>
<td>Main</td>
<td>Los Angeles</td>
<td>16.86</td>
<td>0.47</td>
<td>0.71</td>
<td>0.36</td>
<td>SA</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pomona</td>
<td>Main</td>
<td>Los Angeles</td>
<td>16.86</td>
<td>0.47</td>
<td>0.71</td>
<td>0.36</td>
<td>SA</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pomona</td>
<td>Pine Tree Ranch</td>
<td>Ventura</td>
<td>9.47</td>
<td>0.2</td>
<td>0.12</td>
<td>0.08</td>
<td>SA</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pomona</td>
<td>Westwind Ranch</td>
<td>San Bernardino</td>
<td>26.57</td>
<td>0.63</td>
<td>2.05</td>
<td>2.17</td>
<td>SA</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sacramento</td>
<td>Main</td>
<td>Sacramento</td>
<td>2.96</td>
<td>0.39</td>
<td>0.32</td>
<td>0.04</td>
<td>D</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>San Bernardino</td>
<td>Main</td>
<td>San Bernardino</td>
<td>26.57</td>
<td>0.63</td>
<td>2.05</td>
<td>2.17</td>
<td>SA</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>San Bernardino</td>
<td>Palm Desert</td>
<td>Riverside</td>
<td>25.18</td>
<td>0.71</td>
<td>0.67</td>
<td>1.22</td>
<td>SA</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>San Diego</td>
<td>Main</td>
<td>San Diego</td>
<td>22.78</td>
<td>0.51</td>
<td>1.54</td>
<td>1.30</td>
<td>SA</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>San Diego</td>
<td>Imperial Valley</td>
<td>Imperial</td>
<td>2.33</td>
<td>0.08</td>
<td>0.32</td>
<td>0.04</td>
<td>SA</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>San Francisco</td>
<td>Main</td>
<td>San Francisco</td>
<td>3.04</td>
<td>0</td>
<td>0.36</td>
<td>0.28</td>
<td>D</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>San Francisco</td>
<td>Romberg Tiburon</td>
<td>Marin</td>
<td>12.28</td>
<td>0.04</td>
<td>0.47</td>
<td>0.08</td>
<td>D</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>San Francisco</td>
<td>Sierra Nevada</td>
<td>Sierra</td>
<td>4.38</td>
<td>0</td>
<td>0.16</td>
<td>0.04</td>
<td>D</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>San José</td>
<td>Main</td>
<td>Santa Clara</td>
<td>17.76</td>
<td>0.20</td>
<td>1.34</td>
<td>0.20</td>
<td>D</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>San José</td>
<td>Moss Landing</td>
<td>Monterey</td>
<td>6.63</td>
<td>0.04</td>
<td>0.79</td>
<td>0.04</td>
<td>SA</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>San Luis Obispo</td>
<td>Main</td>
<td>San Luis Obispo</td>
<td>2.01</td>
<td>0.32</td>
<td>0.08</td>
<td>0.08</td>
<td>D</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
(*Note: D=Diablo Wind; SA=Santa Ana Wind; SU=Sundowner Wind)

**Aggregated Historical Severe Weather Hazard Losses for Counties with CSU Campuses**

Severe weather hazards events have been costly across California and the CSU system. Table below shows the aggregated severe weather hazard event losses for counties in which CSU campuses are located.

Table 3-31: Severe Weather Hazard Losses for all Counties with CSU Campuses (01/01/1996 to 04/30/2021) 170

<table>
<thead>
<tr>
<th></th>
<th>Wind</th>
<th>Tornado</th>
<th>Hail</th>
<th>Lightning</th>
<th>Totals</th>
</tr>
</thead>
<tbody>
<tr>
<td>Deaths</td>
<td>66</td>
<td>0</td>
<td>1</td>
<td>9</td>
<td>76</td>
</tr>
<tr>
<td>Injuries</td>
<td>214</td>
<td>7</td>
<td>22</td>
<td>51</td>
<td>294</td>
</tr>
<tr>
<td>Property Damage</td>
<td>$504,943,000</td>
<td>$31,209,700</td>
<td>$19,381,190</td>
<td>$5,539,230</td>
<td>$561,073,120</td>
</tr>
<tr>
<td>Crop Damage</td>
<td>$87,259,500</td>
<td>$311,500</td>
<td>$95,695,150</td>
<td>$315,230</td>
<td>$183,581,380</td>
</tr>
</tbody>
</table>

It is important to note that for all counties in which CSU campuses are located, 87% of all deaths, 73% of all injuries, 90% of all estimated property damages, and 48% of all estimated crop damages have been attributed to wind hazard events alone. Hail hazards are responsible for more than half (52%) of all crop damages.

**Potential Impacts of the Hazard**

The significance (or priority) of a hazard’s potential impacts is based primarily on the frequency and resulting damage caused by the hazard, including deaths and injuries, and property, crop, and economic damage. All assets and people within all CSU campus areas systemwide are at risk from the effects of severe weather hazards.

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Wind Hazards (Including Tornadoes)

Wind hazard events have the potential to impact people, property, and operations on campuses across the CSU system. People caught in the open during an extreme wind event are exposed to high winds and debris and could be injured or killed.

The habitability of buildings can be compromised (by damaging roofs, windows, or other weak points in the building envelope), leading to long-term operational issues for the campus. As with most university campuses, space is always at a premium at each CSU campus, and the loss of any currently utilized space due to building or structural damage would likely disrupt operations and mission for each CSU school.

Extreme wind events can result in power failure, which would impact the operation of the campus. Fallen tree limbs and other potential transportation hazards may also cause disruption to the surrounding community and limit ingress/egress to the campus.

Hail

Hail typically impacts property by damaging structures, cars, and utilities as it falls. Dents in cars, broken glass, and holes in roofs are common impacts of hail. Injuries to people from hail are less common, though they can happen, as hail is a hard object falling in an unpredictable manner at a fairly high rate of speed.

Lightning

Lightning strikes the United States about 20-25 million times a year.\textsuperscript{171} Although most lightning occurs in the summer months, people can be struck at any time of year. Since 1990, lightning has killed an average of 39 people each year in the United States, and hundreds more have been injured.\textsuperscript{172} Property losses due to lightning have been very costly across the U.S. For example, from 2005 through 2020, U.S. homeowner’s insurance claim payouts for lightning losses totaled approximately $15,334,600,000, or $958,412,500 worth of payouts per year.\textsuperscript{173} (Commercial claim payouts for lightning losses for the U.S. were not available.)

Hazard Mitigation Plans Used to Determine Severe Weather Hazard Potential Impacts

Severe weather hazard potential impacts for all CSU campuses have been determined by examining the most recent local hazard mitigation plans for communities in which the campuses are located. These local hazard mitigation plans are listed in Table 3-XX.


\textsuperscript{173} Retrieved on 07.21.2021 from https://www.iii.org/table-archive/20504
Table 3-32: CSU Campuses and their Local Hazard Mitigation Plan (HMP) Jurisdictions

<table>
<thead>
<tr>
<th>CSU School</th>
<th>Local HMP Jurisdiction for Main Campus</th>
<th>Year</th>
<th>Local HMP Jurisdiction for Satellite Campus #1</th>
<th>Year</th>
<th>Local HMP Jurisdiction for Satellite Campus #2</th>
<th>Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bakersfield</td>
<td>Kern County</td>
<td>2020</td>
<td>City of Lancaster</td>
<td>2019</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Channel Islands</td>
<td>Ventura County</td>
<td>2015</td>
<td>Santa Barbara County</td>
<td>2017</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chico</td>
<td>Butte County</td>
<td>2019</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dominguez Hills</td>
<td>City of Carson/ Los Angeles County</td>
<td>2013/2019</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>East Bay</td>
<td>City of Hayward</td>
<td>2016</td>
<td>City of Oakland</td>
<td>2021</td>
<td>Contra Costa County</td>
<td>2018</td>
</tr>
<tr>
<td>Fresno</td>
<td>Fresno County</td>
<td>2018</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fullerton</td>
<td>Orange County</td>
<td>2021</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Humboldt State</td>
<td>Humboldt County</td>
<td>2019</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Long Beach</td>
<td>City of Long Beach</td>
<td>2017</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Los Angeles</td>
<td>City of Los Angeles</td>
<td>2018</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maritime</td>
<td>Solano County</td>
<td>2012</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Monterey Bay</td>
<td>Monterey County</td>
<td>2016</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Northridge</td>
<td>City of Los Angeles</td>
<td>2018</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pomona</td>
<td>City of Pomona/ Los Angeles County</td>
<td>2015/2019</td>
<td>Ventura County</td>
<td>2015</td>
<td>City of Chino</td>
<td>2018</td>
</tr>
<tr>
<td>Sacramento</td>
<td>Sacramento County</td>
<td>2016</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### Potential Impacts of Severe Weather Hazards at CSU Campuses

The potential impacts of severe weather hazards for all CSU campuses are presented below in Table below. Potential impacts ratings for each hazard sub-type are the following (in order of level of potential impact): Minimal (MIN), Minimal to Moderate (MIN/MOD), Moderate (MOD), Moderate to High (MOD/HI) and High (HI).

**Table 3-33: Potential Impacts of Severe Weather Hazards by CSU Campus**

<table>
<thead>
<tr>
<th>CSU School</th>
<th>Campus</th>
<th>County</th>
<th>Wind</th>
<th>Tornado</th>
<th>Hail</th>
<th>Lightning</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bakersfield</td>
<td>Main</td>
<td>Kern</td>
<td>MIN/MOD</td>
<td>MIN</td>
<td>MIN</td>
<td>MIN</td>
</tr>
<tr>
<td></td>
<td>Antelope Valley</td>
<td>Los Angeles</td>
<td>MOD/HI</td>
<td>MIN</td>
<td>MIN</td>
<td>MIN</td>
</tr>
<tr>
<td>Channel Islands</td>
<td>Main</td>
<td>Ventura</td>
<td>MOD</td>
<td>MIN</td>
<td>MIN</td>
<td>MIN</td>
</tr>
<tr>
<td>Location</td>
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<tr>
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<tr>
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</tr>
<tr>
<td>Concord</td>
<td>Contra Costa</td>
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<td>MIN/MOD</td>
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<td>Main</td>
<td>Humboldt</td>
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<td>MOD</td>
<td>MIN</td>
<td>MIN</td>
</tr>
<tr>
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<td>MOD/HI</td>
<td>MOD/HI</td>
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</tr>
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<td>MOD/HI</td>
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<tr>
<td>Pine Tree Ranch</td>
<td>Ventura</td>
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<tr>
<td>Westwind Ranch</td>
<td>San Bernardino</td>
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<tr>
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<td>MOD</td>
<td>MOD</td>
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<tr>
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<td>MIN</td>
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<td>MIN/MOD</td>
<td>MIN</td>
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<tr>
<td>Romberg Tiburon</td>
<td>Marin</td>
<td>MOD</td>
<td>MIN</td>
<td>MIN</td>
<td>MIN</td>
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</tr>
</tbody>
</table>
Probability of Future Occurrence of the Hazard

Areas throughout California, including all California State University (CSU) campuses, experience severe weather events every year. Future occurrences of such events are projected to increase in both their frequency and intensity. Table 3-XX shows the overall severe weather hazard probabilities of future occurrence for all CSU schools. (Category descriptions of probability of future occurrence are presented at the beginning of this document.) Wind hazard events are (by far) the most frequent of the four (4) severe weather hazards profiled here.

Table 3-34: Severe Weather Hazard Probabilities of Future Occurrence

<table>
<thead>
<tr>
<th>CSU School</th>
<th>County</th>
<th>Probability of Future Occurrence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bakersfield</td>
<td>Kern</td>
<td>Highly Likely</td>
</tr>
<tr>
<td>Channel Islands</td>
<td>Ventura</td>
<td>Highly Likely</td>
</tr>
<tr>
<td>Chico</td>
<td>Butte</td>
<td>Highly Likely</td>
</tr>
<tr>
<td>Dominguez Hills</td>
<td>Los Angeles</td>
<td>Highly Likely</td>
</tr>
<tr>
<td>East Bay</td>
<td>Alameda</td>
<td>Highly Likely</td>
</tr>
<tr>
<td>Fresno</td>
<td>Fresno</td>
<td>Highly Likely</td>
</tr>
<tr>
<td>Location</td>
<td>State</td>
<td>Likelihood</td>
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<td>-----------------</td>
</tr>
<tr>
<td>Fullerton</td>
<td>Orange</td>
<td>Highly Likely</td>
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<tr>
<td>Humboldt</td>
<td>Humboldt</td>
<td>Highly Likely</td>
</tr>
<tr>
<td>Long Beach</td>
<td>Los Angeles</td>
<td>Highly Likely</td>
</tr>
<tr>
<td>Los Angeles</td>
<td>Los Angeles</td>
<td>Highly Likely</td>
</tr>
<tr>
<td>Maritime</td>
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<td>Highly Likely</td>
</tr>
<tr>
<td>Monterey Bay</td>
<td>Monterey</td>
<td>Highly Likely</td>
</tr>
<tr>
<td>Northridge</td>
<td>Los Angeles</td>
<td>Highly Likely</td>
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<tr>
<td>Pomona</td>
<td>Los Angeles</td>
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<tr>
<td>Sacramento</td>
<td>Sacramento</td>
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<td>San Diego</td>
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<td>San Francisco</td>
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<tr>
<td>San José</td>
<td>Santa Clara</td>
<td>Highly Likely</td>
</tr>
<tr>
<td>San Luis Obispo</td>
<td>San Luis Obispo</td>
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</tr>
<tr>
<td>San Marcos</td>
<td>San Diego</td>
<td>Highly Likely</td>
</tr>
<tr>
<td>Sonoma</td>
<td>Sonoma</td>
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</tr>
<tr>
<td>Stanislaus</td>
<td>Stanislaus</td>
<td>Highly Likely</td>
</tr>
<tr>
<td>Chancellor's Office</td>
<td>Los Angeles</td>
<td>Highly Likely</td>
</tr>
</tbody>
</table>

Vulnerability to the Hazard

All people, structures, and assets on all campuses are vulnerable to the impacts associated with severe weather. Infrastructure can be damaged or destroyed by hail, wind, tornadoes, thunderstorms, and lightning, which can result in service interruptions and outages. Structures can be damaged or destroyed by hail, wind, tornadoes, thunderstorms, and lightning. People can be injured or killed by lightning, flying debris, hail, or extreme wind events. Each CSU school also has vehicles that are all vulnerable to a severe weather event.

Estimate of Potential Losses

Severe weather is a non-spatial hazard that affects all CSU campuses. Each of the hazards associated with severe weather can result in losses throughout the planning area.
The population across the entire CSU system varies throughout the day. As of Fall, 2019, CSU systemwide had a total of 480,541 students and 53,763 faculty and staff.\textsuperscript{174} All are at risk from severe weather events, with 534,304 being directly vulnerable in this scenario.\textsuperscript{175} (Please note: These population numbers do not include visitors to or contracted employees working on CSU campuses.) No loss of life from severe storms has been recorded on a CSU campus.

### Property

All structures at all CSU campuses are at risk from severe weather. There are approximately 2,448 buildings across the CSU system that could be damaged by wind, hail, and/or lightning. If even a fraction of these assets were to be damaged, the resulting estimated losses would still be in the millions of dollars. According to the most current information provided by CSU campus, total replacement costs due to severe weather hazard for all CSU campuses are at least $8,351,298,709 for 1,661 buildings and are unknown for the remaining 787 buildings. Building replacement costs for each CSU school are presented in Table 3-XX below.

(Please note: An analysis of projected dollar losses of campus buildings from severe weather as a percentage of building replacement costs is not currently available. CSU leadership may pursue such data in the future.)

**Table 3-35: Total Building Replacement Costs (By CSU School)**

<table>
<thead>
<tr>
<th>CSU School</th>
<th>Number of Buildings with Known Replacement Costs</th>
<th>Total Building Replacement Costs</th>
<th>Number of Buildings with Unknown Replacement Costs</th>
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<td>No Information</td>
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<td>66</td>
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<tr>
<td>East Bay</td>
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</tr>
<tr>
<td>Fresno</td>
<td>107</td>
<td>$395,965,157</td>
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</tr>
<tr>
<td>Fullerton</td>
<td>38</td>
<td>$453,119,067</td>
<td>11</td>
</tr>
</tbody>
</table>

\textsuperscript{174} Retrieved on 07.19.2021 from [https://www2.calstate.edu/csu-system/about-the-csu/facts-about-the-csu/enrollment/Pages/default.aspx](https://www2.calstate.edu/csu-system/about-the-csu/facts-about-the-csu/enrollment/Pages/default.aspx)

\textsuperscript{175} Retrieved on 07.19.2021 from [https://www2.calstate.edu/csu-system/faculty-staff/employee-profile/csu-workforce/Pages/employee-headcount-by-campus.aspx](https://www2.calstate.edu/csu-system/faculty-staff/employee-profile/csu-workforce/Pages/employee-headcount-by-campus.aspx)
<p>| | | | |</p>
<table>
<thead>
<tr>
<th></th>
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<tbody>
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<td>Maritime</td>
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<td>No Information</td>
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<tr>
<td><strong>Totals</strong></td>
<td>1,661</td>
<td><strong>$8,351,298,709</strong></td>
<td>787</td>
</tr>
</tbody>
</table>

**Vulnerability Assessment Conclusions**

Severe weather presents a variety of hazards to all CSU campuses. People, assets, infrastructure, and vehicles can all be damaged by this hazard, and losses can quickly begin to rise. In the aggregate, severe weather is a frequently occurring hazard (mostly in the form of wind hazard events) that presents a variety of risks to the entire CSU system.

It is evident that the California State University system has vulnerabilities to and risks from severe weather hazard incidents, and that pre-event planning, communication, and mitigation efforts should be implemented. Public education and outreach regarding areas of shelter that could be used by campus populations during severe weather events is considered by campus leadership to be one viable mitigation option. The campus planning committees for each CSU school will continue to look for feasible and cost-effective options for the mitigation of severe weather risks going forward.
Identified Data Limitations

Numerous federal agencies maintain a variety of records regarding losses associated with hazards. Unfortunately, no single source is considered to offer a definitive accounting of all losses. The Federal Emergency Management Agency (FEMA) maintains records on federal expenditures associated with declared major disasters. The US Army Corps of Engineers (USACE) and the Natural Resources Conservation Service (NRCS) collect data on losses during the course of some of their ongoing projects and studies. Additionally, the National Oceanic and Atmospheric Administration’s (NOAA) National Centers for Environmental Information (NCEI) collects and maintains data about natural hazards in summary format, as well as occurrences, dates, injuries, deaths, and estimated costs for individual storm events. Many of these databases and other data collection services, including the NCEI, have inherent data limitations when searching for information at a scale as small as a single campus.

The best available data and records have been used throughout this section. Where no data or records exist or could be located, that deficiency is noted.
3.4 Climate Change

Introduction

Globally, the climate is experiencing climbing average temperatures, with the past five years being collectively the warmest years in the modern record. 2016, 2015, 2017 and 2018 were the four warmest years recorded.\textsuperscript{176} NASA predicts that the global temperatures will continue to rise for decades. The Intergovernmental Panel on Climate Change (IPCC) forecasts a temperature rise of 2.5 to 10 degrees Fahrenheit over the next century.\textsuperscript{177} Climate change related hazards have intersectionality with multiple hazards and extensive impacts. For example, public health, agriculture, economic and ecosystem hazards arise from:

- Extreme heat and cold events
- Drought and impacted water quality
- Fire, smoke and PSPS shutdowns
- Storms and long-term aftermath
- Agricultural products and food impacts

California’s experience of dramatic impacts of climate change on communities continue to grow and are projected to become more severe and damaging. Hazard mitigation and adaptation are complementary strategies for reducing the likelihood of unmanageable change, managing the risks, and taking advantage of new opportunities created by our changing climate. Climate change impacts are primary and secondary, with both rapid and slow onset.

Potential climate impacts must inform and influence emergency management decisions for all communities, including the CSU campuses. Addressing climate change in this HVRA is intended to provide information that reflects data, recent trends, perceptions, and invite consideration for both near term and future projections in hazard mitigation planning for the CSU system. How to address these climate impacts and projections in hazard risk reduction for campus emergency management requires further data analysis and collaborative planning discussions. Even within that context, projections related to climate change are not firmly fixed. In the section entitled, Anticipating Climate Changes, from Second Nature, the authors caution campuses planners to remember that future projections are uncertain.

“High resolution future climate projections are not always supported by the science. Specific future values imply accuracy in prediction, which the scientific community does not currently have. Campus vulnerability assessments will need to incorporate some degree of uncertainty in projections. Framing the process as building overall resilience

\textsuperscript{177} NASA. The Effects of Climate Change. \url{https://climate.nasa.gov/effects/}. Accessed December 15, 2019.
capacity (instead of responding to a specific expected climate change) can help reduce vulnerability to a range of possible impacts.”

Ultimately, the purpose of an assessment is to inform the planners of the good ways to further build risk resilience in the physical campus, its systems and amongst the populations served. Second Nature defines climate resilience: Resilience is the ability of a system or community to survive disruption and to anticipate, adapt, and flourish in the face of change. This section introduces the concerns of climate change being experienced throughout the state of California, impacts on vulnerable populations, and offers insight into how the campus emergency managers are experiencing climate impacts in relation to their campuses, risk resilience efforts, capacities, and resources.

Climate Terms

In the context of climate change related risk reduction, many definitions are available, and extensive resources are available building off the Intergovernmental Panel on Climate Change (IPCC) Climate Change 2014 work178 and offer examples of the impacts of climate change in helping frame climate risk.

Hazard: refers to any potential occurrence of a natural or human-induced physical event that may cause damage to property, infrastructure, livelihoods, service provision, environmental resources etc. As an example, as sea level rises, increased frequency of inundation of an area during storm event is a potential hazard for a low-lying coastal area.

Risk: the potential for consequences where something of value is at stake and where the outcome is uncertain, recognizing the diversity of values. Risk is often represented as probability of occurrence of hazardous events (likelihood) or trends multiplied by the impacts (or consequences) if these events or trends occur. Risk results from the interaction of vulnerability, exposure, and hazard (IPCC 2014). As an example, as sea level rises, increased frequency (likelihood) of inundation (a hazard) of an area during storm event can put the structural integrity of a nearby infrastructure, such as road into a risk.

Vulnerability: The propensity or predisposition to be adversely affected. Vulnerability encompasses a variety of concepts and elements including sensitivity or susceptibility to harm and lack of capacity to cope and adapt (IPCC 2014). As an example, older populations are more sensitive to heat-stress and have limited physical capacity to adapt, therefore highly vulnerable during a heatwave.

Exposure: refers to the degree to which a system is exposed to a given hazard (E.g., sea-level rise). As an example, a coastal community in a low-lying area can be exposed to certain degree of hazard of inundation during a storm event.

Sensitivity: refers to the degree to which a system is affected by, or responsive to a hazard. In other words, sensitivity captures the potential of a system to be impacted by a

178 https://www.ipcc.ch/site/assets/uploads/2018/02/WGIIAR5-PartA_FINAL.pdf
hazard. Sometimes sensitivity is determined by the criticality of the service that the system provides. For example, a community uses a road located close to the low-lying area of the coast as its main access to a major hospital.

Adaptive Capacity: describes a system’s ability to adjust to climate change (including climate variability and extremes) to moderate potential damages, to take advantage of opportunities, or to cope with the consequences (IPCC2014).

**Impacts of Climate Change**

Climate change results in numerous specific effects to human lives, health, environment and the economy. An overview of these impacts include\(^1\):*

- **Agricultural threat.** Rising heat, combined with wildfire, drought, and agricultural pests, will negatively have impacts on overall yields of major U.S. crops. Livestock will also be negatively affected by elevated heat. Internationally, prices and availability of certain foods will be affected. While the rise in temperature may prove beneficial for some crops in some areas, such as in the Northern Great Plains, California will more likely see negative impacts. \(^2\)

- **Air pollution.** Air pollution includes ground-level ozone and particulate matter. Ozone is due to heat, chemicals and methane. Particulates are produced mainly from wildfires but from other factors, as well. Health problems include diminished lung functions, asthma and even death.

- **Allergens.** Pollen-related allergies increase with warmer temperatures and increased carbon dioxide. Increased rainfall and rising temperatures contribute to indoor air pollutants.

- **Civil unrest.** Food shortages, public health outbreaks, long-duration water shortages or contaminations, and other climate induced incidents may cause stress on populations and result in increase in civil unrest.

- **Drought threat.** The rising air and water temperatures, along with change in precipitation, intensify droughts. The prediction of future warming will add to the stress on water supplies in the western United States.

- **Extreme Heat.** Heatstroke, cardiovascular disease, respiratory disease and cerebrovascular disease are related to extreme heat events. Increased number of heat waves creates heat-related physical stress on populations and is exacerbated in metropolitan areas where greater amounts of heat-absorbing surfaces (e.g., asphalt and concrete) trap heat and emit higher temperatures throughout the night.

- **Food security and agriculture.** Due to climate change, some aspects of food production (plants, livestock and fish production) and quality are at risk, threatening food availability, prices and distribution. Rising prices cause food insecurity, which often cause people to eat calorie-rich, but nutrient poor foods,

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which in turns leads to obesity. Higher CO2 levels are associated with reduced protein in many crops. Further, as temperatures increase, farmers are expected to use more pesticides to manage pests and weeds.

- **Illness.** Changing temperatures also brings illnesses related to frequency and severity of allergic illnesses (e.g., asthma and hay fever).

- **Precipitation.** While an increase in extreme precipitation and total precipitation have been shown to contribute to flood related injuries and deaths, many other hazards exist once the flood has abated. Waterborne disease outbreaks are reported weeks after the flood events. Mold contamination leads to indoor air issues. Damp indoor environments lead to increased prevalence of asthma, and also upper and lower respiratory symptoms.

- **Vector born disease.** The heat also extends the geographic range and the distribution of disease-carrying insects and pests. Health professionals are concerned that California’s warming climate will allow species to acclimate. Such vectors include such pests as ticks that carry Lyme disease, and mosquitos that transmit Zika, dengue fever, West Nile, plague and tularemia. Some others, such as chikungunya, Chagas disease, and Rift Valley fever virus, are threats as well.

- **Wildfire.** Increased temperatures and droughts contribute to wildfire conditions. Wildfires produce smoke, carbon monoxide, nitrogen oxides, and organic chemicals leading to ozone release. Asthma, chest pain, COPD, and other respiratory ailments may follow. Already, wildfire is associated with hundreds of thousands of deaths annually worldwide.

### Climate Impacts on Socially Vulnerable Populations

Socially vulnerable populations often have lesser capacity to improve their resilience than that of communities with greater access to resources and social capital. As has been experienced in the COVID pandemic, poverty and social exclusion are tied to health inequalities, and climate change exacerbates health disparities. Pre-existing social, health and economic factors often intersect and combine to contribute to communities’ increased degrees of vulnerability and resilience. For example, low-income households are further exposed to heat-related health risks because the houses are not being insulated sufficiently and lack air conditioning. These are significant concerns with the increasing numbers of heat incidents in the state.

Public health surveillance in Sacramento County has shown that the climate-related issues (extensive heat, poor air quality, ground water impacts) lead to more Emergency Department (ED) visits, more requests for inhalers, and greater stress on the more vulnerable people (e.g., those without homes) and those who have no insurance. Furthermore, the California Department of Public Health reports the increased public health risks and risk indicators include heat-related emergency department visits, populations living in wildfire areas, adults with multiple chronic conditions, populations living in poverty, race/ethnicity, outdoor workers, public transit access, air conditioner ownership and tree canopy.
Impact on socially vulnerable populations can be exemplified in California’s wildfires. Recent wildfires have demonstrated that some demographics are disproportionately affected. Native Americans are six times more likely to be affected than white people. Blacks and Hispanic people are 50 percent more vulnerable. These values take into account the likelihood of a community being affected and the greater difficulty of that community to recover. These statistics reflect the lack of access to resources to pay for insurance, to rebuild and recover, to implement fire safety measures, and to access other resources. Price gouging after a fire (such as documented in Sonoma County after the 2017 Tubbs Fire) further exacerbates the disparity. Furthermore, the disabled and the elderly are at particular risk from extreme wildfire conditions, as they are often not as able to effectively evacuate. Of the 85 people who died in the Camp Fire in Butte County in 2018, 62 of them were at least 65 years old.

Safeguarding those populations who are most vulnerable, and the importance of the vulnerability of students in any community, particularly the CSU campuses, is recognized. The increase and severity of California’s climate events may affect CSU’s most vulnerable populations in their ability to cope with, respond to and adapt to the increased. The influence of climate challenges on CSU’s populations who are impacted by their adaptive capacities in their level of exposure to campus and community hazards, vulnerabilities (physical and social), and social capital in their community. (These issues are the focus of the social vulnerability section of this HVRA.) As many of the CSU student population reflect communities of color, first generation college attendees, and as commuters, are transportation dependent, the increasingly serious climate change impacts may add an extra dimension of potential marginalization and hardship. The issue of equity becomes even more problematic if their ability to become (and remain) resilient and absorb stressors is reduced because of increased limitations to access of resources, despite those resources offered by the CSU system.

Hazards and Climate Change in California

Climate change is expected to bring more frequent and intense natural disasters to California. Over the years, what was once a disaster uncharacteristic to landscape is now occurring outside of historical areas. These changes have created a variability at a rate that makes historical data a poor predictor of future climate. For example, the warmest years on record in California occurred in 2014, 2015, and 2016. The following are specific concerns related to the changing hazards landscape in California.

**Extreme Heat**

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The climate induced extreme heat impact leads to public health threats, including illness, disease, smoke, loss of clean water. It leads to agricultural threats, with stress on both agricultural crops and animals. An importantly for the state of California, extreme heat leads to an exacerbated drought threat and increased wildfire threat as the local flora dry out.

**Wildfire**

The warming change to the climate is driven in part due to carbon dioxide and greenhouse gases caused by human activity. The wildfire threat especially occurs in the end of fall, when conditions are driest, but before the winter rains have come; an east-to-west wind gusts exacerbate fire risk. Fire is related to dryer conditions, typically also associated with drought. Impacts of increased heat include increased wildfire threat and public health threats. Wildfire threats have the concomitant threat of Public Safety Power Shutoffs (PSPS). And, in the case of an actual wildfire, danger exists both from fire and from the smoke. Fire cause smoke issues and is related to elevated AQI.

While frequent fires are an integral part of the California natural history, the size and ferocity of fires has grown since the 1980s, with 15 of the largest 20 fires on record having occurred since 2000. Climate change plays a role in magnifying these fires, as California has warmed approximately three degrees Fahrenheit (more than the global average of one degree Fahrenheit) over the last century. This hotter air draws more moisture out of plants, trees, shrubs and grasslands, leaving areas more susceptible to burning. Challengingly, with every degree of warming, the impact to dry conditions is exponential. The most critical time is the end of fall, when conditions are driest, but before the winter rains have come. To exacerbate the effect, the rain is warmer, meaning snow lines are higher, snow levels are lower, and snow is melting earlier, which in turn extends the dry season. CalFire notes that the fire season is now 75 days longer within the past few decades. California’s east-to-west winds that traditionally come over the Sierras further exacerbate the fire risk, as gusts can reach 70-80 miles an hour, which spread a wildfire even wider. The 2018 Camp Fire in Butte County and the 2017 Thomas Fire in Ventura and Santa Barbara County were fanned by such gusts.

**Public Safety Power Shutdowns (PSPS) Situation/ Energy Shortage**

PSPS has been implemented across the state of California with the intention of reducing wildfire risk during periods of high winds and significant fire threat. The PSPS has impacts on the state’s high-risk wildfire areas. Loss of power creates economic hardship to the region, as many businesses close, including gas stations, grocery stores, and local retail establishments. PSPS increases risks to the public due to inability to use medical devices, spoilage of food and medicines, and disruption to infrastructure, such as supply

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of clean water and electricity used to run home medical equipment, such as lift chairs and ventilators.

Changes in temperatures, precipitation patterns, extreme events, and sea-level rise have the potential to decrease the efficiency of thermal power plants and substations, decrease the capacity of transmission lines, render hydropower less reliable, spur an increase in electricity demand, and put energy infrastructure at risk of flooding.

With climate warming, higher costs from increased demand for cooling in the summer are expected to outweigh the decreases in heating costs in the cooler seasons. Hotter temperatures in California will mean more energy (typically measured in “cooling-degree days”) needed to cool homes and businesses both during heat waves and on a daily basis, during the daytime peak of the diurnal temperature cycle. During future heat waves, historically cooler coastal cities (e.g., San Francisco and Los Angeles) are projected to experience greater relative increases in temperature, such that areas that never before relied on air conditioning will experience new cooling demands. Secondary impacts of energy shortages are most often felt by vulnerable populations. For example, those who rely on electric power for life-saving medical equipment, such as respirators, are extremely vulnerable to power outages. Also, during periods of extreme heat emergencies, the elderly and the very young are more vulnerable to the loss of cooling systems requiring power sources.

Climate change is a contributor to power outage hazards in California, including the CSU System. It is important to decipher the frequency and intensity of extreme temperatures throughout the year in California, especially in the widespread areas covered by the state’s largest provider coverage areas, Power, Gas& Electric and Southern California Edison. The probability of California experiencing an extreme temperature can be difficult to quantify but is considered a hazard that occurs yearly during the same seasonal periods throughout the calendar year.

Climate models suggest summer global temperatures are likely to increase while changes between temperature extremes would be more pronounced. The length of days above 100 degree may also increase at a rate that is difficult to keep pace, as we have experienced in the last 20 years, especially in southern-most and northern-most regions of California. Additionally, extreme heat and wind events as a result of climate change; future years are projected to see a continuation or worsening of fire events across California increasing the need for Public Safety Power Shut-Offs (intentional power outages), although, the CSU Chancellor’s Office does not consider its campus susceptible to Public Safety Power Shut Offs, more than half of the CSU System campuses fall within PSPS affected locations.

**Floods, Storms and Water Quality**

Drawing the specific comparison of flood relationships to climate change is difficult. However, the *Fourth National Climate Assessment* contained a Climate Science Special Report that demonstrated climate change “has detectably influenced” several of the water-related variables that contribute to floods, such as causing heavier rainfall and
snowmelt. The conclusion is floods are exacerbated by climate change. The frequency and strength of winter storms has increased across the nation which are being exacerbated by climate change. Other severe storm trends, including thunderstorms, tornadoes and hail, are still being studied as to their relationship to climate change. 185

Storms, floods, and water runoff, (as well as extreme heat events), all that can be influenced, increased and exacerbated by climate change impact water quality, impacting human health, animal health, ecosystem health. Contaminated water also negatively impacts industries that rely on clean water supplies, and the overall economic well-being of a community. A strong intersectionality exists between climate influenced floods and storms and other hazards. Drought conditions can exacerbate floods as the surface soils are hardened and not as ready to allow surface water absorption. Extreme heat events can cause snowmelt, inundating waterways and causing flood and water quality issues.

**Drought**

From 2012-2016 California experienced an historic drought, one of six major droughts recorded over the last century in California. California Governor Jerry Brown declared a drought state of emergency in April 2017, which has since been lifted, but with an ongoing mandate to conserve water in the state. Drought impacts, human consumption, agricultural production, hydroelectric production, and other economic drivers for the state. The most recent drought has been estimated to have cost California $10.0 billion, along with the loss of significant jobs. While small compared to the state’s $2.3 trillion/year economy, it was still a significant emergency event for farmers and as it related to environmental impacts such as impacts to fish, and fowl, and impacts to the groundwater.186

Droughts include both minimal precipitation and also high levels of water runoff during rain events. With each successive drought, California has continued to put mitigation measures and adaptive capacity in place (e.g., water banking, conservation methods, alternating to drought resistant crops, et. al.). 187

Climate scientists are modeling future drought based on the North American paleoclimate records.[17] NASA’s modeling in all cases shows that future droughts are likely to last longer and be more intense, even leading to “megadroughts” in the western states. Fresh water supplies are predicted to be full of extremes, with both droughts and extreme precipitation events being more severe. Extreme rain events will be problematic if increased rainfall is not managed.

**Erosion**

As climate change raises sea levels and induces more frequent and intense weather events, coastal and other erosion may generally become more widespread or severe throughout the state. These events can cause erosion or exacerbate areas already experiencing erosion.

**Excessive Heat**

While the ability to predict future heat events at CSU campuses is limited, the effects of climate change may provide some information. Figure below from the Environmental Protection Agency (EPA) depicts the change in temperature over the last century. Areas of Southern California have warmed as much as 3 – 3.5 degrees. Coupled with less rainfall, this may lead to stronger and more frequent heat events, drought, and an increased risk of wildfires.\(^\text{188}\)

![Rising Temperature Change Over the Last Century (EPA)](image)

**Landslides**

The USGS estimates that climate change-induced shifts in weather will increase the frequency of post-wildfire landslides, which are expected to occur almost every year in California.\(^\text{189}\)

**CSU and Climate Change**

**University Climate Commitments**

"Climate change is a global challenge, but local decisions have a major impact. Our cumulative action is what will make the difference for current and future generations."


California is currently and historically a leader on environmental stewardship, and the California State University plays a significant role in our state’s work.”
CSU Chancellor Timothy P. White, (Ex Officio)

As a signatory of the Second Nature’s Climate Leadership Network, a collaboration of presidents and chancellors of colleges and universities in the United States concerned about the increasing pace and intensity of global climate change, CSU agreed to commitments in areas of climate, carbon and resilience. In the context of this hazards assessment, the focus on resilience directly related to on climate adaptation and community capacity-building to deal with a changing climate and resulting extremes. The focus of the higher education leadership is addressing climate change for a “sustainable, healthy, and more prosperous future. Second Nature serves as guidance for campuses assessing their strengths and vulnerabilities in the context of climate change.

In May 2014, the first systemwide Sustainability Policy was adopted by the CSU Board of Trustees, applying sustainable principles across all areas of operations. “The 2014 Sustainability Policy seeks to integrate sustainability into all facets of the CSU, including academics, facilities operations, the built environment, and student life.” In February 2018, CSU issued its first CSU-wide assessment of progress toward the goals outlined in the policy. Findings included: CSU had met and exceeded its 2020 goal for reducing greenhouse gas; systemwide energy use continued to decrease with $128 million in energy efficiency projects since 2005; CSU had met the 2016 water conservation goal of reducing use by 10% and was on track to meet the 2020 goal of 20%. (Findings were updated March 2018.)

Additionally, in June 2017, CSU joined the We Are Still In, a national program that includes college and university leaders dedicated to supporting climate action to meet the Paris Agreements. All 23 campuses of the CSU system participate in the creation of opportunities for students, faculty and staff to find solutions to sustainability challenges and lead in the global effort to fight climate change. Fifteen CSU campus presidents have signed one of the Second Nature Climate Leadership Commitments, the largest initiative to address climate change in higher education.

These campuses have committed to developing climate action plans to achieve carbon neutrality, integrating these efforts not only into facilities design and management but into the institution’s research and curriculum. Eight of these CSU campuses have additionally committed to assessing the institution’s vulnerability and capacity to adapt to the impacts of climate change. These CSU campuses represent 8 of the 11 California higher education institutions that have signed this more comprehensive Climate Commitment, demonstrating the CSU’s clear leadership in the field of climate adaptation and resilience.

191 California State University. https://www2.calstate.edu/csu-system/news/Pages/CSU-Statement-on-Joining-‘We-Are-Still-In’-Climate-Declaration.aspx
Climate Resilience Actions

The CSU campuses face a wide variety of climate-change induced hazards, increasing the risk of the health, socioeconomic levels and over all wellbeing of the campus populations of students, faculty, and staff. For example, hazards such as the increasing heat events, with associated air quality index and impacts on infrastructure systems such as HVAC, create serious and accumulating risks. As a university, much attention and effort has been put on moving the system towards addressing these climate changes. Campus sustainability efforts are demonstrated through initiatives ranging from climate action and adaptation planning, green building, transportation, water conservation, procurement, recycling and sustainable food system. Several campuses across the system are involved in climate action planning. Current CSU policy requires all new construction and major renovations to be capable of achieving a silver level of certification under the U.S. Green Building Council’s Leadership in Energy and Environmental Design (LEED) rating system. While the current systemwide policy does not require projects to pursue LEED certification, several campuses do have such a requirement.

These efforts are directly linked to the essential efforts by campuses to address the shifting local climates that are causing events more severe events than have been experienced in the past and gaining in criticality for influencing decisions regarding mitigation and adaptation initiatives. For example, campuses reported climate related heat and drought mitigation actions related to HVAC systems, drought tolerant landscaping, drought response plans, recycled water, and sourcing of water. Sustainability and resilience concerns of food insecurity (particularly during the COVID pandemic) were voiced in all campus interviews. Efforts to address this growing social equity concern were a variety of initiatives including campus good pantries, campus food partnerships, edible gardens, and direct telephone support lines for students to call for assistance.

For CSU, critical mitigation efforts building upon campus emergency management responses to climate change need to be emphasized as part of an ongoing systematic resilience building effort. These types of efforts often include such actions as community education and engagement to raise risk awareness and promote protective action, identification of vulnerable locations and groups and individuals who may require assistance, and facilitation and support of emergency management research.

CSU Hazard Example

The CSU Planning Committee understands that the high degree of vulnerability posed by drought will be exacerbated by greater climate variation in the future and therefore greater variation and uncertainty regarding the availability of water supplies which are already under tremendous stress. In response to such vulnerability, state legislation passed in 2014 requires local governments to regulate pumping and recharge to better manage groundwater supplies, and groundwater-dependent regions are required to halt overdraft and bring basins into sustainable levels of pumping and recharge by the early
2040s. That said, the Committee will continue to work with local, regional and state partners and stakeholders to explore solutions for mitigating the drought hazard on its campuses by accessing the best available data and resources on climate change and its relationship to drought.192

Assessing Climate Hazard Risk for Hazard Mitigation Planning

Addressing climate change is a growing requirement in hazards planning and is a critical element in hazards planning for CSU. There is an increasing focus on mitigation and adaptation efforts throughout California and the nation. Climate change affects the emergency management capacity to support preparedness, response and recovery efforts. The complexity of emergency management responsibilities includes planning for the risk reduction to a range of social, technical and infrastructure systems that are affected by disasters (including events induced by climate change) and the need to interact ahead of time to mitigate these impacts. Linking climate change to emergency management allows a focus on these interdependencies of the planning, constructions, and policy, safety decisions, and emergency management exercises.

Managing the complex challenges of these changing environmental condition is coupled with the demands of the University to coordinate data, design the mitigation programs, support emergency management practices and increase clarity on impacts to the students, faculty and staff. As extreme events such as California wildfires increase, so will the demands on those responsible to safety and resilience of the university community. Full-time and volunteer emergency service personnel and supporting organizations will be affected. This requires increased resourcing, including volunteer support, and more creative partnerships between the university and the public and private sectors to meet critical infrastructure needs affecting the campuses.

Many questions can be asked when specifically assessing climate risk. One such approach is the assessment process developed in Australia and published by Coast Adapt. This approach can be used for the CSU system and individual campuses. Information derived from an initial assessment on past hazards in the planning area leads into assessing the system assets or component affected in the past events. Key questions formulate a “first- or second-pass” assessment and series of steps that walk through assessing the situation and analyzing and evaluating risk. Questions include:

- Identify whether any record of occurrence of climatic hazard in the past in the area?
- Are there any risk management strategies in place to tackle any future occurrence of that hazard?
- Identify whether any record of occurrence of climatic hazard in the past in the area?
- What was the consequence of that event (i.e. identify systems that were affected)?

- Are there any risk management strategies in place to protect previously affected systems from future occurrence of that hazard?
- What was the consequence of those events? (qualitative or quantitative estimation)
- Are there any risk management strategies in place to tackle any future occurrence of that risk?
- Understand and identify residual risk of a given system (i.e. risk that remains even after putting a risk management strategy in place)

Figure 3-22: CoastAdapt: How to undertake a climate change risk assessment

For the CSU system, gathering input and to understand campus emergency management staff perspectives of the quickly shifting landscape helps campus decisionmakers identify how climate change may increase existing risks or create new ones and prioritize areas where action may be required. The climate information provides valuable data points for longer range hazard mitigation and climate adaptation planning.

The initial inquiry conducted for CSU offers a high-level snapshot of climate change risks and impacts based on the opinions of the campus emergency managers. While limited, the information helps determine whether a more comprehensive assessment, perhaps in conjunction with the risk management and sustainability offices, may be helpful for the campuses to undertake in the context of emergency management, or to begin appropriately framing a hazard risk informed climate adaptation approach to impending impacts. The information can assist in a number of ways, including:

- Prioritizing mitigation planning decisions.
- Identifying campus systems that need further assessment of risk related to climate changes occurring in the proximity of the campuses properties or communities within which the campuses are located.
- Communicating risks to key campus stakeholders, including students, student families, faculty and staff.
- Identifying who needs to be engaged to further assess climate risks.
- Assessing a broader understanding of the climate adaption options and opportunities for implementation through the hazard mitigation planning process.
- Informing emergency management planning processes and development of operational plans.

Campus Assessments

Campus emergency management representatives and their collaborating campus partners were interviewed to gain understanding of how climate change was impacting their campuses and how climate change was being integrated into disaster management plans and the planning processes. Campus EM interviewees identified the records of occurrence in climatic hazards and if any risk management strategies were in place to tackle the future occurrence of the hazards. Three questions drawn from the CoastAdapt model cited above were drawn from and posed to the interviewees.

- Is there any record of occurrence of climatic hazards in the past in the area around your campus?
- Are there any risk management strategies in place to tackle any future occurrence of that hazard?
- Is climate change an issue of interest at your university?

Data limitations existed for the information gathered. Interviewees gave top of mind responses so responses were often not fully developed, and because of severe interview time limitations, not provided ample opportunity for being well thought out. The experiences shared of the emergency managers are then best informed alongside assessing locally available information and aping into local expert climate knowledge. This assessment does not serve as a risk assessment for climate change or climate change adaptation but the initial offering of insight as to how the emergency management staff and their counterparts reflected on the campus’s evolving hazard risk exposure due to their location’s changing climate-related patterns and the organizational movement towards mitigating the risks.

If an assessment for climate mitigation or adaption is chosen moving forward, it is important to determine the scope, purpose, and timeframe of the planning horizon. The planning timeframe will influence the climate change scenario(s) selected for analysis and which factors will be included in the analysis. When identifying the future climate change risks and opportunities, determine if any existing risk will get worse under future projected changes. Also consider if any new risks can emerge from the future projected changes.
<table>
<thead>
<tr>
<th>Campus</th>
<th>Q1: Is there any record of occurrence of climatic hazards in the past in the area around your campus or community?</th>
<th>Q2: Are there any risk management strategies in place to tackle any future occurrence of that hazard?</th>
<th>Q3: Is climate change an issue of interest at your university?</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Bakersfield</td>
<td>Wildfires that last longer into the fall</td>
<td>Drought tolerant plants</td>
<td>Yes, drought and mitigation</td>
</tr>
<tr>
<td></td>
<td>● No, except it is getting hotter in the summer months</td>
<td>● Done a lot of drought resistant plants around the campus</td>
<td>● I think it is, but not talked about it since February</td>
</tr>
<tr>
<td></td>
<td>● Not seeing as much rain</td>
<td>● Bell tower area – the biggest mall, took out grasses and put in pavers, removed dead trees</td>
<td>● Not been party to the discussion; it is part of env health and safety but director left; now only 2 people in EHS</td>
</tr>
<tr>
<td>2. Channel Islands</td>
<td></td>
<td>● use the recycled water to water plants</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>● replaced the riprap where bridge is; conscious about this; put decomposed granite – natural filters, only concrete is under the bridge</td>
<td></td>
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<tr>
<td>3. Chico</td>
<td>● Biggest thing – argue what percentage, etc. but impacting the megafires</td>
<td>● Heat and the drying spells – crops watering more – the more underlying issues</td>
<td>● The power distribution network around chico has hydroelectric – huge powerlines – PSPS – until PGE cuts fuels back and repairs and replaces the lines the infrastructure can be impacted.</td>
</tr>
<tr>
<td></td>
<td>● Huge impact keeps getting bigger</td>
<td>● The power distribution network around chico has hydroelectric – huge powerlines – PSPS – until PGE cuts fuels back and repairs and replaces the lines the infrastructure can be impacted.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>● Weather is getting more extreme, dry spells and rainstorm cells more frequent</td>
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<td></td>
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<tr>
<td></td>
<td>● Everything is changing</td>
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Table 3-36: Campus Responses to Climate Change Interviews
<table>
<thead>
<tr>
<th>Location</th>
<th>Substation Status</th>
<th>Risk Management Follow-up</th>
<th>Sustainability Coordinator</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>4. Dominguez Hills</td>
<td>NO</td>
<td>No, will follow up with risk management</td>
<td>Definitely, is a sustainability coordinator and have a program of env sustainability. Do webinars and presentation, even during covid.</td>
<td></td>
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<tr>
<td>5. East Bay</td>
<td>No - TBD</td>
<td>TBD</td>
<td>TBD</td>
<td></td>
</tr>
</tbody>
</table>
| 6. Fullerton | • AQI issues but not huge impact to this point  
• Expressed concerns about temperatures, heat index  
• Drought impacts - power outages or access to water, secondary impacts to wildfires | None known | • Middle of the road, not something of it as its own issue, but the potential impacts  
• Solar generation issues, seeing a reduction of their ability to generate power as a cascading impact |
| 7. Fresno | Heat, gradual change |  | No |
| 8. Humboldt | • Megafires – never had days were air quality sat at purple  
• August pump ex fires – largest fire in history  
• Getting hotter – used to rain and be cold and not any more | • Working on a microgrid project that would provide enough power generation to have minimal operations  
• Power generation – getting generators, call something else because of the sustainability initiative | • Oh yes – first green party city council  
• Use all plasticware  
• Purchased a giant filter and filter into drinking water |
<table>
<thead>
<tr>
<th>9. Long Beach</th>
<th>10. Los Angeles</th>
</tr>
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</table>
| - Committee convened 2 years ago reported to the president and chaired by sustainability for the campus  
  - looking at what impacts are to the campus with severe weather and heat  
  - not tracked of impacts of climate | - Fires – smoke – air quality  
  - Infrastructure – HVAC system only pulls in air from outside from 6 pm to 6 am – when an air situation – pulls in bad air |
| - HVAC project – seeking grant funding  
  - Trinidad marine lab is working on climate, sea level rise and dune restoration project which will benefit the community  
  - Sustainability program rolling out new projects – have a new dashboard | - Hope to be corrected this year – couldn’t generate cold water for staff to work  
  - Monitor the air – EH&S – each campus is different; go with the standards from airnow.gov  
  - If air meets a certain level – will direct the depts to work indoors, if bad, will advise them to go home  
  - Implemented short fixes  
  - Brad – sustainability committee |
| - Changed for strategies of preparing for storms, cleaning storm drains, identifying parts of campus in advance of storms.  
  - Adapted to how prepared for storm  
  - Heat educational campaigns | - Yes, weather, heat and air quality  
  - Is an issue but not a top two |
<p>| Yes | |</p>
<table>
<thead>
<tr>
<th>10/22</th>
<th>10/22</th>
<th>10/22</th>
</tr>
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</table>
| • Wildfires, drought, lightening strikes are frequent – heat changes, more hot days  
• Report completed for the Second Nature Climate Commitment - reported to Second Nature; the first stab at social elements and Adaptation, resiliency and climate change  
11/17  
• Extreme drought; most recent; increasing wildfires  
• Many secondary  
  • more direct impacts from sea level rise and other impacts from surrounding communities and power engines  
  • downtown Monterey fishing  
| • Have a plan that is compliance with LA county and sustainability – county and city created a plan  
• Use a battery powered generator  
• Audited so are compliant – decals on the drains, do regular testing  
| • One of the priorities on campus, response for cc and future  
• more difficult decisions and forward looking  
• move towards integrating the living community and living building challenge  
• considering things around storage of solar power; stranded assets  
• move towards resiliency – those conversations – have a carbon neutrality  
• independent decisions in near future  
• Needs to be better defined is what is critical infrastructure to build resiliency systems around it, life safety pieces | • AQI – managing facility – finished a report for air quality and COVID and the system can contain – heat, fire, ability to maintain  
• Pure water Monterey pipeline project – treats water, and seaside groundwater basin and campus can access a percentage of that  
• North quad to recycle water – small pilot project from washing machines and landscape  
• Faculty doing research – retrieving water from fog  
• Study on student resiliency – food security, staff and health and wellness  
11/17  
• Not directly  
| 11/17  
• Absolutely! |
| Industry have trickle down impact               | Overall – carbon neutrality, sustainable procurement |
|                                               | Inclusive sustainability plan |
| • Not a lot of flood risk                     | • 3 core goals, for 10-year plan and a series of recommendations, including a 2030 trees planting, |
| • Have an impact to campus itself; support the three cities affected - anything that affects those three communities affects the universities | • In past few years, the wildfire intensity, fuel reduction project |
| • Look at the background of climate change in the area (links to reports) | • “Lacey done some great work” |
| • Extreme heat and impact to vegetation, and level of fog decreases, have impacts | • rubber is going to have to meet the road about climate / carbon reduction |
| • Sustainability issues come to a head | • affinity group talks about the energy resiliency, resistance working on CCA and procuring more renewable energy |
| • Increased resiliency coming from local | • At EM level, not looking not at climate change and impacts of climate change, temps, health and safety and EM – lots being coordinated. |

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<tbody>
<tr>
<td>• Increased heat, smoke, direct impact of heat event</td>
<td>• Improved heat, smoke, direct impact of heat event</td>
</tr>
<tr>
<td>• No cooling centers</td>
<td>• No cooling centers</td>
</tr>
<tr>
<td>• AQI</td>
<td>• AQI</td>
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<tbody>
<tr>
<td>• drought tolerant plants</td>
<td>• No, per say</td>
</tr>
<tr>
<td>• Speak to the sustainability office</td>
<td>• Water osmosis is example for resilience planning – unique to their campus</td>
</tr>
</tbody>
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<th></th>
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</tr>
</thead>
<tbody>
<tr>
<td>• Yes, but not the predominant issue</td>
<td>• Absolutely</td>
</tr>
</tbody>
</table>
| • Population is more politically charged | • work on carbon footprint, reducing – important at a high level,
<table>
<thead>
<tr>
<th>14. Cal Poly SLO</th>
<th>Big solar farm – figuring out how to fund additional generators to not impact carbon footprint</th>
</tr>
</thead>
</table>
| 15. Sacramento  | • Smoke  
|                  | • Longer durations of temperatures  
|                  | • Shutting down the campus for smoke  
|                  | • Power effected by heat  
|                  | • Big one -- revised the landscape by planting drought tolerant plants  
|                  | • Created permeable concrete and water retention basins underneath to draw water from parking and utilize runoff  |
|                  | Yes |

- Implement mitigation – faculty side interest
- Lots of students – keep track via Instagram (had to learn it through COVID) active messaging – update the webpage - put info and resources – climate justice, dashboards for questions for students
- Talk with professors; connectivity around the issues
- Social media is increasing- started later than other campuses – on smaller size than other campuses
- Worries: how to get vulnerable pops to an area in a short time, backup generator, get students evac.

- If evac, due to wildfire, if both campuses let out – what could potentially happen?
  - Water use, drought – handful of wildfires put out

- To transport people out?
| 16. San Bernardino | • I’m sure there is but not coming to mind. Not been impacted but the potential is there. Just don’t how ready we are to tackle it.  
• Wildfire is always there but no specific incidents but not closed the campus  
  • Have a sustainability office who has a student assistance/ she is now the interim risk manager, have a lot of focus...  
• discussed how to partner with EM  
  ○ Great progress  
• Across the campuses, there is no consistency on who you report to or what dept we are in  
• Pandemic – made it a risk management issue  
• Wildfire plan was first thing we addressed on the campus  
  • AQI  
| 17. San Diego | • No idea  
• Imperial valley – extreme weather – flash flooding  
| 18. San Francisco | • Sea level rise exposure but no king tides  
• AQI from area wildfires  
• Power outages when PGE cuts the lines  
| Note: early interview, CC questions not yet formed; all data from | Upgrade sump pumps in Maloney Field  
| | Not a lot of talk  
| | • Out there but not at our office  
| | • Sustainability yes, but climate change not necessary  
| | • Trying  
| | • Yes – very much is for students  
| | • Sign on to the president’s commitment  
| | • robust sustainability committee  
| | • Operational roles, strong academic curriculum and projects in the field  

<table>
<thead>
<tr>
<th>Question</th>
<th>San Jose</th>
<th>San Marcos</th>
<th>Sonoma</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>No CC</strong> Questions Asked: all data from hazards interview</td>
<td><strong>19.</strong> Fukushima EQ created a tsunami that impacted the docks at Moss Landing</td>
<td><strong>20.</strong> Fire events closed campus, high AQI</td>
<td><strong>21.</strong> Wildfire and AQI</td>
</tr>
<tr>
<td></td>
<td>Very high AQI for smoke from wildfires</td>
<td>Safety health and sustainability have a specialized person for environmental impacts may have something</td>
<td>2017 complex fires – large ash debris on campus; needed to replace all building filters; closed for 9 days</td>
</tr>
<tr>
<td></td>
<td>Sea level rise affects the docks at Moss Landing, have impacts at the beach</td>
<td></td>
<td>Air quality: 2 or 3 days shut down partial days at 330-340 during glass fire – when reaches the limits, can automatically shut down the buildings</td>
</tr>
<tr>
<td></td>
<td>Landscaping water is using non-potable water for all irrigation</td>
<td>Changed the landscaping to drought tolerant plants</td>
<td>Approach is pretty static</td>
</tr>
<tr>
<td></td>
<td>Have own gas-powered power plant that provides 80% of electrical needs</td>
<td>Well water</td>
<td>Since 2017 instead of identifying risk but looking at what severe weather is causing; recognizing to identify everything and how it can impact it in response</td>
</tr>
<tr>
<td></td>
<td>Library built to sway</td>
<td>Reclaimed water for irrigation</td>
<td>Developing a microgrid for solar</td>
</tr>
<tr>
<td></td>
<td>Old building retrofitted</td>
<td>Done mitigation</td>
<td>Energy – what means in terms of electric and solar coming online to offset the peak costs to pay for utilities</td>
</tr>
<tr>
<td></td>
<td></td>
<td>met with local about some brush mitigation in area</td>
<td>Very much so</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>President signed a climate commitment</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Multiple committees on sustainability</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Planning on solar and microgrids</td>
</tr>
<tr>
<td>22. Stanislaus</td>
<td>23. Chancellor’s Office</td>
<td></td>
<td></td>
</tr>
<tr>
<td>----------------</td>
<td>------------------------</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Walbridge and Glass fires</td>
<td>• Wildfire smoke and AQI</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Prolonged droughts</td>
<td>• 2018 shut down for 2 weeks</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Fear of wells drying up so developing scope and budget funding</td>
<td>• 2020 shut down for 8.5 days</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Extreme heat created HVAC system failures</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Power outages from transformers blowing out</td>
<td></td>
<td></td>
</tr>
<tr>
<td>22. Stanislaus</td>
<td>23. Chancellor’s Office</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Note: early interview and CC questions not yet formed; all data from hazard interview</td>
<td>• Lot on sustainability: LEED, water retention ponds</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Have holding ponds on campus, awards for sustainability on retention ponds—beautiful</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• No</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Backlash from community not understanding about the water a couple of years ago.</td>
<td></td>
<td></td>
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<tr>
<td>3.5 Social Resilience Assessment</td>
<td></td>
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</tbody>
</table>

Introduction

Resilience is all about being able to overcome the unexpected. Sustainability is about survival. The goal of resilience is to thrive. Jamais Cascio (San Francisco Bay Area-based author and futurist). In order to succeed, people need a sense of self-efficacy, to struggle together with resilience to meet the inevitable obstacles and inequities of life. Albert Bandura (social cognitive psychologist, Professor Emeritus at Stanford University).

Purpose

The intersection between social vulnerability and risk resilience is an essential concept for evaluating the risks and coping capacities of the rich diversity of CSU campus populations. This section of the HVRA serves a starting point for shedding light on the risks and vulnerabilities of the students, staff and faculty, based on each campus’s unique population and social constructs and inform the overall adaptive management strategies for coping with hazard risks.

The ultimate goal for this high-level assessment is to provide a starting point to further explore the social risks and vulnerabilities for each campus with their unique social
composition and planning efforts. The assessment data inform this process but do not provide the level of accuracy found in a traditional physical risk and vulnerability assessment. A more robust inquiry based on methodical and scientific research-based data is encouraged to gain an accurate picture. Creating such an accurate picture will be an important step in planning for socially based impacts and more accurately identifying opportunities to improve social resilience among all of the CSU community.

This assessment also serves as a platform to encourage campus dialogue, increase resilience capacities, expand the emergency management planning activities, and inform adaptive risk management strategies. Such an effort would be envisioned through both nuanced discussions with a variety of campus stakeholders and the invitation of nontraditional stakeholders to join in a collaborative resilience partnership. Socially informed mitigation investments move beyond standardized planning and regulations, structure and infrastructure projects, and natural systems protections to embrace a more expanded, customized emergency operations plan and an integrated education and outreach program unique to the campus. Such a forward-leaning effort would be directly in keeping with CSU’s commitment to inclusion and equity in risk reduction.

Inclusivity at CSU and Social Resilience

Within the CSU system, campus leadership places high priority on environmental justice and cultural competence. These cornerstones serve as a fundamental university ethic. Each campus is committed to providing inclusive and safe environments for all individuals living, learning and working with or on the campus. As one of the most ethnically and racially diverse university systems in the county, CSU campuses are committed to supporting the need of its diverse population of students, faculty and staff. In particular, the campuses take great effort to ensure a lens of equity and inclusion is provided to its historically underserved and first-generation students. Students of color make up more than half of the student population at the CSU with nearly 40 percent alone being Latino. 193 194 195

Table 3-37: List of CSU Campuses Designated as Hispanic-Serving Institutions (HSIs) and/or Asian American and Native American Pacific Islander-Serving Institutions (AANAPISIs)

<table>
<thead>
<tr>
<th>CSU Campus</th>
<th>HSI Campus? (As of 05/2021)</th>
<th>AANAPISI Campus? (As of 05/2021)</th>
</tr>
</thead>
<tbody>
<tr>
<td>California State University, Bakersfield</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>California State University Channel Islands</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>California State University, Chico</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>California State University, Dominguez Hills</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>California State University, East Bay</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>California State University, Fresno</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>California State University, Fullerton</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Humboldt State University</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>California State University, Long Beach</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>California State University, Los Angeles</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>California State University Maritime Academy</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>California State University, Monterey Bay</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>California State University, Northridge</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>California State Polytechnic University, Pomona</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>California State University, Sacramento</td>
<td>Yes</td>
<td>Yes</td>
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<tr>
<td>California State University, San Bernardino</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>San Diego State University</td>
<td>Yes</td>
<td>Yes</td>
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<tr>
<td>San Francisco State University</td>
<td>Yes</td>
<td>Yes</td>
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<tr>
<td>San José State University</td>
<td>Yes</td>
<td>Yes</td>
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<tr>
<td>California Polytechnic State University, San Luis Obispo</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>California State University San Marcos</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Sonoma State University</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>California State University, Stanislaus</td>
<td>Yes</td>
<td>Yes</td>
</tr>
</tbody>
</table>

In keeping with University’s mandate for inclusion and equity, CSU’s hazard mitigation efforts need to be conducted in an inclusive, culturally competent manner. Taking a
whole community approach ensures that all persons within the campus system are assessed and effectively served with fair and equitable treatment.

In order to ensure student success, and continuity of the school’s operations, it’s important to consider a wide range of social factors that potentially influence safe and secure living during “blue sky” periods as well as during a disaster event. CSU prides itself on strongly supporting key populations such as the LGBTQI. Many factors influence an individual’s ability to be resilient and respond effectively to risk. They also influence an ability to return to a healthy functioning campus life after a disaster event has passed.

For effective preparedness, response and recovery to occur, population groups at risk need to have the capacity, skills, and knowledge to understand, access and participate in a meaningful way. In the campus communities, having strong social support networks and active involvement in community disaster responses may impact this process. Addressing the needs, concerns and issues of various population groups throughout the CSU system will better inform emergency management, mitigation planning, complex decision-making processes that leads to financial investments.

Background on Social Vulnerability

Social vulnerability incorporates the traits and conditions that make humans vulnerable (e.g. social structures and inequalities) of the various population in coping with disasters. While vulnerability speaks to the conditions that make populations susceptible to harm, resiliency refers to the ability to coping with and recover from a hazard event—often described as the ability to “bounce back.” When populations lack resilience, their inability to bounce back can significantly disrupt and delay recovery. While every person is vulnerable to risk, individuals from diverse populations, such as those with access and functional needs, are disproportionately more vulnerable and may be at a higher risk to harm to a disaster event. The ability of the diverse populations to respond to unfolding situations may not be the same as more mainstreamed populations. The CSU campus populations are no different.

Presidential Policy Directive 8 defines resilience as the ability to adapt to changing conditions and withstand and rapidly recover from disruption due to emergencies. Presidential Policy Directive 21 expands this to prepare and adapt. Resilience includes “the ability to withstand and recover from deliberate attacks, accidents, or naturally occurring threats or incidents.” Social vulnerability researcher Dr. Susan Cutter and colleagues offer this description: “resilience is the ability of a social system to respond and recover from disasters and includes those inherent conditions that allow the system to absorb impacts and cope with an event, as well as post-event, adaptive processes that

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196 California State University. Diversity. https://www2.calstate.edu/impact-of-the-csu/diversity/Pages/LGBTQ-Centers.aspx
facilitate the ability of the social system to re-organize, change, and learn in response to a threat.”  

How individuals are imbedded in and supported by their communities also strongly influences one’s abilities to navigate disaster risk and is of particular concern for diverse populations. “Elevated risk factors and inherent social dynamics need to be considered for assessing individual resilience and response capacities and capabilities. Diverse populations with limited or lessened social capital (e.g., networks of relationships among people who live and work in a community) are implicitly at greater risk to harm. Communities with robust social networks are better able to coordinate response and recovery, quickly disseminate information and support physical assistance.”

**Historically Vulnerable Populations at Risk**

Historically, hazard events have more deeply affected vulnerable populations. “There is a general consensus within the social science community about some of the major factors that influence social vulnerability. These include lack of access to resources (including information, knowledge, and technology); limited access to political power and representation; social capital, including social networks and connections; beliefs and customs; building stock and age; frail and physically limited individuals; and type and density of infrastructure and lifelines.”

For socially diverse communities, the emergency management support system can deeply influence that ability to navigate a hazard event. For example, life-saving emergency information delivered in a language that is not fully understandable to students or campus workers due to cultural or linguistic differences, or disseminated through technology and notification systems to which there is limited access due to digital equity in commuter student homes, increases risk. Recent firestorm events have demonstrated the dire consequences when evacuation information and procedures did not incorporate the unique needs.

“…Among the generally accepted [factors that influence social vulnerability] are age, gender, race, and socioeconomic status. Other characteristics identify special needs populations or those that lack the normal social safety nets necessary in disaster recovery, such as the physically or mentally challenged, non-English- speaking immigrants, the homeless, transients, and seasonal tourists. The quality of human

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settlesments (housing type and construction, infrastructure, and lifelines) and the built environment are also important in understanding social vulnerability, especially as these characteristics influence potential economic losses, injuries, and fatalities from natural hazards.  

populations that the less obvious human connections between natural hazards and the variables that may potentially impact the actions, inactions, or activities of the students, staff and faculty that mitigate the resilience and exposure to natural hazards on the campus.

Research points to the many challenges for those with limited or low socio-economic status during disaster hazard events, including:

- Perception of disaster risk
- Not taken preparedness actions due to it being too costly
- Responding to warning communication due to inability to evacuate or having nowhere to go.
- Housing that is not built or retrofit to effectively withstand hazard impacts
- Lack of adequate resources to address hazard events, resulting injuries and other health related problems
- Difficulty to recover from economic losses due to accessing and receiving aid

Issues such as food and housing security, disabilities and functional needs are among the many social factors that are well known to influence resilience. Others such as low income, gender diversity, sexual orientation, and immigration status concerns influence consistent the availability of support safety nets.

Individuals with low income and limited resources often have increased vulnerability to events due to being less able to afford housing, supplies, medical care and insurance. Age impacts vulnerability. Children and the elderly may have less physical strength and resilience to the event impacts, less financial resources, ability to take preparedness actions prior to and during an event. People with disabilities and access and functional needs can be particularly vulnerable. For example, for those with hearing impairments, they may be unable to receive adequate warnings in time to evacuate. For those with mobility challenges, they may not have access to supportive equipment to access ramps or lifts.

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201 Susan L. Cutter, ibid. p 245.

While some populations are more readily considered in the emergency management planning process, others have not been. For example, LGBTQI individuals may face challenges of discrimination in shelter environments or concerns regarding issues surrounding disclosure of sexual identities. Transgender individuals may have discomfort with assignments to the appropriate government shelters due to traditional assignments in same sex facilities. Racial and gender discrimination may impact disaster response and assistance due to institutionalized racism. Concerns regarding the lack of documentation of citizenship may influence an individual’s comfort level in asking for and receiving assistance. Gender has historically been a challenge in disaster resilience due to the elements of safety and support during an event, who bears the responsibility of family and added support needs during the recovery, as well as potential challenges of working through bureaucratic system afterwards.

“That social systems play a prominent role in human vulnerability to hazards is central to the idea of social vulnerability. Cutter (1996) describes social vulnerability as including “the susceptibility of social groups or society at large to potential losses (structural and nonstructural) from hazard events and disasters” (p. 530). Commonly used factors to measure social vulnerability include economic, demographic, and infrastructure traits of a community (Cutter et al. 2003). Understanding what drives social vulnerability is an essential step toward helping communities to acquire the resources and strategies needed to minimize losses from disasters.”

For effective preparedness, response and recovery to occur, impacted population groups need to have the capacity, skills, and knowledge to understand, access and participate in a meaningful way. In the campus community, having strong social support networks and active involvement in community disaster responses may impact this process.

The factors examined offered a glimpse into potential challenges to coping capacity and these processes being able to successfully happen. Beginning this exploration of different variables is an important step in understanding the campus social vulnerabilities. For example, gender inequality has long been cited as a characteristic of social vulnerability in disaster response and recovery. Women’s heightened exposure to hazards is attributed to their social class, their caregiving roles, and their relative lack of power and status. Income is another key factor as economically and socially disadvantaged individuals more likely to reside in substandard housing that is at greater risk of damage in a disaster event. Older adults present higher risks for worse health outcomes with increased

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emergency department visits following disasters, and overall, have increased morbidity and mortality in the post-disaster environment due to factors like preexisting physical and mental illnesses, disabilities, and specific care needs at an individual level. Other social vulnerability factors that may influence such a transitioning system as CSU, and overall the quickly shifting demographic makeup of the State of California, include race and ethnicity due to crisis preparation and information seeking behaviors and culturally appropriate emergency risk communication for low-income minorities.

All of these social issues can be complex and do not always place a person at a higher risk simply because a person falls within a certain social sector or, for example, is dependent upon a wheelchair as a person with AFN. The intersectional nature of what makes an individual’s personal experience and resilience to an event is unique. The role of social capital, an individual’s resilience levels, and the system that supports them all play a major role in risk exposure.

The level of vulnerability of the CSU campus’s faculty, staff and students may be strongly influenced the level of community social capital available to provide various emergency response and recovery needs, such as food, shelter and other types of assistance.

“The social capital component includes measures of social support, social embeddedness, organizational ties, citizen participation, a sense of community, and attachment to place. It has been operationalized through measures regarding rates of two parent households, sports/arts and civic organizations, voters in a presidential election, religious adherents, net migration, and property crime (Sherrieb et al. 2010). Information and communication refer to responsible media, trusted sources of information, and the skills and systems in place for informing the public, as well as communal narratives that allow groups to frame experiences and share meanings. Lastly, community competence speaks to a community’s ability to organize collectively to identify and address problems in ways that are efficacious, creative, flexible, and empowering.”

National Focus on Equity and Inclusion in Disaster Management and the Increasing Lens on Social Vulnerability

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Ongoing community planning efforts prioritize and elevate concerns for inclusion and equity in disaster response.\textsuperscript{210} This topic has been a key focus for both practitioners and academics for many years and continues to grow in prominence. The National Advisory Council Report to the FEMA Administrator November 2020 describes the issues of equity, cultural competency, and understanding and building social capital as being amongst the most critical challenges facing the field of emergency management.\textsuperscript{211}

California’s current populations is among the most diverse in the nation. Historical influx of immigrants, along with a growing racial and ethnic diversity presents challenges for outreach and hazard mitigation strategies. The population is mobile and aging. These shifts in the social landscape have strong implications for addressing populations risk issues.

Individuals in a local community’s population base who are considered to be more vulnerable to disaster risk have been a critically growing concern for the disaster management community across the state. Importantly, individuals with access and functions needs are disproportionately impacted by disaster events. Individuals with disabilities often need assistance with evacuation, may be unable to see approaching danger or hear announcements to evacuate. Recent wildfire events throughout the state in recent years saw tragic results related to supporting the AFN community as well as those with English as a Second Language. The planning and response efforts for the state’s high-risk populations (also termed as vulnerable populations) came under intense scrutiny during the 2019 auditing of disaster response to recent wildfire events.\textsuperscript{212}

Two bills recently passed in California requiring disaster planning to use culturally appropriate strategies and resources to effectively engage and serve culturally diverse communities and populations deemed to have higher vulnerability to hazards and less capacity for resilience.

\textbf{CA Senate Bill 160 (cultural competency):} Passed on October 2019, the bill requires the plans to address how culturally diverse communities within its jurisdiction are served. (”Culturally diverse communities” includes, but is not limited to, the following: race and ethnicity, including indigenous peoples, communities of color, and immigrant and refugee communities; gender, including women; age, including the elderly and youth; sexual and gender minorities; people with disabilities; occupation and income level including low-income individuals and the unhoused; education level; people with no or limited English language proficiency; and geographic location.) Response actions for climate caused events (and all other) must include culturally appropriate approaches, resources, and outreach in emergency communications, including the integration of interpreters and translators; and emergency evacuation and sheltering. Additionally,

response engagement needs to create a forum for community engagement in geographically diverse locations.

**CA Assembly Bill 477 (access and functional needs):** Passed September 2019, the bill requires that jurisdictions specifically serve the access and functional needs population through the following actions: emergency communications, including the integration of interpreters, translators, and assistive technology; emergency evacuation, including the identification of transportation resources and resources that are compliant with the federal Americans with Disabilities Act of 1990 (42 U.S.C. Sec. 12101 et seq.) for individuals who are dependent on public transportation; emergency sheltering, including ensuring that designated shelters are compliant with the federal Americans with Disabilities Act of 1990 (42 U.S.C. Sec. 12101 et seq.) or can be made compliant through modification and that showers and bathrooms are fully accessible to all occupants.

**Research Methodology**

In this assessment, the interviewers asked campus emergency managers and colleagues about social factors that may potentially impact campus populations. This inquiry was done during the same interview as the campuses were asked about the physical vulnerabilities and hazard risks data. The interviewers asked questions regarding a set of variables known to influence and increased level of risk for social vulnerability.

**Development Guidance**

The social vulnerability variables selected were based on the assessment team experience and guided by informal input and feedback from three prominent social vulnerability experts:

- Susan Cutter, PhD: Distinguished Professor of Geography at the University of South Carolina and director of the USC Hazards and Vulnerability Research Institute
- Lori Peek, PhD: professor in the Department of Sociology and director of the Natural Hazards Center at the University of Colorado Boulder
- Nnenia Campbell, PhD: research associate at the Natural Hazards Center, Deputy Director of the Bill Anderson Fund, and co-founder of the Collaborative for the Social Dimensions of Disasters.

**Data Limitations**

The assessment measured indications of social vulnerability by asking a set of pre-established questions related to vulnerability factors. The social vulnerability assessment data are not definitive or authoritative. The answers and the analysis of this assessment are indicators for increased social risk. This assessment provides indications of increased risk, not accuracy of response nor a true reflection of the situation of a campus. They do not represent an accurate data capture as limitations on the data gathering process influenced the ability to provide accuracy. Limitation factors included:
• **Time Limitation:** Limited time was available for the social resilience/social vulnerability questions during the interview process. Approximately 20 – 25 minutes maximum was allocated at the end of the two-hour interview. The answers were quickly captured, and the interview moved forward.

• **Context:** Lack of interviewee familiarity regarding the connection with, or reason why, the variable was being asked about in context of emergency management/risk reduction. Many times, there was a brief explanation or informational process to explain why the question was being asked along with a brief explanation of the connection to risk and social factor vulnerability.

• **Data Access:** Many interviewees did not have situational awareness and/or access to the variable data so they often provided a best guess. A few gave detailed accounts based on their experience.

• **Research Evolution:** The data assessment process evolved as the interviews progressed. Initial campus interviews were not clearly formatted nor the questions provided with clarity. The initial interviews were more free flowing questioning and the answering. The question format structured formed organically as the research inquiry process progressed. The write up was written as concretely as possible. When questions were not specifically asked or the answers were not provided, the coding “not asked” (NA) was provided on the answer graphs.

• **Limited Staffing:** Many campuses have minimal staffing in the emergency management position, with interviewees serving as a “one-person shop,” responsible for many activities so had little situational awareness of the breadth of the campus populations.

**Interview Approach and Questions**

The assessment began with a brief explanation as to the purpose of the interview questions. Then two sets of questions designed to get high level situational awareness were asked. The first set of questions asked about the populations of concern for emergency management. The second set of questions asked about as set of resilience factors being consider for two planning elements specific to emergency management. At the end of the interview, interviewees were invited to add any additional information or bring up any issue not included in the question set.

**Part One: Campus Populations of Concern**

Interviewees were asked the following: “In considering the diverse population group(s) amongst student body, faculty and staff, which are of the most concern in your emergency management planning:

- Who has the highest social or physical vulnerabilities?
- Who is most difficult to reach in an event?
- Who has little or limited support networks if impacted in an event?”

Interviewees gave a brief response to each of the three questions. In the campus write up, the questions and answers are listed in two ways; first, displayed as a graphic with icons representing the questions and answers, and second, as a table of the questions along
with the interviewee bulleted responses. The menu of graphic icons below should be used as a reference when reviewing the campus annexes.

Figure 3-23: Menu of icons used to graphically display interviewee answers to the three questions in “Campus Populations of Concern.”
Part Two: Resilience Variables of Concern for Campus Emergency Management

Interviewees were asked the following two questions in relation to a set of 11 variables or groups/issues that might influence social vulnerability:

- Is this factor a particular issue of concern for emergency management on your campus?
- Is this factor reflected in the emergency plans/processes for your campus?

Variables used for the campus surveys:

- Homelessness (housing insecurity)
- Food security (food insecurity)
- Health and wellness
- Disability/access and functional needs (DAFN)
- Racial equity
- Digital equity
- Communications (e.g., planning for ESL, out-of-state, international, special needs)
students/translators...example actions would be resident staff identifying international students and students with disabilities)

- International students
- Immigrants/immigration status issues *(undocumented, DACA, etc.)*
- LGBTQI
- Transportation dependency

The following approach was used to code (rate) the answers to the variable questions. For question one (Is this factor a particular issue of concern for emergency management on your campus?) responses were summarized as **Very High, High, Medium, Low**. It is critical to note that this question was not asking about the issue for the campus as a whole but specific to the concerns for emergency management. The answers were coded based on interviewer understanding of the answer given, along with the system of response averaging, as explained below.

For question two (Is this factor reflected in the emergency plans/processes for your campus?), the responses were summarized as **Yes, No, In Progress, NA**. If there was activity related to plan such as the EOP or to the planning and outreach engagement process, the answer identified as a **Yes**. If the campus interviewee was not linking social vulnerability factors to EM plans or planning process, or didn’t think this was of concern, the answer was given a **No**. If the interviewee was aware of how the variable or issue impacted population risk and emergency management on campus and was actively planning to take action or considering on taking action to integrate into the EM plans or planning processes, then the answer was given **In Progress**. If the question was not asked, or the answer not adequately captured, the answer was given as **NA**.

**Response Averaging**

In order to provide a high-level qualitative response for the answers, the approach of “response averaging” was used. This method was recommended by the social vulnerability researchers who offered guidance on the assessment. If conflicting answers were expressed by the interviewees, the code was averaged out. For example, if one interviewee replied that a variable was not an issue of concern to emergency management (low) and another interviewee replied an opposing response (high), the code was averaged to medium. The response averaging approach supports qualitative answers that offer indicators, not a definitive or authoritative data capture. The purpose is to address disparate responses within a specific campus group of respondents. Specific details of each response were not included in the campus annex write up.

Response averaging was used in the following situations:

**Discrepancy** was expressed between a variable being of concern for the overall campus in general and a concern specifically for emergency management (e.g., answer became medium or NA; if answer was expressed with strong emotions at the campus level but not in emergency management, the answer became medium)
• **Opposing opinions** were expressed amongst interviewees on the variable being an issue of concern for emergency management or currently integrated in the planning process (e.g., answer became medium)

• **Confidence** in the interviewee(s) understanding the relevance of the role/importance of a variable issue or how it impacted the campus for emergency management (e.g., answer became medium or NA)
Table 3-38: Graph of campus-specific emergency management issues of concern and inclusion in emergency management plans and processes.

<table>
<thead>
<tr>
<th>Issue of Concern</th>
<th>Plans &amp; Processes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Homelessness (Housing Insecurity)</td>
<td>Low</td>
</tr>
<tr>
<td>Food Security</td>
<td>Low</td>
</tr>
<tr>
<td>Health &amp; Wellness</td>
<td>Low</td>
</tr>
<tr>
<td>AFN</td>
<td>Low</td>
</tr>
<tr>
<td>Digital Equity</td>
<td>Low</td>
</tr>
<tr>
<td>Comms.</td>
<td>Low</td>
</tr>
<tr>
<td>International Students / Immigrants</td>
<td>Low</td>
</tr>
<tr>
<td>DACA</td>
<td>Low</td>
</tr>
<tr>
<td>LGBTQI</td>
<td>Low</td>
</tr>
</tbody>
</table>

### High Level Analysis Narrative

Each campus annex includes a brief bulleted summary of any key take away points, elements of interest, issues and concerns, or new work being done. When there were any notable agreements or disagreements if multiple persons were interviewed, this was noted as "in some important areas there were disagreement in answers."

If a particular vignette was described for a campus, it is described at a high level in this narrative section. For example, the interviewee from Chico State expressed concern about transportation dependency during a wildfire. They use the local bus system. They can get students back home throughout the state but then they have no means to get them back to campus. Another concern expressed was that Chico’s outgoing alerts and notification communications are only in English. This limitation is problematic for urgent notification of an impending wildfire to the Hmong staff with limited English skills, who maintain the landscapes.
System-wide Analysis

The following is a high-level narrative summary of social vulnerability assessment (resilience) answers for the overall CSU system. Each individual campus annex provides details on the questions asked, the ratings of social variables, and key takeaways for that campus. This summary reflects a synopsis of key themes, take away points, any major agreements or disagreements, and specific vignettes of the campuses and the system. The narrative follows the interview framework: part one: Campus Populations of Concern and part two: Resilience Variables of Concern for Campus Emergency Management

Campus Populations of Concern

The question asked was the following: “In considering the diverse population group(s) amongst student body, faculty and staff, which are of the most concern in your emergency management planning?

- Who has the highest social or physical vulnerabilities?
- Who is most difficult to reach in an event?
- Who has little or limited support networks if impacted in an event?”

The answers to the three questions asked in part one of the interview tracked closely with ten of the eleven social variables in the question set of the second part of the interview. The one exception variable that was not given was racial equity. While this was not specifically articulated as an answer; it is encouraged that racial equity be considered as a factor in the context of the other answers.

Who has the highest social or physical vulnerabilities?

Populations with Access and Functional Needs (AFN) was repeatedly identified as a population of the most concern by many of the campuses. Some campuses were very specific to disabilities unique to their campus. Northridge, home for the National Center of Deaf Studies, identified the deaf and hard of hearing, describing the physical challenges associated with hearing impairments. Some campuses described emergency planning activities to address this concern. Every semester Los Angeles sends out the list of students with disabilities and where they are located during a Monday through Friday schedule. Humboldt specified students enrolled in their disability resource center. Because the campus has the highest number of students on psychiatric drugs, there is concern about the resiliency and potential coping mechanism of these students, and the needs if students can’t get their medications.

First generation students were cited by multiple campuses as a population of concern. Fresno reported that major of their students are first generation college students who may not have support if significantly impacted and was concerned that their population had a lot of vulnerability without a lot of resources in transportation or technology. Students with lower socio-economic standing that were not resourced well was repeatedly cited by multiple campuses, along with homeless or housing insecure, those who are food insecure, and those without financial stability. San Marcos specifically cited migrant family worker students. Other answers given multiple times though not as consistently as the above were DACA students. Concerns regarding international students were expressed. Pomona included out-of-state students. Sonoma identified students and
staff of the more rural populations due to wind, power outages, being less likely to have running water. Another trending theme was foster populations who are housed in campus residencies. For many of these students, the campus is the only form of housing available to them. Sonoma described their foster population numbers run between 50-100 individuals at a time.

Unique answers came from CalPoly which cited the LGBTQI populations, their very first response to the question, and Monterrey, which identified faculty and staff in employee housing who are leasing or short-term owning on university property and dependent on the WIFI capabilities.

Who is most difficult to reach in an event?

Themes from answers to the first question were reflected in answers to this question including AFN populations, first-generation students from low socio-economic backgrounds, and all those with equity issues who lack technology or are financially challenged without internet access.

Specific issues pertaining to AFN including deaf and hard of hearing students who depended on text to communicate. Sacramento interviewee described the campus as having a high number of hearing-impaired populations and pointing out the deaf studies professors whose offices have doorbells with lights.

Another trending answer was non-English speaking students. Dominguez hills expressed a need to start looking for translation services for emergency notification. Pomona, which sends out all emergency information in English, expressed concern regarding language barriers for their top five populations of Spanish, Arabic, Chinese, Japanese and Korean.

Fullerton described concerns and need to “convince participation” in emergency communications for those students who are undocumented or of DACA status. Technological (digital) inequities were cited in this discussion, along with the challenges faced by the international students because they no social network to fall upon, some have language barriers in crisis and being able to communicate is a problem.

Access was cited in different situations. Humboldt described a communications issue that was unique to their campus and not expressed by other campuses: faculty who have opted out of the RAVE system. RAVE text message and alerts are an opt out – so there is concern for those not receiving the messages. While few students have opted out, but many of the faculty have. At the other end, San Marcos felt this was not an issue for their campus with everyone preloaded into the emergency coms system and the system is an opt out. Sonoma have faculty and staff who either haven’t updated their information for emergency communications or live in the rural areas outside of the incorporated areas.

An issue identified by Long Beach, primarily a commuter campus, was how to reach individuals before they get to the campus, as they don’t have reliable communications. Northridge also described a challenge in contacting commuter students and getting the message out to them on their way into campus.

An issue of access to the students because of which platforms the target audience was using was identified by two schools. East Bay expressed concern over students who don’t
read emails. Since they read text, they have had to strategize and prioritize since everyone uses a different method but felt this was an issue. CALPOLY identified the challenge of reaching students whose social media platforms are primarily Instagram and snapchat.

A unique audience challenge was expressed by Monterrey where the concern was not the students, faculty or staff but “partners.” Partners are other people who lease facilities across the campus for storage and for the contracts depts. EM doesn’t have a list of these renters and would need to notify property management contacts. They have emails for residential renters.

Who has little or limited support networks if impacted in an event?”

Answers to this question generally followed trending themes of the earlier questions: residents in the housing populations who had no place else to go (e.g., those in or who have come out of foster care system), individuals with little or no access to nutrition or technology, homeless, socio-economically disadvantaged, first-generation students, international students, and those with English as a Second Language (ESL). Monterrey identified those with concerns of mental health support (note the similarity to the answer given by Humboldt to the first question).

Two responses provided additional insight. Sacramento identified Dreamers/DACA students as a result of immigrations issues with parents whom they were living with off campus. Sonoma County cited those who rely on student housing and are middle income students are “making it work until they can’t.” Interviewees noted that they are reaching out to those students on these issues. Dominguez Hills interviewees shared there was a need for a “plan b for housing.”

It should be noted that individuals with AFN were not given as an answer to this question.

Resilience Variables of Concern for Campus Emergency Management

Homelessness (housing insecurity)

Several campuses voiced general campus concerns regarding growing issues of housing insecurity for their students. Couch surfing and sleeping in cars were heard in some of the answers. The challenges may come from reduced job security and not being in dorms during times of COVID. Some campuses described active outreach and programs for supporting students. Few described actively incorporating elements of homelessness in their EM plans or planning process outside of an event response. For example, Stanislaus described their Homeless program for those who are vulnerable, where they house them in housing dept and provide rooms that allow them to stay for 30 days. They also provide them with community outreach to get them back on their feet. This was cited as a low issue of concern and not reflected in their EM plans or their planning processes.

Food security

Food security came up as a strong, ongoing issue of concern for most of the campuses. Many described how the food pantries had been forced to shift operations during COVID. Most had adjusted operations but continued to provide food, while some had stopped all
together. Some campuses responded that this was not of concern due to excellent, readily available food pantries off campus. However, campuses such as Dominguez Hills, located in a very low-income area, expressed a very high concern about the issues but had not yet had a chance to address it in the plans or planning processes. Overall, addressing food security was not a regular part of the EM planning process or included in the plans.

Health and Wellness

Concerns regarding health and wellness were consistent throughout the campus system ranking from very high to not of concern to EM due to the active process of addressing the issues on the campus by the health centers. In early interviews they were asked if there was a spike in issues due to COVID to which many responded yes. At the very onset of the interviews, a question was asked about increased suicide attempts, to which there were affirmative responses. This question was stopped when the questions became focused on the impacts of the EM plans and processes and not just generally. Some campuses responded to the active engagement with their other centers.

There were several explicit examples given for this variable. When Sonoma State anticipates events, the director of psych and counseling is part of their EM response planning. SONOMA CARES, developed in the 2017 fires was cited as a program to connect students with counselors during a crisis. They also addressed the faculty and had counselors on call to come into the EOC. They also bring in mental health into the response plan. Stanislaus described seeing a spike in mental health issues now. They have representatives on their infectious response team and in the EOC and talks all the time with county EOC. They have counselors available through telehealth services. Also, the Employee Assistance Program (EAP) and encouraging engagement because the isolation is affecting people. They are actively working this in their planning process so were listed as an In Progress. Dominguez Hills described this as “definitely, a very high” issue of concern. For their campus, it is treated like an EOC branch, having developed 6 Toro Teams to address employee success and wellness and have a chair to set up online platforms. They’ve opened up to expand to students; this effort has never been done. When asked if it was reflected in plans, the answer from the emergency manager, was yes, it is “Nora’s Plan” and is In Progress, as it currently sits in the campus COVID safety and response plans but at some point, the plan will transition to the EOP. The issue around health and welcome was identified as a strong need for the campus, and the group reports up to the EOC, whose structure has been a “lifesaver.”

Disability/access and functional needs (DAFN)

Of all the variables, this one generated the most consistent response. This population group ranked among the highest of those populations of concern generally and for communications outreach in the part one question set. All campuses responded positively when asked about their inclusion of AFN in the EM process and plans, as it is a mandated element for emergency management. There were different responses on how they include it into the plan. Some responded that it was “baked” throughout the plan
while other campuses described AFN as being a specific annex. Many campuses actively engage their campus community in AFN preparedness activities by including AFN association/support representatives in EOC and general EM planning activities, meeting with and training residential hall leaders, asking guidance from campus support services, and incorporate AFN activities in their exercises.

Racial equity

This variable was added as a late addition question after being strongly encouraged by the informal social vulnerability research advisors. Of all questions asked, this variable resulted in the least amount of concern specific to campus emergency management or was racial equity included in the EM planning processes and plans. In some circumstances, the interviewees expressed disagreement amongst themselves regarding racial equity being an issue for EM on their campus. Some campuses referenced the racial issues in context for their campus overall but not in relation to EM. One campus noted racial equity issues pertaining to national social strife resulting campus protests and demonstrations were more associated to security and policing.

Humboldt State was the only campus that responded racial equity was actively on their emergency management radar due to the ongoing, just off-campus demonstrations that continue to place a couple of years since the (off campus) death of a student of color. Campuses located in low-income communities expresses more concerns regarding the variable and the ways in which they felt they needed to address it in their planning processes. Dominguez Hills was the only campus which cited this being a “very high” issue of concern. The campus emergency manager expressed a strong desire to address the issues pertaining to racial equity at some point in the future.

Overall, there seemed to be an underlying lack of understanding on how the variable directly pertained to the EM efforts. Some campus interviewees asking for further explanations on why the question was asked and clarifications how could (or should) racial equity be incorporated. Further, the emergency management incorporation of racial equity and providing a stronger connection for planning for racial diversity inclusion demonstrated itself to be an opportunity for improvement.

Digital equity

In addition to question regarding AFN, response to this variable consistently ranked high on the radar for all campus interviewees. Most campuses had not included digital equity in their EM plans and processes, though some campuses noted that they now realized that the variable needed to be proactively addressed in EM planning documents and in the planning processes. Some noted the issue was adequately addressed in campus continuity plans. As an issue of concern, digital equity was noted as high or not being of key concern because of the proactive efforts of the IT department during the recent COVID period. Consistently, the campus interviewees expressed admiration and utmost respect for the work of their campus leadership, administration and IT departments in the quick response to extensive, and often complex, needs of many students who needed digital equity support. Many interviewees provided exact details of how the campus had
responded to supplement needs for those students who did not have access to ensure continuity of education. It was noted that there were differing perspectives on providing expanded campus access to digital support (e.g., parking structures). While some expressed concerns on the ability of students to access support elements such as WIFI connection on campus facilities during high heat days, other interviewees expressed security concerns about expanded access due to criminal activity or use by off campus individuals.

**Communications**

This variable was explained as planning for ESL, addressing the needs of students out-of-state or country or AFN populations. This variable trended to interviewees expressing their concerns that their campus systems distribute their alerts and warnings in English only and there was a strong need for multiple languages being incorporated in the outreach, particularly for rapid events such as a wildfire. Such was the case for Chico State, one of the campuses that issues English only communications. Chico cited a concern being the Hmong staff is a growing population on the campus landscape staff and during a rapidly moving wildfire event, reaching them in an understandable way would be an issue of concern. They are in process of addressing this issue. For campuses in a highly ESL environment, the communications being only English was cited of concern. Dominguez Hills described it as being of Very High concern for their non-English speaking community and they were “not doing enough to address any of that.” While it is not reflected in current plans or the planning process, interviewee Nora Garcia reflected “boy do I have plans for them!”

**International students**

The questions related to international students and immigrant/immigration status issues were merged into one variable at the beginning of the interview process. Later it became evident that two distinct variables were needed due to the different responses that were given. For the international students, campuses trended towards expressing proactive engagement for active campus with support, supplemented with active leadership from the Chancellor’s Office on issues for the international student populations. Few campuses noted it as a high issue of concern for EM or have included it in their EM plans and planning processes. Channel Island reported a two-page annex in their planning documents. When Chico State was interviewed, the two variables were still merged as one. Chico responded that they have a small population of students international but that the office is integrated into the emergency, State Department protocols are documented, and the information is in the EM system. Therefore, the issue was of low concern due to it being addressed in their plans.

**Immigrants/immigration status issues (undocumented, DACA, etc.)**

This variable, once separated from the international students, trended towards very mixed responses. Many did not express immigrants, as being an issue of EM concern. Some did express certain immigrants, particularly DACA students, as being of high concern, but had not actively addressed immigrants/immigration status issues in their EM
plans or planning processes. Stanislaus described issues with DACA students because they have “lots of children of migrants.” They expressed this variable as a medium issue of concern and had not included it in the plans or processes. Bakersfield reported that it actively engages on immigration issues in their EM planning processes, have representatives from immigration center in their EOC group, and actively “go to them” (dreamer center) every semester for discussion. Dominguez Hills expressed this as a very high issue of concern. Reference was made to how the revoking of a related presidential order a couple of months before the interview created concerns over potential civil unrest and reflections on how it could negatively impact the EM program. Most campuses did understand the growing significance of this issue as it pertain to EM while some campuses did not see the specific connection with EM planning.

**LGBTQI**

This variable invoked widely varying responses as it pertained to the relationship between issues of the LGBTQI community and emergency management. Some campus representative inquired as to how the variable connected to EM, while some interviewees made it clear that LGBTQI concerns were not to be considered in their EM planning since everyone is seen as the same and treated equally. For other campuses, this variable had been thought out.

Bakersfield incorporates LGBTQI in its EM plans and has a consideration in sheltering, plans to place one person per room in a shelter/off campus. San Marcos EMs actively engage with the campus LGBTQI community on emergency management concerns, proactively address issues and concerns of the community, and integrate the variable in their emergency plans and process. In their planning and community outreach, San Marcos EM meets with LGBTQI groups annually to review EM processes and discuss EM procedures and discuss their specific vulnerabilities. More specifically, they look at the issues of the community members “being targeted” in their spaces and talk about what to do if there is a lock down. When the first interview question was posed asking the campus to cite their top communities of concern, CAL POLY cited LGBTQI community as their first response. As it being an issue of concern, they rated it high, and mentioned the outspoken leadership of the Dean of Students on the topic. They cited the abundance of LGBTQI organizations working to improve diversity (and champion racial equity) and shared that they all contribute to the emergency planning efforts through designated liaisons, task forces and planning groups.

**Transportation dependency**

This variable was addressed in some degree by most campuses, either through a transportation annex associated with their EOP or in evacuation planning efforts with the other campus departments. There are many circumstances that impact the transportation issues for the different campuses: some students travel from far away and come by bus or family cars, some are car dependent but more local, and others rely on local public transportation.
Los Angeles reported transportation dependency is an issue of concern because the campus is a heavily commuter campus with Metro Link adjacent to the campus. Many who work and study on campus rely on public transportation and are provided incentives. It is a problem when public transport is down or when risk is involved, such as in COVID. They have addressed the variable in their plans, as did Channel Islands, which cited transportation as a very high issue of concern and have addressed it in evacuation plans. For their campus, a number of a number of individuals experienced with transportation issues a couple of years ago during the fires. Their representative is now part of the county’s EM transportation planning effort, and the soon to be released plan includes CSU which will help the campus relieve the issues, if evacuated. Some issues on transportation dependencies were unique for those campuses where students commute from long distances, Chico State being one. At Chico, students come from a long way away. If they have to close the campus for situations such as bad AQI, and they need to evacuate, they will be asking students to go home. The issue is the time for the student’s support network to get them and concern about when to tell them to come back to campus. They have MOUs with bus contractors and are working with school districts such as Tahema county in order to move them to an evac site close.

**Linking Campus Social Resilience and Hazard Vulnerabilities**

This section brief introduces to the link between socially vulnerable populations and a particular hazard. Extensive research has been conducted on the impacts of hazards on the general population. Not all linkages have been documented or published regarding all hazard impacts on each specific population described in this document. Researching and detailed scholarly research on those linkages are beyond the scope of this assessment.

It’s important to note, the intersectional nature of what makes an individual’s personal experience and resilience to an event is played out by unique factors for that individual or population. The nuanced social vulnerabilities often come from the social and physical environment in which a person is embedded. In order to aid in further assessing campus resilience, below is a general description of the known impacts. From some hazards, the descriptions are robust, while others are only brief introductions.
Geological

Earthquake

Impacts on populations from earthquakes are complex, with long term implications on social stability for all populations. In addition to the physical impact exposure during a no-notice earthquake event and the social and logistical challenges of a recovering community, an earthquake can have lasting impacts long afterwards due to post traumatic stress disorder (PTSD).

Socioeconomic vulnerabilities of populations at risk were analyzed in the hypothetical yet scientifically realistic earthquake sequence that is being used to better understand hazards for the San Francisco Bay region during and after a magnitude-7 earthquake (mainshock) on the Hayward Fault and its aftershocks. In this study, the at-risk populations located in areas of concentrated damage are anticipated to experience longer recovery trajectories, increased long term housing displacement, and transportation impacts due to dependencies on transit dependencies. When neighborhood schools close, families with school age children may move to other areas to keep their children in schools. Persons with access and functions needs are likely to be more dependent on access to functioning medical, social and personal health care services that would be overwhelmed by the event and therefore increasing their vulnerabilities. For the homeless populations, the loss of social community services and damages to shelters could add to protracted relocations. For the young and mobile populations who rent, the major disruption to housing, jobs and transit will also drive relocation. Widespread housing damage and preexisting housing market constraints will make it “extremely challenging” for the socially and economically vulnerable populations to find alternative housing near their home communities. Those who utilize interim and irregular housing for months and years after a disaster are more vulnerable to physical, social, and mental disorders, including suicide, substance abuse, and physical and verbal abuse. Aftershocks and post disaster conditions delay population return and increase outmigration.213

Landslides

Although infrastructural losses are of secondary importance to the risk to humans themselves, research investigating the vulnerability of people to landslides is rare. The many reasons for this lack of data are related to the fact that the collapse of occupied buildings which makes it a function of structural vulnerability and therefore, indirect. The degree of vulnerability to landslides by an individual considered at high risk, or even the general populations, also depends on human behavior, including many of the traditional

social factors that are difficult to measure such as situational awareness, prior knowledge of hazards, and decision-making capabilities.214

**Volcanoes**

There has been limited analysis on the full social and economic impacts of volcanic eruptions, but known impacts show extensive disruption to livelihoods, through evacuation or destruction of land and resources. Typically, indirect fatalities happen across even longer time scales than primary fatalities, and so social processes associated with wellbeing and secure livelihoods are even more likely to be a driver for risky behavior.215 Access to warning systems or neglecting warning system impact decisions to leave. A volcanic eruption can impact health. Ashfall from volcanoes contain carbon dioxide and fluorine, gases that can be toxic to humans, and can collect in volcanic ash. The resulting ashfall can lead to crop failure, animal death and deformity (impacting financial security for those dependent on farming), and human illness. Ash's abrasive particles can scratch the surface of the skin and eyes, causing discomfort and inflammation. Further effects are the deterioration of water quality, fewer periods of rain, crop damages, and the destruction of vegetation. During volcanic eruptions and their immediate aftermath, increased respiratory system morbidity has been observed as well as mortality among those affected by volcanic eruptions. Health hazards can range from minor to life threatening. Exposure to acid gases such as sulfur dioxide, hydrogen sulfide, and hydrogen chloride can damage eyes and mucous membranes along with the respiratory system and, under extreme conditions, can lead to death.216

Although ashfall is typically a nonlethal volcanic hazard, it is the most widespread and disruptive. Falling ash can damage crops, electronics, and machinery. It can also impact human health by irritating the respiratory tract, eyes, and skin. The particles may enter drinking water and structures and may cause structure failure if it is thick and heavy enough. Even a fine layer of ash can disrupt utilities. A portion of California's major electric transmission lines, aerial telecommunication lifelines, transportation corridors, and water storage and conveyance lie within the state’s volcano hazard zones.

The potential impacts of gases released during volcanic eruptions are as follows:

- Carbon dioxide typically becomes diluted very quickly and is not life threatening. However, it can become trapped in higher concentrations in low-lying areas and has the potential to be fatal.

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- Sulfur dioxide can cause acid rain and air pollution downwind of a volcano.
- Hydrogen sulfide can cause irritation of the upper respiratory tract. At high concentrations it can cause unconsciousness and death.

Hydrogen halides can coat ash particles and once deposited, poison drinking water, agricultural crops, and grazing land.

**Water**

*Dam and Levy Failure*

Risk from dam and levy failure are infrastructural losses. The degree of vulnerability to these events and their impacts depends on human behavior and the traditional social factors such as situational awareness, prior knowledge of hazards, social capital and decision-making capabilities, as well as increased vulnerability due to social factors, such as racial and economic disparities.

*Erosion*

Risk from erosion relates to earthen and infrastructural losses. The degree of vulnerability to these events and their impacts depends on human behavior and the traditional social factors such as situational awareness, prior knowledge of hazards, social capital and decision-making capabilities, as well as increased vulnerability due to social factors, such as racial and economic disparities.

*Landslide*

Risk from landslide relates to earthen and infrastructural losses. The degree of vulnerability to these events and their impacts depends on human behavior and the traditional social factors such as situational awareness, prior knowledge of hazards, social capital and decision-making capabilities, as well as increased vulnerability due to social factors, such as racial and economic disparities.

Landslides can result in primary lifeline failures through the loss of roads or power and communication lines. Transportation routes are often expensive to clean up, and prolonged obstruction can disrupt the movement of people and goods.

*Sea Level, Tsunami*

Tsunamis can leave individuals homeless and without resources after an event and be psychologically damaging long term. The contaminated water and food supplies pose a risk to people’s health. Flood waters can carry many sources of contamination such as dirt or oil, and infectious diseases.

Risk from tsunami and sea level rise are secondary impacts relating to, water inundation, infrastructural losses, and changes in hydrology and land use. The degree of vulnerability to these events and their impacts depends on human behavior and the traditional social factors such as situational awareness, access to alerts and warnings, cultural understanding of the alerts and warnings, prior knowledge of hazards, social capital and decision-making capabilities, as well as increased vulnerability due to other social factors.
Tsunamis can destroy homes, change landscapes, seriously impact local economies, spread disease and kill people living within the tsunami inundation zone. The threat of disease comes from a mix of fresh water, sewage and salt water. The force of the tsunami wave may kill people instantly or they may drown as water rushes on the land. People are killed through flooding, hit by floating debris or being thrown into buildings and walls. Additionally, there threat of collapsed buildings, electrocution and explosions from gas and damaged tanks. Those impacted often suffer psychological problems such as PTSD afterwards.\textsuperscript{217}

For sea level rise, the water finding its way to farms and reservoirs can harm drinking water and the ability to grow crops, impacting those financially dependent on farming. It exacerbates the issues related to increased severity of storm-surge events. Research is now seeking to better understand the serious risks posed by SLR and the potential for socially vulnerable populations to be disproportionally impacted by these risks. One analysis indicated that many socially disadvantaged Americans living in coastal areas are very likely to be disproportionately affected by SLR. “While there have been significant research efforts focusing on the distributional and equity aspects of greenhouse gas mitigation policies, such as carbon taxes and revenue redistribution schemes (BEJEAP 2010), there has been less focus on distributional implications of impacts, and even less on distributional implications of adaptation actions.” \textsuperscript{218}

\textbf{Flood}

Risk from floods relates to community risk, exposure and infrastructural losses. The degree of vulnerability to these events and their impacts depends on human behavior and the traditional social factors such as situational awareness, prior knowledge of hazards, social capital and decision-making capabilities. The exposure of humans to floods continues to increase, driven by changes in hydrology and land use. The adverse impacts on socially vulnerable populations are amplified because a disproportionately high number live in flood-prone areas. Research has shown that places of social vulnerabilities are places characterized by housing and racial disparities, such as mobile home parks, structural fragility and poverty, and higher percentages of populations such as Black and Native Americans, and others with shared histories of discrimination, marginalization and exclusion. \textsuperscript{219}

Health impacts from flooding are well recognized due to the extensive history of flooding in California and around the nation. The impacts range from waterborne illnesses from contaminated waters, respiratory illnesses that impact the lungs, throat, and airways from airborne particles, mold on flooded buildings that can trigger asthma, allergies and other


illnesses—all which are particularly impactful to older, younger and individuals with pre-existing health condition. Foodborne illnesses can increase if there are issues with power outages or sewer overflows. Individuals with increased mental health concerns can be impacted by the stress or anxiety from the impacts of the flood. Poor quality housing can increase vulnerability to many flood risks, including flood inundation, power outages, mold growth, rodent vectors, and serious health impacts. For those with limited finances, flood inundation and impacts to infrastructure or farmlands may lead to extensive income losses.

The poorest residents suffer disproportionately to flood situations, especially those who have been less able to fund homeowner’s insurance to protect against flood losses. Loss of life is not unusual in flooding situations, as is loss of property, livestock, pets, workplaces, and tourist industries. There is a strong interrelationship between water events and other hazards. Flooding, storms and water quality are related to each other. Drought conditions can exacerbate floods as the surface soils are hardened and not as ready to allow surface water absorption. Extreme heat events can cause snowmelt, inundating waterways and causing flood and water quality issues. Flooding and storm events can have impacts on public health, environmental health, agricultural health and economic system health. Mental health issues are reported for all people who have experience flood losses, including anxiety, fear, anger, sadness and grief. Additionally, waterborne disease outbreaks are reported weeks after the flood events. Mold contamination leads to indoor air issues. Damp indoor environments lead to increased prevalence of asthma, and also upper and lower respiratory symptoms.

These issues may influence the diverse CSU populations, both on and off campus, in a number of ways long after a flood event, or the related hazards impacts, has concluded.

**Severe Weather**

**Tornado/High Wind**

Public health risks and impact of tornadoes in these settings are not well investigated with mainly studies focused on death and injury. Wind speeds from tornadoes and high winds can destroy buildings, cause automobiles to become airborne, and turn debris into flying missiles. When sucked up into the winds. Impacts from tornadoes and high winds are known to damage and destroy mobile homes, often built with lighter-weight materials than regular houses, and much more affordable and therefore financial accessible for individuals on limited incomes. Children and older adults may be at a greater risk of death and injury due to pre-existent medical illnesses, poor mobility, decreased ability to respond to tornado warnings, and greater susceptibility to injuries. More social vulnerability work is now examining linkages between risk and lack of understanding of risk communications, such as alerts and warnings. The issue of language barriers as well as access to hearing an alert put communities at higher risks as tornadoes can strike quickly with little or no warning, giving those in impacted areas barely enough time to take shelter. Individuals with mental health issues may be at higher risk. Because of the unpredictable nature of tornadoes and severe storms, it’s normal for people to experience emotional distress. Feelings such as overwhelming anxiety, trouble sleeping, and other depression-like symptoms are common responses to these types of disasters. Symptoms of distress may appear before, during, and after a tornado or severe storm and may manifest in the hours, days, weeks, months, or even years after the storms occur. For individuals in high places of risk, in substandard housing, and limited financial support, these events may impact on a short- and long-term basis.

**Hail**

**Extreme Temps**

People susceptible to respiratory ailments (asthma, lower and upper respiratory disease) disproportionately suffer from the effects of fire, smoke, air pollutions, allergens, heat and PSPS. Those with limited income or without resources are affected disproportionately due to the inability to provide safe shelter, air conditioning, cooling, air purification, medical care, and quality foods, and are also least able to obtain information related to climate risks and adaptation strategies.

**Heat**

Heatstroke, cardiovascular disease, respiratory disease and cerebrovascular disease are related to extreme heat events. Increased number of heat waves creates heat-related physical stress on populations and is exacerbated in the metropolitan areas where

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greater amounts of heat-absorbing surfaces (e.g., asphalt and concrete) trap heat and emit higher temperatures throughout the night.

The heat also extends the geographic range and the distribution of disease-carrying insects and pests. Health professionals are concerned that California’s warming climate will allow species to acclimate. Such vectors include such pests as ticks that carry Lyme disease, and mosquitoes that transmit Zika, dengue fever, West Nile, plague and tularemia. Some others, such as chikungunya, Chagas disease, and Rift Valley fever virus, are threats as well.

Some communities of color and some low-income, homeless, and immigrant populations are more exposed to heat waves, as these groups often reside in urban areas affected by heat island effects. In addition, these populations are likely to have limited adaptive capacity due to a lack of adequately insulated housing, inability to afford or to use air conditioning, inadequate access to public shelters such as cooling centers, and inadequate access to both routine and emergency health care. These social, economic, and health risk factors give rise to the observed increase in deaths and disease from extreme heat in some immigrant and impoverished communities.

Heat stroke, the most serious heat-related illness, occurs when the body is unable to control its temperature. Body temperature rises rapidly, the sweating mechanism fails, and the body cannot cool down. In extreme causes, heat stroke can cause confusion and unconsciousness, so the victim is unable to seek treatment without assistance.

There are several groups of people who are uniquely vulnerable to the effects of extreme heat, such as infants and children, older adults aged 65 and up, athletes and outdoor workers, low-income households, and individuals with certain chronic medical conditions.

When dealing with an extreme heat event, the most common impacts are those generally felt by the people living in the targeted area. For people in particular, heat can kill when the body is pushed beyond its limits. Most heat disorders occur because the victim has been overexposed to heat. As discussed, the major human risks associated with extreme heat include dehydration, sunburn, fatigue, heat exhaustion, heat stroke, and in severe cases, death.

Some portions of the population are more at risk to the effects of extreme heat. The very young, the elderly, and certain groups with chronic medical conditions (such as asthma or other pulmonary illnesses, heart disease, poor blood circulation, neurological illnesses, and obesity) are generally more vulnerable to the effects of extreme heat, and are more likely to suffer illness or death as a result.

This is especially true if exposure is extended for a period of time and preventative measures are not taken immediately.
Cold

Research shows that excess morbidity and mortality occurs during cold weather periods. We critically reviewed evidence relating temperature variability, health outcomes, and adaptation strategies to cold weather. Health outcomes included cardiovascular-, respiratory-, cerebrovascular-, and all-cause morbidity and mortality. Individual and contextual risk factors were assessed to highlight associations between individual- and neighborhood- level characteristics that contribute to a person’s vulnerability to variability in cold weather events.

Skin exposure to cold weather may render one susceptible to adverse health outcomes. Respiratory tract infections are more likely to occur during periods of low temperatures and low humidity. Socioeconomic indicators related to morbidity and mortality do not appear to strongly contribute to a person’s susceptibility to cold weather. However, the role of socioeconomic status is not clear as some evidence implies that income disparities and fuel poverty contribute to cold-related mortality.

The greatest danger from extreme cold is to people, as prolonged exposure can cause frostbite or hypothermia, and can become life threatening. When someone is suffering from hypothermia, body temperatures can become so low that they affect the brain, making it difficult for the victim to think clearly or move well. In the case of frostbite, the frozen tissue becomes numb and the victim may be unaware that anything is wrong until someone else notices. This makes hazards from extreme cold particularly dangerous, as people may not understand what is happening to them or what to do about it.

The primary hazards from extreme cold are frostbite and hypothermia. Frostbite is caused by freezing of the skin and underly tissue. It causes a loss of feeling and color in the affected areas of the body, and most often affects the nose, chin, fingers, or toes. It can be permanently damaging if not treated promptly and can lead to infection, nerve damage, or amputation in severe cases. The risk of frostbite is increased in people with preexisting conditions, the elderly, people with reduced blood circulation, and people who are not dressed warmly enough for the conditions.

Hypothermia occurs when the body loses heat faster than it can produce heat, causing a dangerously low body temperature. A normal body temperature is around 98.6° F. Hypothermia occurs when your body temperature falls below 95° F. As this happens, the heart and other essential organs cannot work properly. If hypothermia is not treated, it can lead to heart failure, respiratory failure, and eventually to death.


Wildfire

Increased wildfire threat occurs especially in the end of fall, when conditions are driest, but before the winter rains have come; an east-to-west wind gusts exacerbate fire risk. Wildfire threats have the concomitant threat of Public Safety Power Shutoffs (PSPS). And, in the case of an actual wildfire, danger exists both from fire and from the smoke. Recent wildfires have demonstrated that some demographics are disproportionately affected. Native Americans are six times more likely to be affected than white people. Blacks and Hispanic people are 50 percent more vulnerable. These values take into account the likelihood of a community being affected and the greater difficulty of that community to recover. These statistics reflect the lack of access to resources to pay for insurance, to rebuild and recover, to implement fire safety measures, and to access other resources. Price gouging after a fire (such as documented in Sonoma County after the 2017 Tubbs Fire) further exacerbates the disparity. \(^{224}\) Furthermore, the disabled and the elderly are at particular risk from extreme wildfire conditions, as they are often not as able to effectively evacuate. Of the 85 people who died in the Camp Fire in Butte in 2018, 62 of them were at least 65 years old.\(^{225}\)

Smoke from wildfires creates a significant public health threat. Especially vulnerable are individuals who have heart or lung issues, such heart disease, lung disease or asthma. Those most vulnerable include the medically fragile, elderly and children. Air Quality Indexes track the level of the following: particulate matter, surface levels of ozone, carbon monoxide, sulfur dioxide, and nitrogen dioxide. All of these can cause respiratory distress and harm lungs. \(^{227}\)

The California Department of Public Health reports the increased public health risks, and risk indicators that include: heat-related ED visits, populations living in wildfire areas, adults with multiple chronic conditions, populations living in poverty, race/ethnicity, outdoor workers, public transit access, air conditioner ownership and tree canopy. \(^{228}\)


Drought

The 2012-2016 drought had severe effects on two vulnerable sectors of our population: those in low-income brackets, and those, especially Native Americans, who rely on subsistence fishing for their livelihoods.\textsuperscript{229} Water bills increased throughout the state. Due to rising water prices, for the working poor, many have paid four to five percent of their income for water. Since many CSU students are commuters, and many living with families, future drought impacts may potentially affect a percentage of non-resident students. NASA’s modeling shows that future droughts are likely to last longer and be more intense, even leading to “megadroughts” in the western states.\textsuperscript{230} Fresh water supplies are predicted to be full of extremes, with both droughts and extreme precipitation events being more severe. The interrelationship between drought and other hazard conditions may lead to a set of secondary impacts. Drought conditions lead to water quality issues due to loss of drinking water, increased fire danger that leads to drought-induced fires and elevated AQI levels, as well as extreme heat or prolonged heat events. (sac annex)

Hazmat

The severity of a hazardous materials release depends upon the type of material released, the amount of the release, and the proximity to populations or environmentally sensitive areas such as wetlands or waterways. The release of materials can lead to injuries or evacuation of nearby residents. Wind direction at the time of the release can also have a bearing on the severity (as well as the location and extent) of a hazardous materials release.

Potential Impacts of the Hazard

The primary threat from the hazardous materials incident hazard is to the structures located along transmission lines and transportation routes or near facilities that use or store hazardous materials. Minor incidents would likely cause no damage and little disruption, assuming they could be contained quickly. Major incidents could have fatal and disastrous consequences. The severity of a hazardous material release relates primarily to its impact on human safety and welfare and on the threat to the environment.

Threats to human safety and welfare include:

- Poisoning of water or food sources and/or supply
- Presence of toxic fumes or explosive conditions
- Damage to personal property
- Need for the evacuation of people

- Interference with public or commercial transportation

Environmental risks are not uniformly distributed across groups of people. Age, poverty, and minority status place some groups at a disproportionately high risk for environmental disease.

231 Poor access to health information and health care means less health promotion, less risk avoidance, a less healthy diet, and more adverse conditions that increase susceptibility to exposure. Delayed recognition of exposure, diagnosis, and treatment allows effects to accumulate. 232

directs specific funds to be spent on emergency preparedness campaigns and outreach focusing on “California’s most vulnerable populations, including the elderly, disabled, and those in disadvantaged communities.”

The term “disadvantaged communities” along with a state focus upon them began with AB 32 (California Global Warming Solutions Act of 2006. AB-32. 2005-2006 (2006), which directed the public investment associated with that bill towards “the most disadvantaged communities in California.” This term was further defined in SB 535 (California Global Warming Solutions Act of 2006: Greenhouse Gas Reduction Fund. SB-535. 2011-2012 (2012) which stated:

“The California Environmental Protection Agency shall identify disadvantaged communities for investment opportunities related to this chapter. These communities shall be identified based on geographic, socioeconomic, public health, and environmental hazard criteria, and may include, but are not limited to, either of the following:

- “(a) Areas disproportionately affected by environmental pollution and other hazards that can lead to negative public health effects, exposure, or environmental degradation.
- “(b) Areas with concentrations of people that are of low income, high unemployment, low levels of homeownership, high rent burden, sensitive populations, or low levels of educational attainment.”

The second consideration was a desire to unify the focus here with other actions already undertaken by the State to address hazard vulnerability. This importantly includes the information contained in the 2018 State Hazard Mitigation Plan. This plan was developed by the Governor’s Office of Emergency Services and gives guidance to hazard mitigation efforts in the state. It includes a hazard vulnerability assessment based upon a

231 https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3222496/
consideration of major hazard event types and socio-economic and demographic characteristics related to vulnerability and resilience.

The social vulnerability index used in the 2018 SHMP is of particular interest in the context of this work. Social vulnerability was there described as representing “the cumulative influence that socio-economic and demographic characteristics exert on differential hazard outcomes.” The social vulnerability index included in the 2018 SHMP can therefore also be used in the identification of disadvantaged communities.

**Power Outage/Public Safety Power Shutdowns (PSPS)**

Loss of power creates economic hardship to a region experiencing regular PSPS events, such as those experienced throughout the state over the recent years. Many businesses close, including gas stations, grocery stores, and local retail establishments. These impacts may deeply impact students dependent on support jobs, as well impacting family members of campus staff and faculty. PSPS increases risks to the public due to inability to use medical devices, spoilage of food and medicines, and disruption to infrastructure, such as supply of clean water and electricity used to run home medical equipment, such as lift chairs and ventilators.

**Communicable Diseases**

Next Steps

The indicators and reflections in this assessment provide a valuable starting point for further honing the stakeholder engagement process and gathering stakeholder input. It offers guidance for conducting educational outreach. Offering emergency management presentations and distributing information packages to the different groups listed in the assessment may be a valuable option. For example, outreach to campus’s LGBTI organizations, as is being proactively conducted on one campus, may be a financial investment worthy of consideration, if that need were appropriate for the campus. Gaining accurate situational awareness will guide the determination of mitigation measures targeting the social demographic needs and existing social capital support on campus. This requires thoughtful research, and inclusive approaches to drive the investments for the campus’s unique community.
Section 04
California State University, Bakersfield

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4.1 University Profile

University History

Following the creation of the California State Colleges system, Bakersfield was selected as a site for a new four-year university. The school was established as Kern State College in 1965 and founded as California State College, Bakersfield (CSU Bakersfield) in 1968. Twenty years later, the school was granted university status and adopted its present name. Today, the school includes four colleges and is classed as a Master’s College by the Carnegie Institute. In 2015, CSU Bakersfield was selected for the Carnegie Foundation for the Advancement of Teaching’s Community Engagement Classification, recognition for exemplary institutionalized community engagement. It is designated as a federally recognized Hispanic-Serving Institution (HSI).

University Governance

The campus president is the chief executive officer who oversees the administration of the entire university. The president manages campus operations and fundraising, sets campus priorities, and oversees the hiring and support of staff and faculty. The president also maintains a close working relationship with the CSU’s systemwide office, reporting to the chancellor and participating in the systemwide Executive Council.

The provost is the chief academic officer of the university, overseeing all academic affairs and programs of the university. The provost reports directly to the president.

The Academic Senate recommends to the president policies and procedures that support the university’s mission. It consists of twenty-four members, twenty of whom are elected faculty. There are four committees of the Senate which support academic affairs, faculty affairs, student services, and budget and planning.

The division of Business and Administrative Services on campus is responsible for fiscal and support services, facilities management, and safety and risk management.

University Mission

“CSU Bakersfield will be a model for supporting and educating students to become knowledgeable, engaged, innovative, and ethical leaders in the regional and global community.”

CSU Bakersfield outlines five goals in support of their mission and vision. The priorities are directed towards strengthening and advancing faculty, staff, and student success and learning; working together with the community to address regional needs; diversifying and stewarding campus resources; and developing high-quality academic programs and supports.

University Location

The CSU Bakersfield main campus comprises 375 acres in the city of Bakersfield, home to 350,000 residents. Located in central California in the San Joaquin Valley, the campus and
city are found in one of the most productive agricultural (by value) and oil-producing counties in the United States. City limits extend to the Sequoia National Forest, at the foot of the Greenhorn Mountain Range, and to the Temblor Range, behind which is the San Andreas Fault. Along with the main campus, CSU Bakersfield operates a satellite campus in Lancaster, CA, CSU Bakersfield - Antelope Valley (CSUB AV).

**University Population**

Typically, enrollment at CSU Bakersfield falls slightly above or below 10,000 per semester. In fall 2019, the 11,200-student population was overwhelmingly made up of undergraduate degree seekers, 78% of whom are under the age of 25. Hispanic students make up 63% of CSU Bakersfield students, with white students making up the second most populous group at 16%.

In addition to the student population, the University is home to 1,277 employees, 50.6% of whom are faculty.

**4.2 Interim Final Rule for Hazard Vulnerability and Risk Assessment**

**Requirement §201.6(c)(2):** The plan shall include a risk assessment that provides the factual basis for activities proposed in the strategy to reduce losses from identified hazards. Local risk assessments must provide sufficient information to enable the jurisdiction to identify and prioritize appropriate mitigation actions to reduce losses from identified hazards.

**Requirement §201.6(c)(2)(i):** [The risk assessment shall include a] description of the type...location and extent of all natural hazards that can affect the jurisdiction. The plan shall include information on previous occurrences of hazard events and on the probability of future hazard events.

**Requirement §201.6(c)(2)(ii):** [The risk assessment shall include a] description of the jurisdiction’s vulnerability to the hazards described in paragraph (c)(2)(i) of this section. This description shall include an overall summary of each hazard and its impact on the community.

**Requirement §201.6(c)(2)(ii):** [The risk assessment] must also address National Flood Insurance Program (NFIP) insured structures that have been repetitively damaged floods.

**Requirement §201.6(c)(2)(ii)(A):** The plan should describe vulnerability in terms of the types and numbers of existing and future buildings, infrastructure, and critical facilities located in the identified hazard area.

**Requirement §201.6(c)(2)(ii)(B):** [The plan should describe vulnerability in terms of an] estimate of the potential dollar losses to vulnerable structures identified in paragraph (c)(2)(ii)(A) of this section and a description of the methodology used to prepare the estimate...

**Requirement §201.6(c)(2)(ii)(C):** [The plan should describe vulnerability in terms of] providing a general description of land uses and development trends within the community so that mitigation options can be considered in future land use decisions.
Requirement §201.6(c)(2)(iii): For multi-jurisdictional plans, the risk assessment must assess each jurisdiction’s risks where they vary from the risks facing the entire planning area.

4.3 Hazard Identification and Risk Assessment

Overview of California State University, Bakersfield History of Hazards

Numerous federal agencies maintain a variety of records regarding losses associated with hazards. Unfortunately, no single source is considered to offer a definitive accounting of all losses. The Federal Emergency Management Agency (FEMA) maintains records on federal expenditures associated with declared major disasters. The US Army Corps of Engineers (USACE) and the Natural Resources Conservation Service (NRCS) collect data on losses during the course of some of their ongoing projects and studies. Additionally, the National Oceanic and Atmospheric Administration’s (NOAA) National Centers for Environmental Information (NCEI) database collects and maintains data about natural hazards in summary format. The data includes occurrences, dates, injuries, deaths, and estimated costs. Many of these databases and other data collection services, including the NCEI, have inherent data limitations when searching for information at a university scale.

The best available data and records were used throughout this assessment.

Hazard Identification

As part of the initial hazard identification process, the Bakersfield Campus Assessment Team considered potential hazards with the most chance to significantly affect the planning area. The hazards include those that have occurred in the past and may occur in the future. A variety of sources were used to develop the list of hazards considered including national, regional, and local sources such as emergency operations plans, FEMA’s How-To Series, websites, published documents, databases, and maps, as well as discussion among the Campus Assessment Team members.

In the initial phase of the planning process, the Campus Assessment Team considered 14 hazards and the risks they create for the University and its material assets, population, and operations. The hazards initially considered, and the determinations as to the treatment of those hazards, are shown in Table 4-1 (following).

Table 4-1: Hazard Identification Determinations

<table>
<thead>
<tr>
<th>Hazard</th>
<th>Determination (Yes/No)</th>
<th>Reason for Determination</th>
<th>Future Occurrence Probability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Communicable Disease</td>
<td>Yes</td>
<td>Hazard of concern for campus</td>
<td>Highly Likely</td>
</tr>
<tr>
<td>Dam and Levee Failure</td>
<td>Yes</td>
<td>Hazard of concern for campus</td>
<td>Unlikely</td>
</tr>
<tr>
<td>Hazard</td>
<td>Occurrence</td>
<td>Hazard of concern for campus</td>
<td>Probability</td>
</tr>
<tr>
<td>-------------------------</td>
<td>------------</td>
<td>-----------------------------</td>
<td>-------------------------------------</td>
</tr>
<tr>
<td>Drought</td>
<td>Yes</td>
<td>Hazard of concern for campus</td>
<td>Highly Likely</td>
</tr>
<tr>
<td>Earthquake</td>
<td>Yes</td>
<td>Hazard of concern for campus</td>
<td>Possible</td>
</tr>
<tr>
<td>Erosion</td>
<td>Yes</td>
<td>Hazard of concern for campus</td>
<td>Unlikely</td>
</tr>
<tr>
<td>Extreme Temperature</td>
<td>Yes - Heat; No - Cold</td>
<td>Hazard of concern for campus</td>
<td>Highly Likely (Heat Only)</td>
</tr>
<tr>
<td>Flood</td>
<td>Yes</td>
<td>Hazard of concern for campus</td>
<td>Possible</td>
</tr>
<tr>
<td>Hazardous Materials</td>
<td>Yes</td>
<td>Hazard of concern for campus</td>
<td>Possible</td>
</tr>
<tr>
<td>Landslide</td>
<td>Yes</td>
<td>Hazard of concern for campus</td>
<td>Unlikely</td>
</tr>
<tr>
<td>Power Outage</td>
<td>Yes</td>
<td>Hazard of concern for campus</td>
<td>Likely</td>
</tr>
<tr>
<td>Sea Level Rise</td>
<td>No</td>
<td>Not a hazard of concern for campus</td>
<td>N/A</td>
</tr>
<tr>
<td>Tsunami</td>
<td>No</td>
<td>Not a hazard of concern for campus</td>
<td>N/A</td>
</tr>
<tr>
<td>Volcano</td>
<td>Yes</td>
<td>Hazard of concern for campus</td>
<td>Unlikely</td>
</tr>
<tr>
<td>Wildfire</td>
<td>Yes</td>
<td>Hazard of concern for campus</td>
<td>Unlikely (Fire); Possible (Smoke)</td>
</tr>
</tbody>
</table>

**Future Occurrence Probability**

In order to determine the probability of future occurrences of each hazard profiled, the following scale was developed:

- **Highly Likely**- 76%-100% that the hazard would occur annually.
- **Likely**- 50%-75% that the hazard would occur annually.
- **Possible**- 11%-49% that the hazard would occur each annually.
- **Unlikely**- 0%-10% that the hazard would occur each annually.
Communicable Disease

Description of the Hazard

Communicable diseases are illnesses that occur due to infectious agents or their toxic products and are infectious due to their potential of transmission from one person or species to another by a replicating agent.\(^1\) They may be transmitted from a reservoir to a susceptible host either directly as from an infected person or animal or indirectly through the agency of an intermediate plant or animal host, vector, or the inanimate environment. Communicable diseases are clinically evident illness resulting from the presence of pathogenic microbial agents, including pathogenic viruses, pathogenic bacteria, fungi, protozoa, multi-cellular parasites, and aberrant proteins known as prions.\(^2\) The degree of spread of a communicable disease depends on both the ability of an organism to enter, survive and multiply in the host and the comparative ease with which the disease is transmitted to other hosts.\(^3\)

Some ways in which communicable diseases spread are by:

- Travel through the air, such as tuberculosis, measles, or COVID-19;
- Physical contact with an infected person, such as through touch (staphylococcus), sexual intercourse (gonorrhea, HIV), fecal/oral transmission (hepatitis A), or droplets (influenza, TB, COVID-19);
- Contact with a contaminated surface or object (Norwalk virus), food (salmonella, E. coli), blood (HIV, hepatitis B), or water (cholera); and
- Bites from insects or animals capable of transmitting the disease (mosquito: malaria and yellow fever; flea: plague).\(^4\)

Collectively, the twenty-three (23) campuses and Chancellor’s Office of the California State University (CSU) system have identified nine (9) communicable disease hazards that have had significant impacts on their respective student, faculty, and staff populations. Of these communicable diseases, COVID-19 is considered to be the most prominent and widespread agent across all CSU campuses. (See Table 4-2 following).

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### Table 4-2: Communicable Diseases at Identified CSU Campuses

<table>
<thead>
<tr>
<th>Collective List of Communicable Diseases Identified by All CSU Campuses</th>
<th>Number of CSU Campuses (Including Chancellor’s Office) Identifying Communicable Disease Having Significant Impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>COVID-19 (SARS-CoV-2)</td>
<td>24</td>
</tr>
<tr>
<td>Meningitis</td>
<td>7</td>
</tr>
<tr>
<td>Measles</td>
<td>6</td>
</tr>
<tr>
<td>Influenza (Including H1N1/Swine Flu)</td>
<td>6</td>
</tr>
<tr>
<td>Tuberculosis</td>
<td>5</td>
</tr>
<tr>
<td>Norovirus</td>
<td>4</td>
</tr>
<tr>
<td>Mumps</td>
<td>2</td>
</tr>
<tr>
<td>E. Coli</td>
<td>2</td>
</tr>
<tr>
<td>Sexually Transmitted Diseases (STDs)</td>
<td>2</td>
</tr>
</tbody>
</table>

(Source: Interviews with CSU campus staff at CSU campuses and at CSU Chancellor’s Office.)

With the exception of COVID-19, there is variability among CSU campuses regarding which communicable diseases have had the greatest impact on individual campus communities. Table 4-3 (following) shows the communicable disease hazards that have had the greatest impact on each CSU campus.

### Table 4-3: Communicable Disease Hazards at CSU Campuses with Greatest Impact

<table>
<thead>
<tr>
<th>CSU Campus</th>
<th>Identified Communicable Disease Hazards with the Greatest Impact on CSU Campus</th>
</tr>
</thead>
<tbody>
<tr>
<td>CSU Bakersfield</td>
<td>COVID-19, Meningitis</td>
</tr>
<tr>
<td>CSU Channel Islands</td>
<td>COVID-19, Measles</td>
</tr>
<tr>
<td>Chico State</td>
<td>COVID-19, Tuberculosis</td>
</tr>
<tr>
<td>CSU Dominguez Hills</td>
<td>COVID-19</td>
</tr>
<tr>
<td>Cal State East Bay</td>
<td>COVID-19, Meningitis</td>
</tr>
<tr>
<td>Fresno State</td>
<td>COVID-19, Meningitis, Tuberculosis</td>
</tr>
<tr>
<td>Cal State Fullerton</td>
<td>COVID-19, Influenza</td>
</tr>
<tr>
<td>Humboldt State</td>
<td>COVID-19, Measles, Norovirus, Influenza, STDs</td>
</tr>
<tr>
<td>Cal State Long Beach</td>
<td>COVID-19</td>
</tr>
<tr>
<td>Cal State LA</td>
<td>COVID-19, E. coli, Measles</td>
</tr>
</tbody>
</table>
Cal Maritime COVID-19

<table>
<thead>
<tr>
<th>Institution</th>
<th>Disease(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>CSU Monterey Bay</td>
<td>COVID-19</td>
</tr>
<tr>
<td>CSUN (Northridge)</td>
<td>COVID-19, Measles</td>
</tr>
<tr>
<td>Cal Poly Pomona</td>
<td>COVID-19, Influenza (Swine Flu - H1N1)</td>
</tr>
<tr>
<td>Sacramento State</td>
<td>COVID-19</td>
</tr>
<tr>
<td>Cal State San Bernardino</td>
<td>COVID-19, Tuberculosis</td>
</tr>
<tr>
<td>San Diego State</td>
<td>COVID-19, Meningitis, Mumps</td>
</tr>
<tr>
<td>San Francisco State</td>
<td>COVID-19</td>
</tr>
<tr>
<td>San José State</td>
<td>COVID-19, H1N1</td>
</tr>
<tr>
<td>Cal Poly San Luis Obispo</td>
<td>COVID-19, Meningitis, Norovirus</td>
</tr>
<tr>
<td>CSU San Marcos</td>
<td>COVID-19</td>
</tr>
<tr>
<td>Sonoma State</td>
<td>COVID-19, H1N1, Norovirus</td>
</tr>
<tr>
<td>Stanislaus State</td>
<td>COVID-19, Tuberculosis</td>
</tr>
<tr>
<td>Office of the Chancellor</td>
<td>COVID-19</td>
</tr>
<tr>
<td>CSU System-Wide</td>
<td>COVID-19, Meningitis, Measles, Tuberculosis, Influenza-Swine Flu-H1N1, Mumps, Norovirus, E. coli, STDs</td>
</tr>
</tbody>
</table>

*(Source: Interviews with CSU campus staff at CSU campuses and at CSU Chancellor’s Office.)*

**Descriptions of Identified Communicable Disease Hazards at CSU Bakersfield**

CSU Bakersfield (CSUB) has identified two (2) communicable disease hazards that have had the greatest impact on campus – COVID-19 and meningitis. The following are brief descriptions of the two (2) communicable disease hazards at CSUB.

**COVID-19 (SARS-CoV-2)**

Coronaviruses are a family of viruses that can cause illnesses such as the common cold, severe acute respiratory syndrome (SARS) and Middle East respiratory syndrome (MERS). In 2019, a new coronavirus was identified as the cause of a disease outbreak that originated in China. This virus is now known as the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2). The disease it causes is called Coronavirus Disease 2019 (COVID-19). In March 2020, the World Health Organization (WHO) declared the COVID-19 outbreak a pandemic.

Signs and symptoms of coronavirus disease 2019 (i.e., COVID-19) may appear two to 14 days after exposure. Common signs and symptoms can include fever, cough, and tiredness. Early symptoms of COVID-19 may also include a loss of taste or smell.

The virus that causes COVID-19 spreads easily among people, and more continues to be discovered over time about how it spreads. Data has shown that the COVID-19 virus
spreads mainly from person to person among those in close contact (within about 6 feet, or 2 meters). The virus is transmitted by respiratory droplets being released when someone with the virus coughs, sneezes, breathes, sings or talks. These droplets can be inhaled or land in the mouth, nose or eyes of a person nearby. In some situations, the COVID-19 virus can spread by a person being exposed to small droplets or aerosols that stay in the air for several minutes or hours (i.e., airborne transmission). It’s not yet known how common it is for the virus to spread this way. The COVID-19 virus can also spread if a person touches a surface or object with the virus on it and then touches his or her mouth, nose or eyes; however, this is not considered to be a main way it spreads.

The severity of COVID-19 symptoms can range from very mild to severe. Some people may have only a few symptoms, and some people may have no symptoms at all. However, some people may experience worsened symptoms, such as worsened shortness of breath and pneumonia. People who are older have a higher risk of serious illness from COVID-19, and the risk increases with age. People who have existing medical conditions also may have a higher risk of serious illness from COVID-19. In some cases, the disease can cause severe medical complications and may even lead to death.5

**Meningitis**

Meningitis is an inflammation of the fluid and membranes (meninges) surrounding the brain and spinal cord. The swelling from meningitis typically triggers signs and symptoms such as headache, fever and a stiff neck. Early meningitis symptoms may mimic the flu (influenza). Symptoms may develop over several hours or over a few days.

Most cases of meningitis in the United States are caused by a viral infection, but bacterial, parasitic and fungal infections are other causes. Some cases of meningitis improve without treatment in a few weeks. Others can be life-threatening and require emergency antibiotic treatment. Bacterial meningitis is particularly serious and can be fatal within days without prompt antibiotic treatment. Delayed treatment also increases the risk of permanent brain damage or death.6

**Location of the Hazard**

Communicable diseases have the potential to affect the entire CSU-Bakersfield planning area equally. As a result, the communicable disease hazard can be found at both the CSU Bakersfield (CSUB) main campus in Bakersfield, CA (Kern County), as well as at the CSUB-Antelope Valley satellite campus in Lancaster, CA (Los Angeles County). Because of the ubiquitous nature of many communicable diseases, students, faculty, and staff at both CSUB locations are at risk of exposure to the communicable disease hazard.7

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CSU Student Housing Locations and Populations

Although CSU-campus-owned student housing opportunities have been severely limited due to the COVID-19 pandemic, this situation is temporary. Eventually, students will be allowed back on campus at full capacity, and many of these students will be living in campus-owned housing. When this occurs at CSU-Bakersfield, approximately 560 students, or 5% of the CSU-Bakersfield total enrollment of 11,199 will be at increased risk of exposure to communicable disease hazards, owing to the “close-quarters” living arrangements in student housing. 8

Extent of the Hazard

Various communicable diseases are categorized by the Center for Disease Control and Prevention (CDC) by levels of containment called Biosafety Levels (or BSLs). The higher the BSL, the greater the level of containment and level of effort necessary to prevent transmission of the disease, and therefore the greater the hazard.

Biosafety Levels prescribe procedures and levels of containment for a particular microorganism or material (including research involving recombinant or synthetic nucleic acid molecules) and procedures associated with that containment. BSLs also consider primary barriers (e.g., biosafety cabinets), secondary barriers, facility design, air handling, laboratory security, etc. BSLs are graded from 1 to 4; as the BSL increases so does the relative risk of the agent/procedures as well the stringency of procedures and facility design.

Figure 4-1 describes the different BSLs and provides examples of communicable diseases that would typically fall into these classifications, as well as the typical protections that would be necessary to prevent transmission of each of the diseases.
The Extent of CSU Bakersfield Communicable Disease Hazards Except COVID-19:

Before the COVID-19 pandemic, there were cases of Meningitis at CSU-Bakersfield. Meningitis would be classified at the BSL-2 containment level.\(^8\,9,10\)

The Extent of CSU Bakersfield COVID-19 Communicable Disease Hazard:

As a microorganism, the SARS-CoV-2 (COVID-19) virus requires a high level of containment. It is therefore classified at BSL-3.\(^11\)

History of the Hazard

Over an approximately one-year period, from mid-March 2020 to March 23, 2021, there were a reported 148 cases of COVID-19 at CSU-Bakersfield. CSU-campus-specific COVID-19 case data for CSU-Bakersfield can be found in the *History of the Hazard* section below.

Most communicable disease data are maintained by at the state and at the county levels and are not generally available at the municipal or campus levels, unless (a) the CSU campus falls under the jurisdiction of a city-level health department, or (b) a

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A geographically specific outbreak occurs on campus or in the local community. The exception to this is the current COVID-19 pandemic, where both campus and County-level case data have been collected. As a result, it is important to provide COVID-19 case statistics for both CSU campuses and the counties where CSU campus assets are located.

Figure 4-2: County-Level and Campus-Level COVID-19 Case Data

Figure 4-2 shows County-level and campus-level COVID-19 Case data for CSU Bakersfield. These case data are updated on at least a weekly basis. (Please note that the COVID-19 case numbers here may not reflect the most recent updates, as the figure reflects the date shown from the CSU-Bakersfield COVID-19 Dashboard.)

<table>
<thead>
<tr>
<th>New Positive Reported Cases April 20-27</th>
<th>Cumulative Positive Reported Cases</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>152</td>
</tr>
</tbody>
</table>

Breakdown of Cumulative Cases

<table>
<thead>
<tr>
<th>Total Reported Positive Cases Off-Campus</th>
<th>Total Reported Positive Cases On-Campus</th>
<th>Total Recovered Reported Cases</th>
</tr>
</thead>
<tbody>
<tr>
<td>122</td>
<td>30</td>
<td>150</td>
</tr>
</tbody>
</table>

Potential Impacts of the Hazard

Communicable disease outbreaks and pandemics potentially have (and will continue to have) direct impact on life, health, and safety across the CSU system, including the CSU-Bakersfield campus. The extent of this impact is contingent on the type of infection or

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contagion, the severity of the outbreak, and the speed at which it is transmitted. Property and infrastructure integrity may be affected if large portions of the campus population contracts communicable diseases at the same time and are therefore unable to perform maintenance, operations, and educational tasks. This would be particularly disruptive if those impacted are first responders or other essential personnel. Long-term outbreaks affecting large numbers of CSU - Bakersfield students could result in cancelled classes, delayed matriculation, or other disruptions to the CSU System’s mission. This has already occurred with the current COVID-19 pandemic and could occur again with more virulent strains of communicable diseases, including COVID-19.

Communicable disease hazards found across the CSU system (including CSU – Bakersfield) vary both by level of containment (BSL) (described previously) and by level of individual/public health risk, or Risk Group (RG) level. While BSLs describe the procedures and required levels of containment in a laboratory setting, Risk Groups (RGs) reflect the potential effects of disease exposure on humans or animals. Like BSLs, RGs range from Level 1 (RG1) to Level 4 (RG4), with Level 1 (RG1) posing minimal risk to healthy individuals and public health and Level 4 (RG4) posing a very serious or extreme risks to individuals and public. BSLs generally correlate with Risk Group (RG) Levels (e.g., a RG2 agent is worked with at BSL-2), but there are exceptions (e.g., production volumes, high-risk procedures, etc.).

The World Health Organization’s (WHO) Laboratory Biosafety Manual, 3rd ed., NIH Guidelines, categorizes Risk Groups (RGs) in the following way:

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Table 4-4: WHO Risk Group Categorization

<table>
<thead>
<tr>
<th>Risk Group (RG)</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>RG1</td>
<td>Rarely associated with disease in healthy adult humans or animals and pose no-to-little public health risk (e.g., Saccharomyces cerevisiae, E. coli K-12 strain derivatives often used for recombinant/molecular biology, many environmental organisms)</td>
</tr>
<tr>
<td>RG2</td>
<td>Associated with mild to moderate disease for which preventative measures or post exposure treatments are often available; public health impact is limited (e.g., Streptococcus pyogenes, Salmonella, hepatitis B virus)</td>
</tr>
<tr>
<td>RG3</td>
<td>Associated with serious to lethal human disease for which preventative vaccines or post-exposure therapies may be scarce. Public health impact is limited-to-moderate (e.g., Mycobacterium tuberculosis, hantaviruses, West Nile virus, SARS)</td>
</tr>
<tr>
<td>RG4</td>
<td>Associated with serious to lethal human disease for which preventative vaccines or post exposure therapies are not usually available. Public health impact is high (e.g., Ebola virus, Marburg virus, smallpox virus, etc.)</td>
</tr>
</tbody>
</table>

Table 4-8 describes the four (4) Risk Group Levels (RGs), and provides examples of communicable diseases that would typically fall into these classifications, and the typical protections that would be necessary to prevent transmission of the disease. It is important to note that all but two (2) communicable disease hazards identified by CSU campuses fall under either the lower-risk RG1 or RG2 categories. COVID-19 and tuberculosis are the two (2) communicable diseases fall under the higher-risk RG3 category. However, with the advent of the recently-developed COVID-19 vaccine, and with the expectation of an increasingly robust vaccine supply, it is possible that the RG level for COVID-19 could be lowered in the future, thereby reducing both the extent and the potential impact of COVID-19.

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### Table 4-5 Risk Group Levels (RGs) with Example Diseases and Recommended Precautions

<table>
<thead>
<tr>
<th>Level</th>
<th>Examples</th>
<th>Typical Protection to Prevent Transmission</th>
</tr>
</thead>
<tbody>
<tr>
<td>RG 1</td>
<td>E. Coli</td>
<td>Precautions are minimal, most likely involving gloves and some sort of facial protection. Usually, contaminated materials are left in open (but separately indicated) waste receptacles. Decontamination procedures for this level are similar in most respects to modern precautions against everyday viruses (i.e.: washing one’s hands with anti-bacterial soap, washing all exposed surfaces of the lab with disinfectants, etc.).</td>
</tr>
<tr>
<td>RG 2</td>
<td>Chicken Pox, Hepatitis A, B, C, Lyme disease, Salmonella, Mumps, Measles, Malaria, Scrapie, Dengue Fever, HIV</td>
<td>These bacteria and viruses cause mild disease in humans or are difficult to contract via aerosol. Routine diagnostic work with clinical specimens can be done safely at BSL-2, using BSL-2 practices and procedures.</td>
</tr>
</tbody>
</table>

17 CDC/National Institutes of Health. *Biosafety in Microbiological and Biomedical Laboratories, 6th Ed.* Print. Retrieved 05.03.2021 from: [https://www.cdc.gov/labs/BMBL.html](https://www.cdc.gov/labs/BMBL.html)
Anthrax
West Nile Virus
SARS Virus (Including COVID-19)
Tuberculosis
Typhus
Yellow Fever
Hantaviruses
Avian Flu

These bacteria and viruses cause severe to fatal disease in humans, but vaccines or other treatments do exist to combat them. Laboratory personnel have specific training in handling pathogenic and potentially lethal agents and are supervised by competent scientists who are experienced in working with these agents. This is considered a neutral or warm zone.

H5N1 (Bird Flu)
Dengue
Hemorrhagic Fever
Marburg Virus
Ebola Virus
Smallpox
Lassa Fever
Crimean-Congo Hemorrhagic Fever
Other Hemorrhagic Diseases

These viruses and bacteria cause severe to fatal disease in humans, for which vaccines or other treatments are not available. When dealing with biological hazards at this level the use of a Hazmat suit and a self-contained oxygen supply is mandatory. The entrance and exit of a BSL-4 lab will contain multiple showers, a vacuum room, an ultraviolet light room, autonomous detection system, and other safety precautions designed to destroy all traces of the biohazard. Multiple airlocks are employed and are electronically secured to prevent both doors opening at the same time. All air and water service going to and coming from a BSL-4 lab will undergo similar decontamination procedures to eliminate the possibility of an accidental release.

Probability of Future Occurrence of the Hazard

There have been cases of Meningitis at CSU-Bakersfield. However, there are significant data limitations regarding meningitis disease cases, as the information is outdated, anecdotal, and/or inadequate. As a result, it is not feasible to provide quantitative probabilities of future occurrence for non-COVID-19 communicable disease hazard like meningitis. However, based on the limited data, we can present qualitative probabilities of future occurrence (Table 4-6, 4-7 below) based on ranges of communicable disease frequency.

Table 4-9 shows a probability scale of future occurrence for the nine (9) communicable disease hazards profiled in this assessment. This scale is divided into four (4) levels of probability:
Table 4-6: Likelihood of Future Hazard Occurrence

<table>
<thead>
<tr>
<th>Likelihood</th>
<th>Parameters for Determining Likelihood</th>
</tr>
</thead>
<tbody>
<tr>
<td>Highly Likely</td>
<td>76 – 100% probability that hazard will occur annually (high to very high frequency)</td>
</tr>
<tr>
<td>Likely</td>
<td>50 – 75% probability that hazard will occur annually (moderate to high frequency)</td>
</tr>
<tr>
<td>Possible</td>
<td>11 – 49% probability that hazard will occur annually (low to moderate frequency)</td>
</tr>
<tr>
<td>Unlikely</td>
<td>0 – 10% probability that hazard will occur annually (very low to low frequency)</td>
</tr>
</tbody>
</table>

Due to significant data limitations surrounding non-COVID communicable diseases, the probability of future occurrence of CSU-system-wide communicable disease is measured by the proportion of campuses that have identified a particular communicable disease as having an impact on the campus community. In this measure, the more frequent a communicable disease is seen as impactful CSU-wide, the greater the probability of future occurrence.

Note: Each communicable disease’s system-wide probability ranking (below) reflects the ranking at the individual CSU campus level unless noted otherwise.

Note: For CSU-Bakersfield, there is a higher probability of future occurrence of meningitis than CSU-system-wide, as there has been a previous outbreak of the disease on that campus.

Table 4-7: Probability of Future Occurrence of Communicable Disease Hazard for CSU Systems

<table>
<thead>
<tr>
<th>Collective List of Communicable Diseases Identified by All CSU Campuses</th>
<th>Number of CSU Campuses (Including Chancellor’s Office) Identifying Communicable Disease Having Significant Impact</th>
<th>Proportion of CSU Campuses Identifying Communicable Disease as Having Significant Impact System-Wide</th>
<th>CSU System-Wide Probability Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>COVID-19 (SARS-CoV-2)</td>
<td>24</td>
<td>1.00</td>
<td>Highly Likely</td>
</tr>
<tr>
<td>Meningitis</td>
<td>7</td>
<td>0.29</td>
<td>Possible</td>
</tr>
<tr>
<td>Measles</td>
<td>6</td>
<td>0.25</td>
<td>Possible</td>
</tr>
<tr>
<td>Influenza (Including H1N1/ Swine Flu)</td>
<td>6</td>
<td>0.25</td>
<td>Possible</td>
</tr>
<tr>
<td>Tuberculosis</td>
<td>5</td>
<td>0.21</td>
<td>Possible</td>
</tr>
</tbody>
</table>
Norovirus | 4 | 0.17 | Possible
---|---|---|---
Mumps | 2 | 0.08 | Unlikely
E. Coli | 2 | 0.08 | Unlikely
Sexually Transmitted Diseases (STDs) | 2 | 0.08 | Unlikely

(Source: Interviews with staff at CSU campuses and at the CSU Chancellor’s Office.)

Vulnerability to the Hazard

Vulnerability to a communicable disease hazard resides in the population of a given area – both human and animal – not in the infrastructure or physical assets. While CSU assets and infrastructure could be impacted indirectly by the communicable disease hazard, these impacts would be secondary to the impact that the communicable disease hazard would have on students, faculty, staff, and visitors at the CSU - Bakersfield campus.

CSU campus settings are geographically diverse, with locations ranging from small towns to medium-sized cities to densely populated urban areas. Hundreds of thousands of people work, study, and/or pass through CSU campuses on any given day. (As of Fall 2019, CSU - Bakersfield had 11,199 students as well as additional staff and faculty.18,19 Each of these persons is vulnerable to communicable disease, particularly if it is a pathogen that individual has not been immunized against, or for which no immunization exists. Prolonged outbreaks could result in a loss of services, failure of infrastructure (from lack of operators or maintenance), and closure of facilities. This exact scenario has played out in the current COVID-19 pandemic on the CSU – Bakersfield campus.

Estimate of Potential Losses

The COVID-19 Pandemic Health Impact on CSU Campuses and Surrounding Communities

The most prescient metric for estimating losses from COVID-19 is loss of life. The nationwide campus-related COVID-19 death rate of 0.02% remains well below the average COVID-19 death rate in the U.S. However, due to data limitations, there is no information on CSU-campus-specific deaths by COVID-19 or by any other communicable diseases. In fact, COVID-19 is the only communicable disease for which case reports have been readily available for CSU campuses.

At some point in the future, CSU campuses will return to full capacity. Without adequate surveillance regarding campus access and student and employee interaction, CSU campuses (including CSU – Bakersfield) are at risk of developing an extreme incidence of

18 The California State University. Enrollment. Retrieved 05.03.2021 from: https://www2.calstate.edu/csu-system/about-the-csu/facts-about-the-csu/enrollment/Pages/default.aspx
19 The California State University. Employee Head Count by Campus. Retrieved 05.03.2021 from: https://www2.calstate.edu/csu-system/faculty-staff/employee-profile/csu-workforce/Pages/employee-headcount-by-campus.aspx
COVID-19, and may become “super-spreaders” for adjacent communities.\textsuperscript{20} The emergence of more virulent COVID-19 variants would only add to the potential for high negative impacts on life safety, operations, and service delivery across the CSU system. (Other communicable diseases would also re-emerge, but with low to moderate negative impacts on life safety, operations, and service delivery.)

**Economic Impact of COVID-19 Pandemic on CSU Financial Health**

During the first few months of the COVID-19 pandemic in 2020, the CSU system suffered tremendous negative fiscal impacts. From March through July of 2020 alone, over $146 million worth of revenue losses were sustained across the CSU system due to refunds to students for parking, housing and dining service fees during Spring Semester, 2020. (See Figure 4-5 below for the economic impact to the CSU – Bakersfield campus). Several CSU campuses saw refund losses surpass $10 million. (See Figure 4-5.)

*Figure 4-5: CSU COVID-19 Cost Tracking Showing Revenue Refund Losses and Increased Costs*\textsuperscript{21}

<table>
<thead>
<tr>
<th>Department of Finance - BL 20-07 - COVID-19 Cost Tracking</th>
</tr>
</thead>
<tbody>
<tr>
<td>As of July 2020 (Dollars in Thousands)</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td><strong>Campus</strong></td>
</tr>
<tr>
<td>-----------------------------------------------------------</td>
</tr>
<tr>
<td>Bakersfield</td>
</tr>
<tr>
<td>Chancellor's Office</td>
</tr>
<tr>
<td>Channel Islands</td>
</tr>
<tr>
<td>Chico</td>
</tr>
<tr>
<td>Dominguez Hills</td>
</tr>
<tr>
<td>East Bay</td>
</tr>
<tr>
<td>Fresno</td>
</tr>
<tr>
<td>Fullerton</td>
</tr>
<tr>
<td>Humboldt</td>
</tr>
<tr>
<td>Long Beach</td>
</tr>
<tr>
<td>Los Angeles</td>
</tr>
<tr>
<td>Maritime Academy</td>
</tr>
<tr>
<td>Monterey Bay</td>
</tr>
<tr>
<td>Northridge</td>
</tr>
<tr>
<td>Pomona</td>
</tr>
<tr>
<td>Sacramento</td>
</tr>
<tr>
<td>San Bernadino</td>
</tr>
<tr>
<td>San Diego</td>
</tr>
<tr>
<td>San Francisco</td>
</tr>
<tr>
<td>San Jose</td>
</tr>
<tr>
<td>San Luis Obispo</td>
</tr>
<tr>
<td>San Marcos</td>
</tr>
<tr>
<td>Sonoma</td>
</tr>
<tr>
<td>Stanislaus</td>
</tr>
</tbody>
</table>

| CSU System Total | 5,461 | 8,597 | 3,035 | 30,828 | 47,921 | 146,149 | 194,070 |

**Mitigative Relief from Federal Assistance**

The $1.5 billion in total federal assistance sent to the CSU system will help relieve the losses of revenues from services like dorms, parking and dining services during a year of


mainly empty campuses. (See Table 4-8) However, because of staggering COVID-related revenue losses, the CSU system is planning for three (3) years of fiscal duress.

Note: See Table 4-8 for Relief figures for the CSU – Bakersfield campus.

*Table 4-8: Total Federal Assistance to CSU for COVID-19-Related Losses, 2020 – 2021*[^22] |[^23] |[^24]
--- | --- | --- | ---
**Institution** | **December 2020 Stimulus** | **CARES Act** | **APLU Projection of HEERF Total ARP Act Funding Allocation** | **Total Estimated Federal COVID Relief Funding**
--- | --- | --- | --- | ---
California Polytechnic State University | $20,752,799 | $14,725,000 | $37,000,928 | $72,478,727
California State Polytechnic University, Pomona | $48,614,353 | $31,102,000 | $86,044,649 | $165,761,002
California State University Channel Islands | $14,288,099 | $8,512,000 | $24,915,170 | $47,715,269
California State University Maritime Academy | $1,381,700 | $1,204,000 | $2,472,622 | $5,058,322
California State University - Sacramento | $59,891,260 | $35,643,000 | $104,900,133 | $200,434,393
*California State University, Bakersfield* | **$22,855,632** | **$12,483,000** | **$40,285,565** | **$75,624,197**
California State University, Chico | $31,603,856 | $20,019,000 | $55,754,538 | $107,377,394


<table>
<thead>
<tr>
<th>Institution</th>
<th>Revenues</th>
<th>Direct Costs</th>
<th>Indirect Costs</th>
<th>Total Costs</th>
</tr>
</thead>
<tbody>
<tr>
<td>California State University, Dominguez Hills</td>
<td>$31,843,563</td>
<td>$18,312,000</td>
<td>$55,915,410</td>
<td>$106,070,973</td>
</tr>
<tr>
<td>California State University, East Bay</td>
<td>$24,243,652</td>
<td>$14,394,000</td>
<td>$42,929,208</td>
<td>$81,566,860</td>
</tr>
<tr>
<td>California State University, Fresno</td>
<td>$52,725,317</td>
<td>$32,557,000</td>
<td>$92,926,594</td>
<td>$178,208,911</td>
</tr>
<tr>
<td>California State University, Fullerton</td>
<td>$67,736,949</td>
<td>$41,088,000</td>
<td>$120,859,884</td>
<td>$229,684,833</td>
</tr>
<tr>
<td>California State University, Long Beach</td>
<td>$67,421,424</td>
<td>$41,202,000</td>
<td>$119,508,329</td>
<td>$228,131,753</td>
</tr>
<tr>
<td>California State University, Los Angeles</td>
<td>$61,905,561</td>
<td>$40,067,000</td>
<td>$108,543,672</td>
<td>$210,516,233</td>
</tr>
<tr>
<td>California State University, Monterey Bay</td>
<td>$13,455,716</td>
<td>$8,705,000</td>
<td>$23,922,768</td>
<td>$46,083,484</td>
</tr>
<tr>
<td>California State University, Northridge</td>
<td>$74,004,088</td>
<td>$47,458,000</td>
<td>$131,021,450</td>
<td>$252,483,538</td>
</tr>
<tr>
<td>California State University, San Bernardino</td>
<td>$42,438,131</td>
<td>$27,924,000</td>
<td>$74,982,459</td>
<td>$145,344,590</td>
</tr>
<tr>
<td>California State University, San Marcos</td>
<td>$26,602,684</td>
<td>$15,542,000</td>
<td>$46,496,808</td>
<td>$88,641,492</td>
</tr>
<tr>
<td>California State University, Stanislaus</td>
<td>$22,007,207</td>
<td>$12,928,000</td>
<td>$38,636,391</td>
<td>$73,571,598</td>
</tr>
<tr>
<td>Humboldt State University</td>
<td>$16,130,016</td>
<td>$11,146,000</td>
<td>$28,831,619</td>
<td>$56,107,635</td>
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<tr>
<td>San Diego State University</td>
<td>$45,914,127</td>
<td>$30,394,000</td>
<td>$80,592,385</td>
<td>$156,900,512</td>
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<tr>
<td>San Francisco State University</td>
<td>$47,404,409</td>
<td>$30,000,000</td>
<td>$83,075,470</td>
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<tr>
<td>San Jose State University</td>
<td>$46,631,939</td>
<td>$30,977,000</td>
<td>$82,976,130</td>
<td>$160,585,069</td>
</tr>
</tbody>
</table>
Vulnerability Assessment Conclusions

Before the COVID-19 pandemic, populations at all CSU campuses and CSU-affiliated facilities were substantial. Collectively, as of Fall 2019, CSU campuses had 480,541 students and 53,763 faculty and staff. All were at risk from the communicable disease events, with 534,304 people being directly vulnerable. The COVID-19 pandemic has caused campus population numbers to plummet to a small fraction of full capacity.

At some point in the future, campus population numbers will return to their pre-pandemic levels, and students, faculty, and staff will again be vulnerable to the communicable disease hazard. If just 10% of the total CSU population were to become ill with a highly infective communicable disease like influenza or another strain of SARS, this would mean that approximately 53,430 people would be sick at the same time. This scenario would likely overwhelm available on-campus medical services could even overwhelm portions of the larger community’s medical resources – especially if there were large numbers of infected people with immune system compromises or other underlying health problems.

See Table 4-9 below for the “10% outbreak scenario” projections for the CSU – Bakersfield campus and for the entire CSU system.

*Table 4-9: Scenario of Communicable Disease Hazard Affecting 10% of the CSU Population*

<table>
<thead>
<tr>
<th>CSU Campus</th>
<th>Approximate Enrollment Population (Fall 2019)</th>
<th>Approximate Total FT/PT Faculty/Staff Population (Fall 2019)</th>
<th>Total Combined Approximate Student and Faculty/Staff Population</th>
<th>10% Outbreak Scenario (Students and Faculty/Staff Combined)</th>
</tr>
</thead>
<tbody>
<tr>
<td>CSU Bakersfield</td>
<td>11,199</td>
<td>1,277</td>
<td>12,476</td>
<td>1,248</td>
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<tr>
<td>CSU Channel Islands</td>
<td>7,093</td>
<td>994</td>
<td>8,087</td>
<td>809</td>
</tr>
<tr>
<td>Chico State</td>
<td>17,019</td>
<td>1,969</td>
<td>18,988</td>
<td>1,899</td>
</tr>
<tr>
<td>CSU Dominguez Hills</td>
<td>17,027</td>
<td>1,761</td>
<td>18,788</td>
<td>1,879</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Institution</th>
<th>Total Students</th>
<th>Fall Students</th>
<th>Spring Students</th>
<th>Summer Students</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cal State East Bay</td>
<td>14,705</td>
<td>1,764</td>
<td>16,469</td>
<td>1,647</td>
</tr>
<tr>
<td>Fresno State</td>
<td>24,139</td>
<td>2,534</td>
<td>26,673</td>
<td>2,667</td>
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<tr>
<td>Cal State Fullerton</td>
<td>39,868</td>
<td>3,736</td>
<td>43,604</td>
<td>4,360</td>
</tr>
<tr>
<td>Humboldt State</td>
<td>6,983</td>
<td>1,171</td>
<td>8,154</td>
<td>815</td>
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<tr>
<td>Cal State Long Beach</td>
<td>38,074</td>
<td>4,004</td>
<td>42,078</td>
<td>4,208</td>
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<tr>
<td>Cal State LA</td>
<td>26,361</td>
<td>2,821</td>
<td>29,182</td>
<td>2,918</td>
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<tr>
<td>Cal Maritime</td>
<td>911</td>
<td>329</td>
<td>1,240</td>
<td>124</td>
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<tr>
<td>CSU Monterey Bay</td>
<td>7,123</td>
<td>1,059</td>
<td>8,182</td>
<td>818</td>
</tr>
<tr>
<td>CSUN (Northridge)</td>
<td>38,391</td>
<td>3,832</td>
<td>42,223</td>
<td>4,222</td>
</tr>
<tr>
<td>Cal Poly Pomona</td>
<td>27,914</td>
<td>2,650</td>
<td>30,564</td>
<td>3,056</td>
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<tr>
<td>Sacramento State</td>
<td>31,156</td>
<td>3,228</td>
<td>34,384</td>
<td>3,438</td>
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<tr>
<td>Cal State San Bernardino</td>
<td>20,311</td>
<td>2,118</td>
<td>22,429</td>
<td>2,243</td>
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<tr>
<td>San Diego State</td>
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<td>3,702</td>
<td>38,783</td>
<td>3,878</td>
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<tr>
<td>San Francisco State</td>
<td>28,880</td>
<td>3,401</td>
<td>32,281</td>
<td>3,228</td>
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<tr>
<td>San José State</td>
<td>33,282</td>
<td>3,568</td>
<td>36,850</td>
<td>3,685</td>
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<tr>
<td>Cal Poly San Luis Obispo</td>
<td>21,242</td>
<td>2,871</td>
<td>24,113</td>
<td>2,411</td>
</tr>
<tr>
<td>CSU San Marcos</td>
<td>14,519</td>
<td>1,687</td>
<td>16,206</td>
<td>1,621</td>
</tr>
<tr>
<td>Sonoma State</td>
<td>8,649</td>
<td>1,338</td>
<td>9,987</td>
<td>999</td>
</tr>
<tr>
<td>Stanislaus State</td>
<td>10,614</td>
<td>1,276</td>
<td>11,890</td>
<td>1,189</td>
</tr>
<tr>
<td>Office of the Chancellor</td>
<td>0</td>
<td>673</td>
<td>673</td>
<td>67</td>
</tr>
<tr>
<td><strong>CSU System-Wide</strong></td>
<td><strong>480,541</strong></td>
<td><strong>53,763</strong></td>
<td><strong>534,304</strong></td>
<td><strong>53,430</strong></td>
</tr>
</tbody>
</table>

*Note: Enrollment figures do not include non-specific CSU campus International Programs (455 students) or CALStateTEACH Program (933 students)*

While the case numbers of COVID-19 have been significantly lower (about 1% of the total CSU population) than those in the 10% scenario, the degree of virulence and resultant morbidity and mortality caused by COVID-19 have led to widespread campus shutdowns, educational disruption, and economic harm to the CSU system including CSU - Bakersfield. In short, the real-time COVID-19 communicable disease outbreak scenario has proven far more devastating than the 10% simulated scenario.
Identified Data Limitations

There is a wealth of technical information available for communicable disease. However, there is also limited non-COVID-19 communicable disease data available regarding risk or vulnerability of specific populations throughout the CSU. Much of the data that does exist is protected by privacy policies, and therefore cannot be obtained for more specific populations. As a result, performing a detailed quantitative assessment for this hazard is difficult.

Data that could be collected prior to the next update in order to improve this methodology includes:

- Data regarding infection rates at the campus level and for specific populations;
- Data regarding communicable disease case numbers and outcomes, by CSU campus;
- Data regarding projected population changes;
- Data regarding absenteeism; and
- Data regarding increased operating costs as a result of absenteeism (i.e., temporary shifting of duties resulting in business interruption).
**Dam and Levee Failure**

Description of the Hazard

A dam failure represents the structural collapse of a dam that stores water in a reservoir behind the dam. These failures are typically the result of structural age, damage to the structure caused by earthquake or flooding, inadequate discharge or spillway capacity, inadequate maintenance, improper construction materials, or extreme inflow of water into the reservoir. Prolonged precipitation may result in overtopping of the dam resulting in structural compromise. The tremendous energy generated by a sudden breach of the dam will have significant downstream effects. Flood damage resulting from dam failures potentially will result in economic losses, environmental damage, destruction of agriculture, and human casualties. This type of incident is extremely dangerous as it can occur rapidly, with no warning resulting in an inability to effectively evacuate threatened communities.

A levee failure is similar to dam failures as the result will be a breach causing flooding on the dry side of the levee. Levees are embankments whose primary purpose is to furnish flood protection from seasonal high water or divert the flow of water. Most levees in California are intended to withstand peak water levels generated by heavy precipitation or rapid snowmelt in a watershed. Other levees are designed to withstand fluctuating water levels on a continuous basis such as those in the California Delta exposed to tidal influences. Levees routinely extend for lengthy distances immediately protecting communities. Levees can be found throughout the state but are most prominent in the Sacramento and San Joaquin Valleys.

Levee failures can vary from overtopping to small uncontrolled discharge to catastrophic failure. Areas downstream of the failure will be subject to inundation dependent on the volume of water released. These levee failures are also typically the result of structural age, damage to the structure caused by earthquake or flooding, slumping, seepage underneath the levee, high velocity flows eroding the levee, inadequate capacity, inadequate maintenance, improper construction materials, or extreme inflow of water into the system. Flood damage resulting from levee failures potentially will result in economic losses, environmental damage, destruction of agriculture, and human casualties.

A Dam or levee failure flooding will vary depending on a number of factors including the extent of the collapse or breach, the volume of water behind the structure, and the nature of the exposed downstream features. This unpredictable flooding presents a threat to life and property in addition to critical infrastructure. Lifelines and supply routes will likely be damaged or made impassible by flood erosion or standing water. Water quality and health concerns would likely be cascading effects of dam or levee failures.

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Location of the Hazard

Kern County is home to a variety of flood control facilities and levee systems throughout the Bakersfield region including along the Kern River. The Kern River drains the southern Sierra Nevada Mountains and Isabella Lake into the southern San Joaquin Valley. The Kern River Watershed is fed by snowmelt from the mountains near Mount Whitney and to the south.

The Kern River feeds into Isabella Lake, a reservoir created by the Isabella Lake Dam. The dam is a US Army Corps of Engineers dam in the mountains 50 miles east of the CSU Bakersfield campus. The Kern River flows down through the canyons below the dam and through Bakersfield before reaching the campus. There are three diversion dams on the river downstream from Isabella Lake Dam and upstream from the campus. The CSU Bakersfield campus is situated across from Stockdale Highway separating the campus from the southern bank of the Kern River. The distance from the river to the campus boundary is less than 1,500 feet.

Levees have been constructed to protect the banks of the Kern River as the river extends through Bakersfield. Levees are also used in containment of diversion channels and irrigation aqueducts. The CSU Bakersfield campus is located within a designated levee protected zone identified in the Kern County Multi-Jurisdictional Hazard Mitigation Plan.
Figure 4-6: Dams and Levees near Bakersfield
Dams are classified according to the hazard that they pose to life and property in the event of failure, rather than the likelihood of that failure.

- High hazard potential dams may result in loss of human life, and will likely result in economic, environmental, or lifeline losses.
- Significant hazard potential dams are not expected to result in loss of life, but are expected to cause economic, environmental, and lifeline losses.
- Low hazard potential dams are not expected to result in loss of like, and there is a low expectation of economic, environmental, or lifeline losses. What losses do occur are generally limited to the dam owner.

Dams classified as high hazard are required to have Emergency Action Plans (EAP). EAPS are formal documents that identify potential emergency conditions at the dam and specify preplanned actions to be followed in case of failure. An EAP is required for all high hazard dams and is recommended for all significant hazard dams.
Table 4-10: Kern County Dams Upstream from CSU Bakersfield

<table>
<thead>
<tr>
<th>River</th>
<th>Dam</th>
<th>Storage</th>
<th>Hazard Severity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kern</td>
<td>Isabella Lake</td>
<td>568,000af</td>
<td>High Hazard</td>
</tr>
<tr>
<td>Kern</td>
<td>Kern River Co Park</td>
<td>1,166af</td>
<td>High Hazard</td>
</tr>
<tr>
<td>Kern</td>
<td>Kern Diversion</td>
<td>247af</td>
<td>Low Hazard</td>
</tr>
</tbody>
</table>

The Isabella Lake Dam was constructed to provide flood protection to Bakersfield and to provide storage of domestic and agricultural water to the region. The dam is subject to potential seismic activity as known fault lines extend near the dam including the Kern Canyon and Lake Isabella faults.

The CSU Bakersfield campus lies within the inundation zone of the Isabella Dam. In the event of a catastrophic failure of the Isabella Dam, the CSU Bakersfield campus is expected to experience peak inundation depths of 4-5 feet. The campus is expected to be impacted by one foot of water within 8-10 hours from the time of dam failure. The time between dam failure and arrival at the CSU Bakersfield campus should allow for sufficient time to evacuate the campus. The flood inundation zone from an Isabella Dam failure covers a large portion of the region requiring evacuations to occur over long distances.

Members of the campus community who reside or are employed in these areas would be most impacted. This specific hazard would substantially alter the ability of the campus to maintain operations as damages would be extensive, the campus community would be heavily affected with the loss of life and homes, and student financial capacity to support ongoing education being diminished. Based on the factors above, the planning committee ranks the extent of the hazard as **Moderate**.

**Extent - Levee Failure**

Levees are used along numerous irrigation channels and other waterways in Bakersfield including the Kern River. The southern bank of the Kern River is lined with a levee protecting much of east and south Bakersfield. The CSU Bakersfield campus lies within a levee flood protected area. In the event the Kern River was flowing at elevated levels and a failure of a levee were to occur, the CSU Bakersfield campus would likely experience flood related damages. This specific hazard would substantially alter the ability of the campus to maintain operations as damages would be extensive, the campus community would be heavily affected with the loss of life and homes, access to campus would be limited, and student financial capacity to support ongoing education being diminished. Based on the factors above, the planning committee ranks the extent of the hazard as **Moderate**.
History of the Hazard

California has witnessed only a small number of dam failures over past half century. **There have been no occurrences of dam failures in Kern County. However, there have been instances of various levels of dam compromises in Kern County.**

- April 27, 2006, seepage was identified at Isabella Auxiliary Dam.
- May 2006, heavy precipitation and melting snowpack caused Lake Isabella to fill faster than release capacity. High water levels caused flooding around the lake.

California has an extensive network of levees primarily throughout the Central Valley. These levees have been constructed using a variety of methods and often were built decades ago. Statewide, levee failures have occurred more frequently than dam failures. **In Kern County, there have been the following instances of past levee failures:**

- 1905, Buena Vista Lake levee breached resulting in damage to 12 miles to railroads and 25,000 acres flooded.

Potential Impacts of the Hazard

**Dam Failure Impacts**

Water that is released due to a dam that has failed generates tremendous energy and force causing a flood that will be catastrophic to life and property. Water levels from the failed dam could be significantly higher than those experienced in worst case scenario flood events. Areas closer to the failed dam will be more likely to experience complete devastation while other areas within the inundation zone will see varying levels of flood waters. The extent of the impacts of a failed dam would vary based on a number of factors such as the volume of water released, the base flow of the river, the time of the failure, the amount of warning provided, and the distance from the dam. Potential impacts resulting from a dam failure include:

- Loss of life
- Property destruction or damage
- Loss of property contents
- Infrastructure damage
- Flooded or destroyed lifelines/supply routes
- Damaged or destroyed utilities
- Loss of community economic base
- Employment losses
- Agricultural (crops and livestock) damages or destruction
- Environmental damage
- Floods generating threats to public health
- Flood generated debris

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Levee Failure Impacts

A levee failure may result in substantial amounts of water to enter into developed areas protected by the levee. The force and volume of water that is generated by a levee failure may cause extensive structural damage in close proximity to the breach and effects of flooding spreading well beyond the point of the failure. The extent of the impacts would vary based on a number of factors such as the volume of water released, the time of the failure, the amount of warning provided, the location of the breach, elevation, and distance from the breach. Potential impacts resulting from a levee failure include:

- Loss of life
- Property destruction or damage
- Loss of property contents
- Infrastructure damage
- Public health hazards resulting from mold, mildew, and disease due to flood water
- Flooded or destroyed lifelines/supply routes
- Damaged or destroyed utilities
- Loss of community economic base
- Employment losses
- Agricultural (crops and livestock) damages or destruction
- Environmental damage
- Prolonged periods of necessary dewatering
- Disruptions to education delivery to community

Probability of Future Occurrence of the Hazard

Kern County remains at risk from dam and levee failure. The location of the CSU Bakersfield campus downstream from the Isabella Dam and within a flood protected area demonstrates that the potential exists for future dam or levee related issues. There are no official recurrence intervals that have been calculated for dam or levee failures. However, based on formal dam and levee monitoring and maintenance protocols in place in Kern County, the probability of future occurrence for both dam and levee failures is Unlikely.

Vulnerability to the Hazard

The CSU Bakersfield campus is subject to the effects of flooding resulting from compromised dams and levees. The Isabella Dam upstream from the campus presents the potential for catastrophic flooding and damage through a majority of the Bakersfield area. The Kern River and extending irrigation channels are lined by levees intended to protect the surrounding areas from rises in water level. In the case of dam failure, the amount of time to respond to the needs of the campus community prior to inundation will be limited to about 8 – 10 hours as indicated in the Extent section above.

The most significant challenge regarding dam failures is they generally result in catastrophic outcomes. The levees that line Kern River and those that encase the irrigation channels are owned and operated by a variety of agencies. Any breach along a
levee is impossible to predict where a failure may occur. It is likely that response action will not be fully implemented until the incident situational intelligence provides adequate information as to compromised locations. These variables place all those working and living within the dam inundation and flood protection zones in vulnerable locations.

The dam inundation zone covers the majority of Bakersfield and surrounding areas. Everyone downstream of the dam in the inundation zone will be vulnerable to the effects of floods and forces of moving water. The CSU Bakersfield campus lies within the Isabella Dam inundation zone. The levee systems providing a threat to Bakersfield exist along the Kern River through the heart of the city and along extending diversion irrigation channels scattered throughout the region.

The CSU Bakersfield campus lies in proximity to levees lining the Kern River. However, the distributed placement of levees, most near development may expose significant vulnerabilities to other areas of the region even if the campus is unaffected. There is potential the campus community will be affected as a breach may cause flooding and damages to the homes of students, faculty, and staff or to access/supply routes, utilities, or other critical services. The potential for flood damaged structures being left uninhabitable including campus residence halls will result in numerous displaced individuals and households. The lack of flood insurance will cause extreme financial burdens on those affected.

Vulnerability to a dam or levee failure on the CSU Bakersfield campus will vary depending on when the failure was to occur. The risk to the campus population will be lessened during periods when classes are not in session or during periods of breaks. Conversely, during the days and hours that classes are in session and staff are at their workplaces, the human vulnerability increases. However, in region-wide events this vulnerability may be shared with the homes and workplaces of members of the campus community and their families.

Certain campus populations will experience greater challenges to a post-flood / failure environment. Vulnerable populations will likely need to navigate through flood generated debris, face extreme health safety issues from flood waters, experience extreme stresses of a disaster, an inability to communicate to or gain access to support networks, and find difficulty in accessing equipment or supplies to aid in a specific need.

Estimate of Potential Losses

Estimates of potential losses will be influenced by a variety of factors. The volume and force of the water will determine the scale of damages affecting campus infrastructure, equipment, and other impacted features. The proximity to the failure and elevation above flood waters will affect the level of damage and individuals exposed. The time of the academic year, the day of week, and hour in which the failure was to occur will influence the number of people on campus and potential casualties. Losses will be generated by the physical damages, the loss of revenue, loss of academic research, loss of building contents, and community wide economic reductions. Based on estimate replacement costs of facilities and structures on campus, the total replacement costs are $191,391,025.
Vulnerability Assessment Conclusions

Although the occurrence of dam and levee failures have not been historically relevant in Kern County or near the CSU Bakersfield campus, the potential for hazards related to the region’s levees and dams still exist. The presence of earthquake faults in proximity to the Isabella Dam, the county’s largest reservoir, presents a valid danger to the dam structure in the event of an earthquake. The consequences of a dam failure would generate catastrophic results to downstream communities including Bakersfield. The proximity to the Kern River and the levees providing a barrier between the campus and the river further presents a hazard facing the campus. The potential for dam or levee failure further generates the added potential for a number of cascading effects such as disruptions to the local economy, utility failures, disruptions to providing for the needs of the community, and development of public health hazards. These effects would be exacerbated by effects of seasonal flooding, ongoing heavy precipitation, or excessive run-off from the watershed contributing to the river system. The potential for widespread flooding and damage of structures due to the force of water has exponentially powerful impacts on particular populations among the campus community including those with access or functional needs, international students, the homeless, and students residing in the residence halls.

Identified Data Limitations

Missing campus structural replacement costs and complete inventory of building construction features or mitigation efforts to lessen the impact due to flood inundation.
Drought

Description of the Hazard

Drought is defined as a condition where moisture levels fall significantly below normal for an extended period of time over a large area that adversely affects plants, animal life, and humans. Drought is a gradual phenomenon. Although droughts are sometimes characterized as emergencies, they differ from typical emergency events. Most natural disasters, such as floods or forest fires, occur relatively rapidly and afford little time for preparing for disaster response. Droughts occur slowly, over a multi-year period, and it is often not obvious or easy to quantify when a drought begins and ends.

Throughout California, one dry year does not normally constitute a drought. California’s extensive system of water supply infrastructure (reservoirs, groundwater basins, and conveyance assets) mitigates the effect of short-term dry periods for most water users. Defining when a drought begins is a function of drought impacts to water users. Drought in one location may not constitute a drought for all water users, as some users in relative proximity may have a different water supply. For example, individual water suppliers may use a combination of sources such as rainfall/runoff, water in storage, or expected supply from a water wholesaler to define their water supply conditions.

Drought can be characterized as one or more of the four following types:

- **Meteorological drought** is defined on the basis of the degree of dryness (in comparison to some “normal” or average amount) and the duration of the dry period. A meteorological drought must be considered as region-specific since the atmospheric conditions that result in deficiencies of precipitation are highly variable from region to region.

- **Hydrological drought** is associated with the effects of periods of precipitation (including snowfall) shortfalls on surface or subsurface water supply (e.g., streamflow, reservoir and lake levels, ground water). The frequency and severity of hydrological drought is often defined on a watershed or river basin scale. Although all droughts originate with a deficiency of precipitation, hydrologists are more concerned with how this deficiency plays out through the hydrologic system. Hydrological droughts are usually out of phase with or lag the occurrence of meteorological and agricultural droughts. It takes longer for precipitation deficiencies to show up in components of the hydrological system such as soil moisture, streamflow, and ground water and reservoir levels. As a result, these impacts are out of phase with impacts in other economic sectors.

- **Agricultural drought** focus is on soil moisture deficiencies, differences between actual and potential evaporation, reduced ground water or reservoir levels, and so forth. Plant water demand depends on prevailing weather conditions, biological characteristics of the specific plant, its stage of growth, and the physical and biological properties of the soil.
• **Socioeconomic drought** refers to when physical water shortage begins to affect health, well-being, and quality of life of people, or when the drought starts to affect the supply and demand of an economic product that relies on water.

The drought issue in California is further compounded by water rights. The central challenge is how to prioritize water usage among a broad variety of contexts. It is for this reason that water is a commodity possessed and utilized under a variety of legal doctrines. As such, many competing sets of interests create a dynamic prioritization process between, for example, farming and federally protected fish habitats and water supply for municipal/public use (including usage for CSU - Bakersfield versus water usage for wildfire abatement or natural resource protection.

**Location of the Hazard**

Drought conditions have been identified in Kern county and the city of Bakersfield where CSU-Bakersfield is located. Drought is not a location-specific hazard and affects the entire planning area equally. Drought location is not isolated to each campus footprint but occurs as a geographic sub-set of drought conditions occurring at larger scales. From 2000-2020, drought conditions existed continuously somewhere in the state, with 80-100% of the state impacted for 12 of the last 20 years.²⁹

**Extent of the Hazard**

According to the CSU system-wide planning committee, drought conditions have been in effect since 2000, with severe drought from 2012 – 2017. Given the historical occurrence of severe drought impacts throughout the state, and that its extent will likely be exacerbated by climate change, the CSU Planning Committee recognizes that drought will continue to pose a high degree of risk to the state, impacting crops, livestock, water resources, the natural environment at large, buildings and infrastructure (from land subsidence), and local economies. In addition, although drought affects the entire CSU system-wide planning area, the extent of the hazard is variable and specific to each campus/jurisdiction, depending on contextual factors such as the degree of assets and activities, historically impacted by drought within each jurisdiction.

Note: land subsidence has occurred statewide and will continue in areas where the groundwater basin has been subject to overdraft and long-term recharge is inadequate to maintain the water table elevation, leaving underground voids. Subsidence levels in California have been measured up to 30-feet with subsidence bowls covering hundreds of square miles. As such, drought-related subsidence may result in serious structural damage to buildings, roads, irrigation ditches, underground utilities, and pipelines. These potential effects, though not reported on campus, are applicable to the campus over the long term.

The CSU - Bakersfield campus planning team identifies the extent of the hazard on campus as Low to Medium due to uninterrupted water sources and consistent water conservation efforts. The ranking (qualitatively) corresponds to D0 – D2 on the Extent scale (below), though Kern County has experienced more severe drought conditions for 15 of the past 20 years, including 3 years of D4 levels. As such, the campus planning team recognizes that while historic impacts shaping the extent of drought on campus have been minimal, the potential impacts are tied to trends across larger geographic areas, and, therefore, the committee recognizes that the extent of drought on campus has the potential to increase in the future.

The U.S. Drought Monitor developed tables of impacts reported during past droughts in California in order to depict the extent of drought risk for each level of drought on the U.S. These possible extent conditions for California complement the general impacts column of the U.S. Drought Monitor Classification Scheme.

Table 4-11: Impacts of Drought Levels as Determined by US Drought Monitor

<table>
<thead>
<tr>
<th>Category</th>
<th>Impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>D0</td>
<td>Soil is dry; irrigation delivery begins early</td>
</tr>
<tr>
<td></td>
<td>Dryland crop germination is stunted</td>
</tr>
<tr>
<td></td>
<td>Active fire season begins</td>
</tr>
<tr>
<td></td>
<td>Winter resort visitation is low; snowpack is minimal</td>
</tr>
<tr>
<td>D1</td>
<td>Dryland pasture growth is stunted; producers give supplemental feed to cattle</td>
</tr>
<tr>
<td></td>
<td>Landscaping and gardens need irrigation earlier; wildlife patterns begin to change</td>
</tr>
<tr>
<td></td>
<td>Stock ponds and creeks are lower than usual</td>
</tr>
<tr>
<td>D2</td>
<td>Grazing land is inadequate</td>
</tr>
<tr>
<td></td>
<td>Producers increase water efficiency methods and drought-resistant crops</td>
</tr>
<tr>
<td></td>
<td>Fire season is longer, with high burn intensity, dry fuels, and large fire spatial extent; more fire crews are on staff</td>
</tr>
<tr>
<td></td>
<td>Wine country tourism increases; lake- and river-based tourism declines; boat ramps close</td>
</tr>
<tr>
<td></td>
<td>Trees are stressed; plants increase reproductive mechanisms; wildlife diseases increase</td>
</tr>
<tr>
<td></td>
<td>Water temperature increases; programs to divert water to protect fish begin</td>
</tr>
</tbody>
</table>


4-37
<table>
<thead>
<tr>
<th>River flows decrease; reservoir levels are low and banks are exposed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Livestock need expensive supplemental feed, cattle and horses are sold; little pasture remains, producers find it difficult to maintain organic meat requirements</td>
</tr>
<tr>
<td>Fruit trees bud early; producers begin irrigating in the winter</td>
</tr>
<tr>
<td>Federal water is not adequate to meet irrigation contracts; extracting supplemental groundwater is expensive</td>
</tr>
<tr>
<td>Dairy operations close</td>
</tr>
<tr>
<td>Marijuana growers illegally tap water out of rivers</td>
</tr>
<tr>
<td>Fire season lasts year-round; fires occur in typically wet parts of state; burn bans are implemented</td>
</tr>
<tr>
<td>Ski and rafting business is low, mountain communities suffer</td>
</tr>
<tr>
<td>Orchard removal and well drilling company business increase; panning for gold increases</td>
</tr>
<tr>
<td>Low river levels impede fish migration and cause lower survival rates</td>
</tr>
<tr>
<td>Wildlife encroach on developed areas; little native food and water is available for bears, which hibernate less</td>
</tr>
<tr>
<td>Water sanitation is a concern, reservoir levels drop significantly, surface water is nearly dry, flows are very low; water theft occurs</td>
</tr>
<tr>
<td>Wells and aquifer levels decrease; homeowners drill new wells</td>
</tr>
<tr>
<td>Water conservation rebate programs increase; water use restrictions are implemented; water transfers increase</td>
</tr>
<tr>
<td>Water is inadequate for agriculture, wildlife, and urban needs; reservoirs are extremely low; hydropower is restricted</td>
</tr>
<tr>
<td>Fields are left fallow; orchards are removed; vegetable yields are low; honey harvest is small</td>
</tr>
<tr>
<td>Fire season is very costly; number of fires and area burned are extensive</td>
</tr>
<tr>
<td>Many recreational activities are affected</td>
</tr>
<tr>
<td>Fish rescue and relocation begins; pine beetle infestation occurs; forest mortality is high; wetlands dry up; survival of native plants and animals is low; fewer wildflowers bloom; wildlife death is widespread; algae blooms appear</td>
</tr>
<tr>
<td>Policy change; agriculture unemployment is high, food aid is needed</td>
</tr>
<tr>
<td>Poor air quality affects health; greenhouse gas emissions increase as hydropower production decreases; West Nile Virus outbreaks rise</td>
</tr>
<tr>
<td>Water shortages are widespread; surface water is depleted; federal irrigation water deliveries are extremely low; junior water rights are</td>
</tr>
</tbody>
</table>
History of the Hazard

Historically, drought has been so prevalent in California that its presence is almost continuous. According to the campus committee, drought conditions have been in effect since 2000, with severe drought from 2012 – 2017. According to the US Drought Monitor, Time Series data, Kern County (which surrounds the planning area) has experienced 7 or more periods of drought covering 15 years from 2000-2021.

Figure 4-8: Periods of Drought in Kern County, California, 2000 – 2021

According to the National Drought Mitigation Center, over 3,500 reports and publications covering 370 drought-related events took place across the state (many of which were statewide events) between 2000-2020. In addition, the National Center for Environmental Information (NCEI) reports more than 500 events statewide during this same time period. These events produced a comprehensive range of impacts to water supply, regulations and allocations to businesses and municipalities, budgets and resources for firefighting, water law and policy, and physical impacts to built and natural environments. As such, data records of previous occurrences can be viewed as separate time and event demarcations for a hazard almost continuously in effect across the state with cascading impact potential.

According to the Department of Water Resources, droughts exceeding three years are relatively common in Southern California, but relatively rare in Northern California - the region is the geographic source of much of the state’s developed water supply. The 1929-

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drought established the criteria commonly used in designing storage capacity and yield of large Northern California reservoirs.\(^{32}\)

According to the US Drought Monitor’s time series data, from 2000-2021 (with the exception of a 2–3-month period in 2000 and 2011), some degree of drought conditions have been continuously in effect somewhere in California. In fact, 80% - 100% of the state has been subjected to drought conditions for 12 of the last 20 years, with the most severe drought being the 100% state-wide event from 2012-2017.

*Figure 4-9: Periods of Drought in State of California, 2001 – 2021\(^{33}\)*

Given the extent of the drought risk in California, the following drought event was selected as an exemplar due to its broad and significant impacts on the state and (according to the US Drought Monitor’s Time Series data), on Kern county, the city of Bakersfield and the CSU - Bakersfield campus planning area:

**2012 – 2017** – Drought produced severe impacts to water wells throughout the state of California, with a high number of wells running dry. Land subsidence due to increased groundwater pumping also occurred in numerous areas of the state such as the San Joaquin and Central Valleys. Crop damage was widespread as well. Water allotments were drastically reduced in many towns and water agencies, with extremely high costs for procuring water. In addition, job loss occurred with many families requiring food supply assistance, and water supply assistance provided to home-owners with dry wells. According to a report released by UC Davis Center for Watershed Sciences, the 2012-2017 period of the California drought cost the state's agriculture industry about $1 billion in lost revenue, with a total statewide economic cost of the drought calculated to be $2.2 billion.\(^{34}\) The report says, “it is responsible for the greatest water loss ever seen in California agriculture - about one third less than normal”. The report calls the

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groundwater situation in California "a slow-moving train wreck." Spring snowpack at Donner Summit reached record low levels in 2014, exceeded in 2015 by a remarkable April 1 snow-water-equivalent value of only 5% of average. Decreased precipitation since contributed to near-record low levels in the Shasta Reservoir. The ongoing drought has contributed to declines in crop values across the state. For example, crops including cotton, corn silage and barley (the field crop category) fell by 42 percent.35

Potential Impacts of the Hazard

Drought impacts statewide are wide-reaching and may be economic, environmental, and/or societal. This assessment of its impact recognizes that historic occurrences of drought throughout the planning area are a sub-set of larger and inter-connected local and regional droughts, and that the (related) historic impacts provide a sound basis for understanding potential (future) impacts.

The most significant potential impact associated with drought across the CSU - Bakersfield campus planning area is a reduction in water availability for the municipal area tied to the campus. According to the campus committee, water resources have been an historic concern though no official use restrictions have occurred. Other impacts include crop loss and damage to trees and other natural resources. The footprint of CSU Bakersfield to some extent includes these vulnerable resources based on the campus landscape (trees) and the presence (and footprint size) of any agricultural research crops and/or field stations.

As a secondary impact of drought, wildfire is directly attributable to dry atmospheric conditions. Wildfires almost always coincide with drought in California, though not limited to such.36 However, the wildfire hazard is analyzed separately in this plan. (See section on wildfire hazard).

In reviewing the occurrences of drought for Kern County and the city of Bakersfield which surrounds the campus, the US Drought Monitor and the National Drought Mitigation Center report that tens of millions of trees died during the (2012 - 2017) state-wide drought disaster. Though data sources do not provide data for tree mortality specific to CSU - Bakersfield, the broad geographic extent of the impact (including Kern County) makes it likely that tree mortality occurred to some degree on the campus. Due to the lasting and ongoing effects of drought on the landscape, trees will continue to be impacted within the municipalities, counties and regions wherein lies the CSU campus system as long as drought conditions continue to occur in the future.

Given the lack of campus-level data, it is useful for the CSU Committee to assess the impact of tree mortality by viewing it as a risk sub-set to the probability, location, extent, severity and duration of the drought hazard within each campus-located municipality, county and region. Regarding potential impacts, standing dead trees could fall, posing a

risk to people, buildings, power lines, roads and other infrastructure. In addition, drought-impacted trees become susceptible to diseases and insect infestations (bark beetle) further adding to the risk of tree mortality and related potential impacts. No data is currently available for tree mortality on campus, however, the CSU Planning Team will try to acquire data in the future.

As a potential tertiary impact, prolonged and repeated drought conditions over time can produce land subsidence and the risk of damage to building foundations and infrastructure on campus resulting from ground instability and collapse. Land subsidence is defined as the vertical sinking of the land over manmade or natural underground voids. Subsidence is often the direct result of groundwater over-extraction in response to drought conditions, as well as oil and gas extraction. Weight can accelerate the process of subsidence resulting from surface development and infrastructure such as roads and buildings, vibrations from construction blasting and heavy truck or train traffic. For example, the State Water Project’s 444-mile-long California Aqueduct has required repairs such as the raising of canal linings, bridges, and water control structures on the Aqueduct – in the Central Valley a five-mile reach of the Eastside Bypass was impacted by subsidence, and the Department of Water Resources estimated that it may cost in the range of $250 million to acquire flowage easements and levee improvements to restore the design capacity of the subsided area.37

At present, drought-related damage to campus buildings and infrastructure at CSU - Bakersfield has not been reported, but the potential for such impacts is possible. With regard to overall potential impact, water supply/availability for CSU - Bakersfield is ultimately tied to broader inter-dependent, and more intensive modes of water use at local and regional scales such as agriculture and ranching, wildfire protection, larger metropolitan/municipal usage, manufacturing and commerce, tourism, recreation, and wildlife preservation. During drought periods, the State of California’s regulated water allocations are modified and often reduced, which can result in reduced water availability for all usage contexts, including CSU - Bakersfield. A reduction of electric power generation and water quality deterioration are also potential impact factors.

Table 4-12 : Summary of Drought Impacts on Water Resources38

<table>
<thead>
<tr>
<th>Resource</th>
<th>Type of Impact</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sea Level</td>
<td>Direct</td>
<td>Sea level is rising and will likely impact coastal areas</td>
</tr>
</tbody>
</table>


<table>
<thead>
<tr>
<th>Soil Moisture</th>
<th>Direct</th>
<th>Prolonged dry seasons can lead to decreases in soil moisture; drier vegetation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vegetation</td>
<td>Indirect</td>
<td>Longer and more intense fire season with increased extent of area burned</td>
</tr>
<tr>
<td>Stream</td>
<td>Direct</td>
<td>Increases in water temperature; potential effects on fish</td>
</tr>
<tr>
<td>Conditions</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Snowpack</td>
<td>Indirect</td>
<td>Increases in temperature will lead to decreases in snowpack</td>
</tr>
<tr>
<td>Runoff</td>
<td>Direct</td>
<td>Warmer temperatures are likely to lead to a shift in peak runoff from spring to winter and a likely decrease in summer base flow</td>
</tr>
<tr>
<td>Hydropower</td>
<td>Indirect</td>
<td>Decreased summer flows resulting from earlier snowmelt and a shift in peak runoff could affect hydropower generation during summer months</td>
</tr>
<tr>
<td>Precipitation</td>
<td>Direct</td>
<td>Warmer winter temperatures will result in a greater percentage of precipitation falling as rain rather than as snow</td>
</tr>
<tr>
<td>Groundwater</td>
<td>Indirect</td>
<td>Reduction in snowpack and extended periods of drought are likely to increase dependency on groundwater</td>
</tr>
</tbody>
</table>

**Probability of Future Occurrence of the Hazard**

**Highly Likely** — The US Drought Monitor’s time series data (2000-2020) indicates that some degree of drought has nearly a 100% probability of occurrence in the state in any given year. Given that CSU - Bakersfield lies within a county with drought conditions in effect for 15 of the past 20 years, it is prudent to extend this likelihood of occurrence to the planning area.

**Vulnerability to the Hazard**

In California, rising temperatures are projected to increase the average lowest elevation at which snow falls, reducing water storage in the snowpack, particularly at those lower mountain elevations which are now on the margins of reliable snowpack accumulation. Higher spring temperatures will also result in earlier melting of the snowpack. The shift in snow melt to earlier in the season is critical for California’s water supply because flood control rules require that water be allowed to flow downstream and that water cannot be stored in reservoirs for use in the dry season. As such, state-level drought risk factors that have led to drought’s state-wide severity and extent, and potential impacts also create drought vulnerabilities at the level of the CSU - Bakersfield campus.
Moreover, climate change will likely adversely impact the vulnerability of watersheds and ecosystems in their ability to deliver important ecosystem services. These changes may limit the natural capacity of healthy forests to capture water and regulate stream flows. Sierra Nevada mountain winters and springs are warming, and on average, precipitation as snowfall relative to rain is decreasing. A warming climate with reduced snowpack will result in earlier snowmelt and will subsequently reduce downstream water availability during summer and early fall.

As such, state and planning area stakeholders potentially have less capacity to address future drought risks due to projected temperature increases and shortages in water; ground-water withdrawals have been occurring at a deficit rate of 1 – 2 million acre feet per year, where the impacts of drought include decreased availability of water for agriculture and environmental uses.\textsuperscript{39} In forested and other vegetated areas, prolonged drought decreases the moisture content of forest fuels and increases the risk of high severity wildfires.

It should be pointed out that California is the single most productive agricultural state and its agricultural industry relies heavily on reservoir water supplied by snowmelt and rainfall runoff. Yearly variations in snowpack depths have implications for water availability as snowmelt from the winter snowpack feeds a network of reservoirs. Spring snowpack at Donner Summit reached record low levels in 2014, exceeded in 2015 by a remarkable April 1 snow-water-equivalent value of only 5% of average. Decreased precipitation since 2011 has contributed to near-record low levels in the Shasta Reservoir.\textsuperscript{40}

**Vulnerability of Populations**

Drought vulnerabilities for California’s population include agricultural sector job loss, secondary economic losses to local businesses and public recreational resources, increased cost to local and state government for large-scale water acquisition and delivery, and water rationing and water wells running dry for individuals and families. As drought is often accompanied by prolonged periods of extreme heat, negative health impacts such as dehydration can also occur, where children and elderly are most susceptible. Air quality often declines in times of drought which can affect those with respiratory ailments. These same vulnerabilities apply to the students, faculty and staff of the CSU - Bakersfield campus over the long term.

**Property Vulnerability**

The historical and potential impacts of drought on property statewide include crop loss, injury and death of livestock and pets, and damage to infrastructure, homes and other buildings resulting from the secondary drought impact of land subsidence. The related drought impacts of tree mortality and land subsidence pose risks to vulnerable critical


\textsuperscript{40} National Oceanic and Atmospheric Administration National Centers for Environmental Information. *State Climate Summaries: California*. Retrieved 05.04.2021 from: https://statesummaries.ncics.org/chapter/ca/
infrastructure and property. These same vulnerabilities apply to the properties of the CSU - Bakersfield campus over the long term.

**Natural Environment Vulnerability**

The core issue shaping drought vulnerabilities throughout California is water supply and demand. On campus, primary vulnerabilities are campus flora and landscaping, and the challenge of grounds maintenance. Campus efforts to mitigate include water conservation and conversion to drought resistant plants. Statewide, several factors play into the issue including groundwater basins, surface water run-off, public and agricultural demand, and surface water storage water sheds. A USGS led analysis was first conducted in 2010 through the Forest and Rangeland Assessment and ongoing through the USGS Forest and Rangeland Ecosystem Science Center to identify threats and assets where water supply would benefit from environmental management designed to protect or enhance water resources. This key effort both defines and mitigates the severity of drought risk and vulnerabilities.

With regard to overall threat and asset findings shaping the potential severity of drought, the watersheds in the Sierra region contribute most greatly to the state’s water supply, but are under threat from climate change, wildfire and development. In addition, groundwater basins in the San Joaquin Valley and Sacramento Valley bioregions are an abundant resource that is heavily threatened by over pumping.

**Critical Facilities Vulnerabilities**

Drought vulnerabilities for CSU - Bakersfield’s critical facilities include water shortfalls for facility operations and critical functions, and potential structural destabilization and damage resulting from land subsidence.

**Estimate of Potential Losses**

An estimate of potential losses from drought has not been calculated for the campus or the CSU system as a whole. However, drought related losses to the City of Bakersfield and Kern County, and the surrounding region, such as crop loss and cost increases for water resources have re-occurred over time. Please consult city and county level government, and/or state agricultural agencies for data on the financial impacts from drought.

**Vulnerability Assessment Conclusions**

The CSU Planning Committee understands that the high degree of statewide vulnerability posed by drought will be exacerbated by greater climate variation in the future and therefore greater variation and uncertainty regarding the availability of water supplies which are already under tremendous stress. In response to such vulnerability, state legislation passed in 2014 requires local governments to regulate pumping and recharge to better manage groundwater supplies, and groundwater-dependent regions are required to halt overdraft and bring basins into sustainable levels of pumping and recharge by the early 2040s. That said, the Committee will continue to work with local, regional and state partners and stakeholders to explore solutions for mitigating the
drought hazard on its campuses by accessing the best available data and resources on climate change and its relationship to drought.

Identified Data Limitations

Data is limited concerning campus-related agricultural assets as well as data on campus tree mortality.
Earthquake

Description of the Hazard

An earthquake is a sudden motion or shaking caused by the release of pressure accumulated along the edge of tectonic plates covering the earth. These huge plates are constantly moving and move ever so slowly under, over, or by passing one another. This movement is gradual however the plates may lock together accumulating enormous amounts of energy. When this energy builds, stress develops, and the adjoining plates will eventually break free and result in ground shaking – an earthquake.

Large earthquakes may result in fissuring, ground settlement, and/or vertical or horizontal displacement. Earthquakes occur without warning and can result in extensive damages and human casualties. Damages associated to earthquake generated ground shaking is normally confined to a narrow area along fault trend from the earthquake epicenter. However, seismic waves may generate ground shaking resulting in damages in areas outside of the fault trend.

Fault Rupture – The rupture of faults is the differential movement of the two sides of the earth’s plates at the point of the fault. Horizontal or vertical displacement may be significant and occur over great distances. The movement and energy that occurs along a fault is released in waves resulting in ground shaking. The intensity of ground shaking varies based on the magnitude of the earthquake, the proximity to the earthquake epicenter, the composition of the ground sediment or rock the waves travel through, and the depth of the earthquake.

Liquefaction – In addition to the primary fault rupture that occurs right along a fault during an earthquake, the ground many miles away can also fail during intense shaking. As seismic waves travel through saturated granular soil; the soil begins to liquefy and act as a fluid. Soil strength and stability is lost causing the effects of ground shaking to intensify and for ground deformation to occur. These water saturated soils when shaken quickly lose the ability to support buildings, bridges, utilities, and other structures. Areas susceptible to liquefaction include places where sandy sediments have been deposited by rivers along their course or by wave action along beaches. The greater the magnitude of an earthquake and longer duration of strong ground shaking will result in an enhanced potential for liquefaction to occur. Settlement can cause damage when the amount settlement varies significantly across the length of a structure. Lateral spreading occurs when liquefaction occurs on gently sloping ground and the liquefied material at depth allows the area to slide, often toward a vertical discontinuity or “free face” such as a creek or stream channel. Liquefaction can occur in susceptible soils below bodies of water, and settlement and lateral spreading can damage structures built on or adjacent to these areas. Transportation bridges across water bodies, wharves, piers and other structures at ports and harbors, and underwater utility lines can be severely damaged by this hidden hazard.

Subsidence - Changes in the local environment that cause subsidence or sinkholes are called triggering mechanisms. Water is the primary factor that affects the local

environment and causes subsidence. Water level decline, changes in groundwater flow, increased loading, and deterioration (such as abandoned mines) are all triggering mechanisms. Water level decline may occur naturally, or it may be the result of human action. Factors that lead to water decline are pumping (from wells), localized drainage (for construction activities), dewatering, or drought. Changes in groundwater flow can result from an increase in the velocity of groundwater movement, and increase in the frequency of water table fluctuations, and changes in discharge (either increase or decrease). Increased loading can cause pressure in the soil, leading to the failure of underground cavities and space, such as caves. Vibrations from earthquakes, heavy machinery, and blasting may result in structural collapse, followed by surface resettlement.

Location of the Hazard

The State of California is particularly vulnerable to earthquake activity due to California’s location residing between two large tectonic plates. Bakersfield is located in the southern end of the San Joaquin Valley along the eastern edge at the base of the Sierra Nevada Mountains. In general, fault systems occur to the west, east, and south of Bakersfield. Throughout the valley the ground is saturated with sediment eroded from the mountains and foothills via multiple stream and river channels. The CSU Bakersfield campus is situated near the southern bank of the Kern River.

The Pacific Plate and the North American Plate come together at the San Andreas Fault 35-40 miles south and west of the CSU Bakersfield campus. In addition to the San Andreas Fault, Kern County is home to additional fault systems with the potential to generate strong ground shaking. The Breckenridge-Kern Canyon Faults traverse along the foothills 15-20 miles east of the CSU Bakersfield campus. The White Wolf Fault extends 45 miles in length pointing towards the northeast 20 miles southeast of the CSU Bakersfield campus. The 150-mile long Garlock Fault extends from the San Andreas to the northeast 40-45 miles southeast of the CSU Bakersfield campus. (See Figure 4-8).
Extent of the Hazard

The extent or severity of earthquake damage is expressed in terms of magnitude, intensity and duration. The amount of energy released during an earthquake is normally conveyed as a magnitude measured from a seismogram. Magnitude is expressed in numbers and decimals representing the physical size of the earthquake. The strength and effect of the shaking on the surface of the earth is classified as the intensity. Intensity is further defined from the effects the earthquake has on people, structures, and the natural environment. The intensity of an earthquake in terms of measuring magnitude and evaluating its effects is generally expressed using the Modified Mercalli (MM) Intensity Scale. Duration is the length of time the earthquake’s energy is released.

The Richter magnitude scale (Table 4-18 below) was developed in 1935 by Charles F. Richter of the California Institute of Technology as a mathematical device to compare the size of earthquakes. The Richter Scale is the best-known scale for measuring the magnitude of earthquakes. The magnitude value is proportional to the logarithm of the amplitude of the strongest wave during an earthquake. A recording of 7, for example, indicates a disturbance with ground motion 10 times as large as a recording of 6.
energy released by an earthquake increases by a factor of 31 for every unit increase in the Richter scale.

Table 4-13: Earthquake Intensity and Frequency Comparisons

<table>
<thead>
<tr>
<th>Magnitude</th>
<th>Mercalli Intensity</th>
<th>Potential Damage</th>
<th>Global Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 2.0</td>
<td>I</td>
<td>None</td>
<td>Continually</td>
</tr>
<tr>
<td>2.0 - 2.9</td>
<td>I to II</td>
<td>None</td>
<td>&gt; IM per year</td>
</tr>
<tr>
<td>3.0 - 3.9</td>
<td>II to IV</td>
<td></td>
<td>&gt; 100,000 per year</td>
</tr>
<tr>
<td>4.0 - 4.9</td>
<td>IV to VII</td>
<td>Light</td>
<td>10K to 15 K per year</td>
</tr>
<tr>
<td>5.0 - 5.9</td>
<td>VI to VII</td>
<td>Moderate</td>
<td>1K to 1,500 per year</td>
</tr>
<tr>
<td>6.0 - 6.9</td>
<td>VII to X</td>
<td>Heavy</td>
<td>100 to 150 per year</td>
</tr>
<tr>
<td>7.0 - 7.9</td>
<td>VII &lt;</td>
<td>Very Heavy</td>
<td>10 - 20 per year</td>
</tr>
<tr>
<td>8.0 - 8.9</td>
<td>VII &lt;</td>
<td></td>
<td>1 per year</td>
</tr>
<tr>
<td>&gt; 9.0</td>
<td>VII &lt;</td>
<td></td>
<td>1 per 10-50 years</td>
</tr>
</tbody>
</table>

The Modified Mercalli Intensity Scale provides descriptive values of earthquake intensity that may provide greater meaning to the broader population as the description of intensity refers to the effects actually experienced. This scale uses an arbitrary ranking based on observed earthquake effects. The scale is composed of increasing levels of intensity ranging from shaking that is not recognizable to intense shaking resulting in catastrophic damages and casualties. The Modified Mercalli Intensity Scale is demonstrated below:

Table 4-14: Modified Mercalli Intensity Scale

<table>
<thead>
<tr>
<th>Intensity</th>
<th>Shaking</th>
<th>Description / Damage</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Not felt</td>
<td>Not felt except by a very few under especially favorable conditions.</td>
</tr>
<tr>
<td>II</td>
<td>Weak</td>
<td>Felt only by a few persons at rest, especially on upper floors of buildings.</td>
</tr>
<tr>
<td>III</td>
<td>Weak</td>
<td>Felt quite noticeably by persons indoors, especially on upper floors of buildings. Many people do not recognize it as an earthquake. Standing motor cars may rock slightly. Vibrations similar to the passing of a truck. Duration estimated.</td>
</tr>
</tbody>
</table>

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<table>
<thead>
<tr>
<th>Level</th>
<th>Intensity</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>IV</td>
<td>Light</td>
<td>Felt indoors by many, outdoors by few during the day. At night, some awakened. Dishes, windows, doors disturbed; walls make cracking sound. Sensation like heavy truck striking building. Standing motor cars rocked noticeably.</td>
</tr>
<tr>
<td>V</td>
<td>Moderate</td>
<td>Felt by nearly everyone; many awakened. Some dishes, windows broken. Unstable objects overturned. Pendulum clocks may stop.</td>
</tr>
<tr>
<td>VI</td>
<td>Strong</td>
<td>Felt by all, many frightened. Some heavy furniture moved; a few instances of fallen plaster. Damage slight.</td>
</tr>
<tr>
<td>VII</td>
<td>Very strong</td>
<td>Damage negligible in buildings of good design and construction; slight to moderate in well-built ordinary structures; considerable damage in poorly built or badly designed structures; some chimneys broken.</td>
</tr>
<tr>
<td>VIII</td>
<td>Severe</td>
<td>Damage slight in specially designed structures; considerable damage in ordinary substantial buildings with partial collapse. Damage great in poorly built structures. Fall of chimneys, factory stacks, columns, monuments, walls. Heavy furniture overturned.</td>
</tr>
<tr>
<td>IX</td>
<td>Violent</td>
<td>Damage considerable in specially designed structures; well-designed frame structures thrown out of plumb. Damage great in substantial buildings, with partial collapse. Buildings shifted off foundations.</td>
</tr>
<tr>
<td>X</td>
<td>Extreme</td>
<td>Some well-built wooden structures destroyed; most masonry and frame structures destroyed with foundations. Rails bent.</td>
</tr>
</tbody>
</table>

The graph below illustrates the increasing intensity of energy that is released and as the measured magnitude increases. While each whole number increases in magnitude represents a tenfold increase in the measured amplitude, it represents an increasing rate of 32 times more energy released in the same increase in magnitude. As the magnitude of an earthquake is measured higher, the intensity of the earthquake worsens progressively from one category to the next.
Although the closest fault lines to the campus remain 20 or more miles away, given that the entire area of Kern County is at risk to seismic activity and has a history of significant earthquakes resulting in damages, the planning committee ranks the extent of the hazard as Moderate.

History of the Hazard

The State of California has a long history of chronic and destructive earthquakes throughout the state. On average, earthquakes strong enough to result in structural damages occur three to four times a year in California, while earthquakes Magnitude 6.0 to 6.9 occur once every two to three years. Kern County also has a long history of earthquake activity. The entire area of Kern County is at risk to seismic activity and has a history of significant earthquakes resulting in damages.

Recently, in 2019, a series of earthquakes occurred in Ridgecrest, CA 80 miles to the east of Bakersfield. On July 4, a 6.4 magnitude earthquake struck followed by a 7.1 magnitude earthquake on July 6. Damage and surface ruptures surrounding the epicenter was extensive but shaking intensity in Bakersfield was minor. CSU Bakersfield personnel reported feeling shaking motion but reported no damages.

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Table 4-15: Historic Earthquake Occurrences Near Bakersfield, California

<table>
<thead>
<tr>
<th>Date</th>
<th>Location</th>
<th>Magnitude</th>
<th>Damages</th>
</tr>
</thead>
<tbody>
<tr>
<td>1/9/1857</td>
<td>Ft Tejon</td>
<td>7.9</td>
<td>Heavy property loss</td>
</tr>
<tr>
<td>12/23/1905</td>
<td>Bakersfield</td>
<td>Unknown</td>
<td>Moderate property damage</td>
</tr>
<tr>
<td>3/15/1946</td>
<td>Walker Pass</td>
<td>6.3</td>
<td>Minor</td>
</tr>
<tr>
<td>7/21/1952</td>
<td>White Wolf Fault</td>
<td>7.7</td>
<td>12 fatalities, $60 million</td>
</tr>
<tr>
<td>6/10/1988</td>
<td>32 mi SE of Bakersfield</td>
<td>5.4</td>
<td>Minor</td>
</tr>
<tr>
<td>5/28/1993</td>
<td>20 mi SW of Bakersfield</td>
<td>5</td>
<td>None reported</td>
</tr>
<tr>
<td>9/30/2004</td>
<td>17 mi NE of Arvin</td>
<td>5.0</td>
<td>Roadway damages</td>
</tr>
<tr>
<td>4/16/2005</td>
<td>25 mi S-SW of Bakersfield</td>
<td>5.1</td>
<td>None reported</td>
</tr>
</tbody>
</table>

The July 21, 1952 Kern County Earthquake estimated a Magnitude 7.7 earthquake struck at 4:52 am. The earthquake occurred on the White Wolf Fault in hills east of Bakersfield resulting in numerous surface ruptures. Twelve people were killed in the county and several hundred were injured. The shaking was strong enough to cave in railroad tunnels near Tehachapi, 40 miles east of Bakersfield. Railroad lines were warped, buildings collapsed in Bakersfield, and there was widespread underground utility and pipeline damage. Shaking was felt from Sacramento to San Diego.

The Fort Tejon Earthquake, a Magnitude 7.9 earthquake, struck in 1857 along the San Andreas fault just outside the northwestern corner of Kern County. The earthquake was able to shift the Kern River upstream and run four feet over its banks. Structural damage was limited as the area was sparsely populated at the time. The Fort Tejon Earthquake remains one of the greatest earthquakes ever recorded in the United States producing a surface rupture extending over 220 miles.

Potential Impacts of the Hazard

The shaking of the ground from earthquakes can result in building collapse, bridge failure, utility disruptions and other structural collapse. Large earthquakes can additionally cause natural gas lines to break resulting in structure fires. The proximity to the Kern River and the alluvial soils surrounding the campus presents a potential for liquefaction creating greater ground instability during seismic events. A major earthquake in the Bakersfield area would likely result in region-wide social disruptions in addition to structural damages. The region-wide structural damages may disrupt lifelines and supply

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chain routes limiting the campus from effective evacuation routes and receiving necessary supplies or equipment.

Most injuries resulting from earthquakes are from collapsing walls, flying glass, or other objects moved by ground shaking. The lack of warning allows individuals minimal time to react and find areas of safety. A moderate earthquake occurring near Bakersfield could cause injuries or fatalities to members of the campus community or support networks the campus relies on. These earthquake effects might be aggravated by collateral incidents such as fire, flooding, hazardous material spills, dam/levee compromises, and other cascading events. A catastrophic earthquake near Bakersfield could result in extensive casualties. expansive structural damages, panic, widespread utility outages, communication failures, and secondary emergencies such as fire. A catastrophic earthquake would certainly affect the broader Bakersfield region limiting immediate assistance that the campus may normally expect.

Local impacts to the CSU Bakersfield campus caused by an earthquake could include:

- Damage to any nearby refineries and petrol-chemical plants
- Damage and secondary fires to industrial buildings to the east of campus
- Potential hazardous material releases on and off campus
- Infrastructure damage to freeway system
- Structural damage to bridges over waterways and flood control channels
- Potential isolation of campus from community
- Potential isolation among on-campus residents
- Structural damage to levees
- Structural damage to campus academic and support buildings
- Structural damage to residence halls resulting in displaced student populations
- Structural damage to nearby residences
- Community members arriving on campus for refuge from damaged homes
- Damaged university communications, computer systems, and networks
- Considerable stress and fear among community
- Closure or reduction of service to campus operations
- Reduction of campus revenue

Probability of Future Occurrence of the Hazard

The Working Group on California Earthquake Probabilities (WGCEP), a collaboration between the United States Geological Survey (USGS), the Southern California Earthquake Center (SCEC), and the California Geological Survey (CGS) develops Uniform California Earthquake Forecasts (UCERFs) using the best currently available science and technology.
The UCERF version 3 provides a three-dimensional view of the likelihood a region in California will experience a Magnitude 6.7 or greater earthquake in the next 30 years. The likelihood for the Kern County fault systems surrounding Bakersfield is included in the following table.

Table 4-16: Major Potentially Active Faults in Proximity to CSU-Bakersfield

<table>
<thead>
<tr>
<th>Fault Zone</th>
<th>Recurrence</th>
<th>Maximum Magnitude</th>
<th>UCERF3 Likelihood</th>
</tr>
</thead>
<tbody>
<tr>
<td>Garlock</td>
<td>Historic: 200-3,000 years</td>
<td>6.5 to 7.1</td>
<td>6%</td>
</tr>
<tr>
<td>San Andreas</td>
<td>Varies: 20-300 years</td>
<td>6.8 to 8.0</td>
<td>45%</td>
</tr>
<tr>
<td>South Sierra</td>
<td>Historic: Unknown</td>
<td>6.0 to 7.1</td>
<td>3%</td>
</tr>
<tr>
<td>White Wolf</td>
<td>Historic: Unknown</td>
<td>7.2</td>
<td>2%</td>
</tr>
<tr>
<td>Wheeler Ridge</td>
<td>Historic: Unknown</td>
<td>6.0 to 7.1</td>
<td>4%</td>
</tr>
</tbody>
</table>

Based on the earthquake shaking potential in the Bakersfield area, the proximity to the San Andreas, Garlock, Wheeler Ridge, White Wolf, and the South Sierra Fault Systems, the probability of seismic ground shaking generating damage is considered Possible.

Vulnerability to the Hazard

A considerable challenge regarding earthquakes is they generally occur without warning. The fault systems surrounding the region all cross major transportation routes potentially reducing the availability of the supply chain. The geographic location of Bakersfield sits at the base of river systems that have deposited sediment from the surrounding mountains. In many cases, these sediment-based soils are loose and expose the potential for liquefaction. A large portion of southern Bakersfield is known to have high underground water tables as close to the surface as five to fifteen feet.

The known fault systems generating the threat to Bakersfield generally surround the city but do not cross into the city (including the CSU Bakersfield campus). However, the proximity and potential for large earthquake development from these surrounding systems expose significant vulnerabilities. The potential for earthquake damaged structures being left uninhabitable including campus residence halls will result in numerous displaced individuals and households. The lack of earthquake insurance will cause extreme financial burdens on those affected.

Elements of the vulnerability to a major earthquake on the CSU Bakersfield campus will vary depending on when the earthquake were to strike. The risk to the campus population will be lessened during periods when classes are not in session or during periods of breaks. Conversely, during the days and hours that classes are in session and staff are at

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their workplaces, the human vulnerability increases. Generally, people are safer when at home in wood frame structures as earthquakes tend to generate less structural damage to wood construction than in commercial or industrial facilities. The greater number of people on campus at the time of an earthquake will result in more people being exposed to effects from damaged campus facilities or equipment and require greater evacuation assistance. However, in region-wide events this vulnerability may simply shift to the homes and workplaces of members of the campus community and their families.

The aftermath of a major earthquake will likely result in widespread search and rescue operations for trapped and injured individuals. The demand on emergency services will be great, potentially requiring the campus community to be prepared for these scenarios and initiate response actions as needed. There will be needs for emergency medical care, shelter, water, and food for individuals who have been displaced by the earthquake. In earthquakes causing significant damages, there may be a necessity to provide assistance with identification and support to local agencies in mass fatality management.

There may be a need to evacuate members of the campus community from the campus and to other locations that are deemed to be safer. As the CSU Bakersfield campus is in downstream from dam facilities, the decision to evacuate will need to take into account whether flood control facilities are filled with water and the actual threat to the dam or levees.

Certain campus populations will experience greater challenges to a post-earthquake environment. Vulnerable populations including those that rely on specific services, require electrical power, homeless students, experience disabilities, non-English speakers, those whose age make evacuating difficult, and others will be most affected. These individuals will likely need to navigate through earthquake generated debris, extreme stresses of a disaster, an inability to communicate to or gain access to support networks, and find difficulty in accessing equipment or supplies to aid in a specific need.

Estimate of Potential Losses

Estimates of potential losses will be influenced by a variety of factors. The intensity of the earthquake will determine what scale of damages affecting campus infrastructure, equipment, and other impacted features. Losses will be generated by the physical damages, the loss of revenue, loss of academic research, loss of building contents, and community wide economic reductions. Based on estimate replacement costs of facilities and structures on campus, the total replacement costs due to earthquake are $191,391,025.

Vulnerability Assessment Conclusions

It is difficult to predict the severity of casualties, property, and cascading impacts generated by future seismic events affecting the Bakersfield region and the CSU Bakersfield campus. Each of the earthquake generated effects will vary widely based on the intensity of the earthquake, location of the epicenter, proximity to people and development, time of day and year, the soil composition under the impacted structures,
building construction, among others. In any case, the potential for a major earthquake exists affecting the campus and causing extensive challenges to the CSU Bakersfield campus and community.

In the event that a major earthquake was to strike along the many fault systems surrounding Bakersfield, the effects could be significant to the campus community and campus operations. The widespread impacts generated by a major earthquake would extend the effects of casualties, damages, and other impacts to the broader Bakersfield region creating large-scale regionwide needs for critical assistance and a heavy demand on limited emergency resources. The campus will likely be required to address critical needs independently early phases of the disaster.

The campus population is additionally vulnerable to the effects of major ground shaking that are far reaching. The psychological and social impacts a major earthquake will give rise to will potentially harm individuals and cause tremendous fear. The willingness to return indoors may be hampered especially as after-shock continue. These effects are magnified for populations having specific vulnerabilities or access limitations.
Identified Data Limitations

Missing campus structural replacement costs and an inventory of building construction types to include status of earthquake retrofitting. HAZUS generated analysis is focused on the broader community level versus finetuning the analysis to the micro-level for facilities such as a university campus.

**Erosion**

Description of the Hazard

The US Geological Survey (USGS) defines erosion as “the process whereby materials of the earth’s crust are loosened, dissolved, or worn away and simultaneously moved from one place to another”.\(^{46}\) Erosion may occur in areas of streams and rivers, along bluffs, around immovable objects (such as buildings or bridge abutments), or as a cascading result of other natural hazards, such as earthquakes or wildfires. When erosion occurs along bodies of water, the removal of material causes the shore to move further landward.

Forces such as sea level rise and changes in sediment supply impact erosion gradually and can be difficult to recognize. In contrast, the impacts of short-term events, such as storms and flooding, can be severe and immediately recognizable.

Location of the Hazard

Erosion is a relatively non-spatial hazard that can occur in any location with conducive soil structure and a source of movement such as water or wind. As such, for the purpose of this campus-level analysis, the erosion hazard poses a consistent risk across the terrain of the CSU-Bakersfield campus with erosion-prone characteristics. No areas under threat of erosion or erosion in process have been identified on campus, although campus leadership may decide to look for such locations in the future if it decides that it is necessary to so do. An area’s potential for erosion is determined by several factors, including rainfall, topography, soil characteristics, and vegetative cover. Streambank and bluff erosion can occur near any riverine area, such as the Kern River, which is adjacent to the campus.

Extent of the Hazard

There is no published scale of severity or extent for this geologic hazard. If conditions are favorable, erosion is likely to occur. Given no historical occurrence of erosion on campus nor any data identifying specific sites on campus at risk, the planning committee ranks the extent of this hazard as **Low**.

History of the Hazard

While erosion has been recorded along the Edison-Breckenridge Road east of Bakersfield, no erosion events have been recorded on the CSU Bakersfield campus.

Potential Impacts of the Hazard

Erosion causes instability in soil. During high-intensity rain events, for example, eroded areas will continue to erode, resulting in additional loss of soil and ground stability in the area. This removal of sediment can result in damage to infrastructure, public health, and safety. On campus, areas of erosion can create pedestrian and transportation hazards, and structures may become unsafe if erosion is not controlled.

Probability of Future Occurrence of the Hazard

Erosion is an on-going and dynamic process that occurs regularly. As climate change induces more frequent and intense weather events, such as wildfires and flooding, erosion may generally become more widespread or severe. These events can cause erosion or exacerbate areas already experiencing erosion. As a result, and in consideration of the history of occurrence and extent of erosion statewide, the probability of future occurrence in California is high. That said, with regard to the campus, given the lack of historical events or existing conditions favorable to erosion, the probability of future occurrence is Low. However, conditions could emerge in the future which increase the probability, precipitated by climate change, changes in land-use or other factors.

Vulnerability to the Hazard

Topography, soil structure, land use, and precipitation are all factors of erosion. CSU Bakersfield infrastructure and buildings located on steep slopes, in areas with little vegetation, or in areas with conducive soil types are more vulnerable to erosion. CSU leadership would consider performing an analysis to identify such at-risk buildings, infrastructure, slopes and soil types in the future.

In the wider Bakersfield community, erosion vulnerabilities include agricultural sector job loss, degradation of riverine ecosystems, and loss of water quality.

Estimate of Potential Losses

The historic and potential impacts of erosion on property statewide include reduced agricultural productivity, lower surface water quality, and damaged drainage networks.

A study performed by the Kern River Watershed Coalition Authority in 2015 found that the Bakersfield campus is within an area of higher soil erodibility relative to surrounding areas.\(^{47}\) However, current modeling is not precise enough to allow for an assessment of potential losses to buildings and infrastructure on campus.

Vulnerability Assessment Conclusions

While the ability to predict future erosion on the CSU Bakersfield campus is limited, the core issues shaping erosion vulnerability on campus are flora and landscaping. If left unchecked, erosion can cause significant damage to campus infrastructure and the surrounding environment.

**Identified Data Limitations**

The complex interactions between soil erosion factors make predictive modeling, determination of hazard areas, and quantification of loss difficult. Localized data on this hazard is also limited, resulting in more generalized findings.
**Extreme Temperatures (Extreme Heat)**

**Description of the Hazard**

What is considered an excessively hot temperature varies according to the normal climate for that region. However, when temperatures are extremely high, people are at higher risk for heat-related illnesses, such as dehydration, heat exhaustion, heat stroke, and in severe cases, death.48

Hazards from extreme heat are made worse when high temperatures are accompanied by high levels of humidity, which is defined as the amount of moisture in the air.49 As the temperature climbs, the air is able to hold more moisture. High humidity prevents the human body from cooling down naturally, which leads people to perceive that the temperatures “feels” hotter. The combination of temperature and humidity is known as the heat index.50

Heat stroke, the most serious heat-related illness, occurs when the body is unable to control its temperature. Body temperature rises rapidly, the sweating mechanism fails, and the body cannot cool down.51 In extreme causes, heat stroke can cause confusion and unconsciousness, so the victim is unable to seek treatment without assistance.

There are several groups of people who are uniquely vulnerable to the effects of extreme heat, such as infants and children, older adults aged 65 and up, athletes and outdoor workers, low-income households, and individuals with certain chronic medical conditions.52

**Location of the Hazard**

Extreme heat events are a non-spatial hazard and may occur throughout the CSU Bakersfield campus.

**Extent of the Hazard**

Extreme heat has a wide range of extent and severity markers and characteristics. Monthly average maximum temperatures in June through October range approximately from the low 80s up to 100 in the City of Bakersfield. According to data from the National Climatic Data Center (NCDC), the highest daily temperature recorded in Bakersfield was 114° F on June 28, 1976. With more than 40 extreme heat events since 2007, the campus planning committee ranks the extent of this hazard as **Moderate to High**.

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50 Ibid.
The National Weather Service issues a Heat Advisory when the heat index value is expected to reach 100° – 104° F within the next 12 to 24 hours. Excessive Heat Warnings are issued when there is an anticipated heat index of 105° F or greater that will last for two (2) or more hours. Excessive Heat Warnings are issued by the county when any location in the county is expected to reach that criteria. In anticipation of an Excessive Heat Warning, an Excessive Heat Watch may be issued 1 to 2 days in advance, when the Heat Warning criteria is 50 – 79% likely to occur.

Figure 4-12 (following) depicts the National Weather Service’s methodology for determining the heat index, using the % humidity and the actual temperature.

As the heat index rises, so does the potential danger to people and animals. Table 4-22 (following) shows the health hazards associated with extreme heat.

Table 4-17: Health Risks Associated with Heat Index

<table>
<thead>
<tr>
<th>Category</th>
<th>Heat Index</th>
<th>Health Hazards</th>
</tr>
</thead>
<tbody>
<tr>
<td>Extreme Danger</td>
<td>130° F or higher</td>
<td>Heat stroke / sunstroke is likely with continued exposure.</td>
</tr>
<tr>
<td>Danger</td>
<td>105° – 129° F</td>
<td>Sunstroke, heat cramps, and/or heat exhaustion is likely with prolonged exposure and/or physical activity.</td>
</tr>
<tr>
<td>Extreme Caution</td>
<td>90° – 104° F</td>
<td>Sunstroke, heat cramps, and/or heat exhaustion is possible with prolonged exposure and/or physical activity.</td>
</tr>
<tr>
<td>Caution</td>
<td>80° – 89° F</td>
<td>Fatigue is possible with prolonged exposure and/or physical activity.</td>
</tr>
</tbody>
</table>

**History of the Hazard**

Based on data gathered from the National Centers for Environmental Information (NCEI) Storm Events Database, there have been two excessive heat events in Bakersfield, both occurring within the last two years. More than 40 additional excessive heat events have been recorded in the wider Kern County area since 2007.

**June 10, 2019:** This event occurred during one of the hottest heat waves to ever hit California, with temperatures breaking records across the state and much of the Southwest.

**May 26, 2020:** The month of May ranked as one of the hottest on record for multiple cities in California, with average temperatures ranging approximately 2.5 to 5 degrees above normal.

**Potential Impacts of the Hazard**

CSU Bakersfield may experience impacts from extreme heat due to cancelled classes or postponed outdoor events in order to protect students, faculty, and staff from the weather.

In addition to the threat extreme heat poses to humans, high temperatures also pose a threat to utility production, which in turn threaten facilities and operations that rely on utilities. As temperatures rise, more people stay indoors, increasing the demand for air conditioning, fans, and other electronics. This puts a strain on the electrical grid, which can cause temporary outages. These outages can impact operations throughout campus, resulting in interruptions and delays in service. Outages may also negatively impact research efforts on campus, as the inability to maintain a steady, constant temperature may impact research specimens and experimental results.

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Probability of Future Occurrence of the Hazard

There have been extreme heat events in Bakersfield and Kern County for the past two years. With 40 or more events since 2007 (2.8 events per year), the planning committee ranks the probability of occurrence as Highly Likely that the hazard will occur annually.

Vulnerability to the Hazard

When dealing with an extreme heat event, the most common impacts are those generally felt by the people living in the targeted area. For people in particular, heat can kill when the body is pushed beyond its limits. Most heat disorders occur because the victim has been overexposed to heat. As discussed, the major human risks associated with extreme heat include dehydration, sunburn, fatigue, heat exhaustion, heat stroke, and in severe cases, death.

Some portions of the population are more at risk to the effects of extreme heat. The very young, the elderly, and certain groups with chronic medical conditions (such as asthma or other pulmonary illnesses, heart disease, poor blood circulation, neurological illnesses, and obesity) are generally more vulnerable to the effects of extreme heat, and are more likely to suffer illness or death as a result. This is especially true if exposure is extended for a period of time and preventative measures are not taken immediately.

CSU Bakersfield is aware of the potential for extreme heat events. Fall athletic teams may be exposed to extreme heat during summer training, as well as students during the early part of the fall semester. However, the campus takes precautions to remind students to remain hydrated and runs air conditioning in campus buildings. Kern County also sponsors more than a dozen cooling centers throughout the County that are open to the public when the temperature in the San Joaquin and Kern River Valleys is forecast to be 105° or higher; in the desert areas when the temperature is forecast to be 108° or higher; and in Frazier Park when the temperature is forecast to be 95° or higher. Four of these facilities operate in Bakersfield. The risk of power shut-offs affecting air conditioning is not a concern for the campus because the campus runs on the same power grid as Mercy Hospital Southwest Bakersfield.

Therefore, while this is a hazard that the campus may experience with regularity, the campus has ample familiarity with managing the risks and vulnerabilities.

Estimate of Potential Losses

Based on the previous historical occurrences, annualized losses are considered to be negligible. In an extreme heat event, loss of human life or health impacts are a greater concern than is property damage.

Vulnerability Assessment Conclusions

While the ability to predict future heat events at the CSU Bakersfield campus is limited, the effects of climate change may provide some information. According to the Environmental Protection Agency (EPA), Southern California has warmed about three degrees on average over the last century, with less rainfall. This may lead to stronger heat events, drought, and an increased risk of wildfires.56

Identified Data Limitations

Numerous public and private actors conduct research, acquire data and disseminate meteorological information and forecasting to the general public, including the CSU university system. Currently, it is assumed that, apart from regular access to climate change models on changes to temperature extremes over time, the CSU community maintains sufficient access to the data needed to plan for, respond to, and mitigate the effects of extreme heat.

Flood

Description of the Hazard

The incredible geographic diversity in California presents tremendous challenges for flood planning and response. The state is home to extensive mountain ranges such as the Sierra Nevada, Cascades, Klamath, Coastal Ranges, and the Southern California Transverse Range all creating tremendous watersheds. Large river systems drain the mountains traveling through populated communities including the Sacramento and San Joaquin Rivers draining into the California Delta. The state has a complex system of reservoirs, dams, and levees providing water storage and flood protection. Finally, California’s 840-mile coastline exposes the coastal regions to tidal influences.

Floods are characterized by the rising and overflowing of excess water from a water source such as a stream, river, lake, canal, or coastal body onto an area of normally dry floodplain. A floodplain is a lowland area downstream and/or adjacent to water bodies that are subject to flood events. Flooding is a naturally occurring event that becomes hazardous when populations and property are affected.

Flooding can result from excessive precipitation from weather systems generating prolonged rainfall, excessive snowmelt from watersheds upstream from the floodplain, infrastructure failure, exceeding the capacity of dams or levees, tidal influences, or a combination from any of the previous factors.

Flooding can result from excessive precipitation from weather systems generating prolonged rainfall, excessive snowmelt from watersheds upstream from the floodplain, infrastructure failure, exceeding the capacity of dams or levees, tidal influences, or a combination from any of the previous factors.

Floods represent one of the costliest and most frequent natural disasters that influences human suffering and economic impact in the United States. Flooding will likely result in significant damage to structures, infrastructure, utilities, landscapes, and the environment. Erosion of stream banks, roadways, other feature may result from the movement of flood waters. The saturated ground resulting from standing flood waters may cause ground instability, collapse, erosion, or other damages. Further, floods will often generate substantial debris that will accumulate and be deposited throughout the flooded areas.

Flooding can result from excessive precipitation from weather systems generating prolonged rainfall, excessive snowmelt from watersheds upstream from the floodplain, infrastructure failure, exceeding the capacity of dams or levees, tidal influences, or a combination from any of the previous factors.

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rapidly conversely are water events that present with extremely limited warning times and a limited ability to take response actions until flooding has already begun to occur. Flooding may take on different forms:

- **Flash Flooding** – Flash flooding is typically characterized by a rapid rise, short duration, and large volume of water in a localized area. Heavy rainfall in areas that have limited drainage capacities often contribute to flash flooding conditions. These flooding events frequently occur with limited notice requiring immediate evacuation or rapid response efforts such as sand bagging. Flash flooding may arrive with fast moving water creating added hazardous conditions.

- **Riverine Flooding** – Riverine flooding is usually caused by prolonged rainfall or rainfall combined with heavy snowmelt. When soils are already saturated, the ability for the ground to absorb water is minimized. In a riverine flood, the water way exceeds channel capacity and extends into areas outside of the channel, often in developed communities. In California, riverine flooding is most likely to occur from November through April. The duration of riverine floods may vary from a period of hours to weeks.

- **Localized Flooding** – Localized flooding is commonly the result of stormwater drainage systems being overwhelmed by unusually heavy rainfall. These flooding events frequently occur in areas that are urbanized or developed with greater amounts of impervious surfaces not allowing ground absorption. This generates added runoff into the drainage systems and onto roadways creating backups.

- **Infrastructure Failure** – Failures of dams or levees presents a serious flooding concern for areas downstream from the compromised structure. This situation may result in a catastrophic flood with limited warning time and widespread areas affected.

- **Coastal Flooding** – Coastal flooding can occur in multiple areas along the California coastline. Flooding may result from intense storms coming from the Pacific Ocean that generate elevated water levels or storm surge. The size, duration, winds generated, and intensity of the storm will influence the effect the waves will have on the shoreline. Periods of high tide can aggravate the conditions allowing greater wave impingement into coastal areas.

**Atmospheric River**

California, including the location of this campus, is subject to the effects of a phenomenon referred to as atmospheric rivers. These weather events consist of long, narrow regions in the atmosphere transporting tremendous amounts of water vapor from the tropics. These weather regions behave like rivers in the sky. They can carry heavy volumes of water vapor compared to the amount of water flow at the mouth of the Mississippi River. As these atmospheric rivers arrive into California they tend to generate significant rain and snow.
Atmospheric rivers can arrive in many different shapes and sizes. The larger events are able to generate extreme rainfall amounts resulting in flooding. They can stall over watersheds vulnerable to flooding, often saturated with heavy snow amounts. The atmospheric rivers known as a “Pineapple Express” coming from the tropics and arriving with warmer air may produce heavy rains that will melt ground snow adding to the water volume that will be added in the flood runoff.

These events can produce heavy amounts of precipitation creating extensive damages. However, these events may present as weaker systems that produce precipitation that is enough to be beneficial for the local water supply. At the higher elevations in the California mountains, these events have the potential to generate a tremendous snowpack providing a source of water during the dry summer months.

Figure 4-13: The Science Behind Atmospheric Rivers

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Location of the Hazard

The Kern River has been identified as the primary flood source for the City of Bakersfield including the CSU Bakersfield campus. The CSU Bakersfield campus sits entirely within a Zone X Special Flood Hazard Area (SFHA) designation on the Flood Insurance Rate Map. The Zone X designated areas are minimal flood threat.

Figure 4-14: Dams and Levees near Bakersfield
Figure 4-15: HAZUS Flood Boundaries and Assets Near CSU-Bakersfield

Kern County is home to a number of river and stream systems, flood control facilities and levee systems throughout the Bakersfield region including the Kern River. The Kern River drains the southern Sierra Nevada Mountains and Isabella Lake into the southern San Joaquin Valley. The Kern River Watershed is fed by snowmelt from the mountains near Mount Whitney and to the south.

The Kern River feeds into Isabella Lake a reservoir created by the Isabella Lake Dam. The dam is a US Army Corps of Engineers dam in the mountains 50 miles east of the CSU Bakersfield campus. The Kern River flows down through the canyons below the dam and through Bakersfield before reaching the campus. There are three diversion dams on the river downstream from Isabella Lake Dam and upstream from the campus. The CSU Bakersfield campus is situated across from Stockdale Highway separating the southern bank of the Kern River from the campus. The distance from the river to the campus boundary is less than 1,500 feet.

Extent of the Hazard

The CSU Bakersfield campus sits entirely within a Zone X Special Flood Hazard Area (SFHA) designation on the Flood Insurance Rate Map. The Zone X designated are areas
are minimal flood threat. The CSU Bakersfield campus lies within a levee (flood-protected) area. Only in the very rare case that the Kern River were flowing at elevated levels beyond the capacity of the designed flood protection, would the CSU Bakersfield campus likely experience significant flood related damages. As such, the campus planning committee ranks the extent of the hazard as **Low**.

In support of the NFIP, FEMA identifies those areas that are more vulnerable to flooding by producing Flood Hazard Boundary Maps (FHBM), Flood Insurance Rate Maps (FIRM), and Flood Boundary and Floodway Maps (FBFM). Several areas of flood hazards are commonly identified on these maps, including the 1% annual chance flood zone. Flood zones are further delineated by risk and are assigned a letter signifier. The flood zone designations are defined and described in the following table.

Table 4-18: Flood Zone Designations and Descriptions

<table>
<thead>
<tr>
<th>Zone Designation</th>
<th>Percent Annual Chance of Flood</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Zone V</td>
<td>1%</td>
<td>Areas along coasts subject to inundation by the 1% annual chance of flooding with additional hazards associated with storm-induced waves. Because hydraulic analyses have not been performed, no BFEs or flood depths are shown.</td>
</tr>
<tr>
<td>Zones VE and V1-30</td>
<td>1%</td>
<td>Areas along coasts subject to inundation by the 1% annual chance of flooding with additional hazards associated with storm-induced waves. BFEs derived from detailed hydraulic analyses are shown within these zones. (Zone VE is used on new and revised maps in place of Zones VI-30).</td>
</tr>
<tr>
<td>Zone A</td>
<td>1%</td>
<td>Areas with a 1% annual chance of flooding and a 26% chance of flooding over the life of a 30-year mortgage. Because detailed analyses are not performed for such areas, no depths or base flood elevations are shown within these areas.</td>
</tr>
<tr>
<td>Zone AE</td>
<td>1%</td>
<td>Areas with a 1% annual chance of flooding and a 26% chance of flooding over the life of a 30-year mortgage. In most instances, base flood elevations derived from detailed analyses are shown at selected intervals within these zones.</td>
</tr>
<tr>
<td>Zone AH</td>
<td>1%</td>
<td>Areas with a 1% annual chance of flooding where shallow flooding (usually areas of ponding) can occur with average depths between 1 -3 feet.</td>
</tr>
</tbody>
</table>
Flooding in Bakersfield and the broader Kern County region have typically occurred during the winter months when Pacific storms are more common. The occurrences of significant flooding typically have been the result of successive intense storms with heavy precipitation. The region has experienced flood events that have caused tens of millions of dollars in damages and numerous fatalities. Although no recorded flood events pertain to the campus footprint, the following provides insight into information of past flooding events that are significant to the CSU Bakersfield campus.

Table 4-19: Historic Flooding Events Near Bakersfield

<table>
<thead>
<tr>
<th>Date</th>
<th>Event</th>
<th>Declaration</th>
<th>Damages</th>
</tr>
</thead>
<tbody>
<tr>
<td>11/21/1950</td>
<td>Flood</td>
<td>State</td>
<td>$2 million</td>
</tr>
<tr>
<td>12/23/1955</td>
<td>Flood</td>
<td>Federal</td>
<td>12 fatalities, $60 million</td>
</tr>
<tr>
<td>10/25/1975</td>
<td>Flood; Heavy Rains</td>
<td>State</td>
<td></td>
</tr>
<tr>
<td>12/21/1977</td>
<td>Flood; Heavy Rains</td>
<td>State</td>
<td>$25 million</td>
</tr>
<tr>
<td>2/15/1978</td>
<td>Flood; Heavy Rains</td>
<td>Federal</td>
<td>$5 million</td>
</tr>
<tr>
<td>2/9/1983</td>
<td>Flood; Winter Storms</td>
<td>Federal</td>
<td></td>
</tr>
<tr>
<td>2/10/1992</td>
<td>Flood; DR=979-CA</td>
<td>Federal</td>
<td>$7 million</td>
</tr>
<tr>
<td>1/10/1995</td>
<td>Flood; 1995 Severe Storms</td>
<td>Federal</td>
<td>$6 million</td>
</tr>
</tbody>
</table>

Floods occurring from December 17-20, 2010 were caused as a result of a series of low-pressure systems from the Pacific bringing substantial precipitation to California. Heavy rains were experienced throughout the Bakersfield area in addition to the hills and mountains. Rainfall records were broken at weather stations in Bakersfield and further up in elevation. Roadways were flooded, mudslides were reported, and drainage systems were overwhelmed backing up water into developed communities. Over $5 million in damages occurred during this storm event.

The December 29, 2010 to January 2, 2011 Kern County flooding resulted from heavy rains along the east side of the San Joaquin Valley including eastern portions of Bakersfield. The ground became saturated and was unable to absorb additional precipitation. During this period Bakersfield received almost 6 inches of rain while the higher elevations in the Sierra Nevada mountains received over a foot of additional snow. The flooding that occurred resulted in over $14 million in damages.

Potential Impacts of the Hazard

A flood will potentially result in extensive amounts of water entering onto developed areas. The force and volume of water that is generated by a flood may cause extensive structural damage in areas subject to standing or moving water. The effects of flooding may spread over significant distances covering large areas of land. The extent of the impacts would vary based on a number of factors such as the volume of water flooding, the time of the flood event, the amount of warning provided, the location and extent of the flood boundary, facility elevation, and distance from the flood source. Potential impacts resulting from flooding include:

- Injuries or loss of life
- Property destruction or damage
- Loss of property contents
- Infrastructure damage including roadways, bridges, other transportation means
- Public health hazards resulting from mold, mildew, and disease due to flood water
- Flooded or destroyed lifelines/supply routes
- Damaged or destroyed utilities
- Loss of community economic base
- Employment losses
- Agricultural (crops and livestock) damages or destruction
- Environmental damage
- Prolonged periods of necessary dewatering
- Flooding erosion may alter natural drainage channels
- Societal and community impacts
- Psychological impacts of impacted populations
- Disruptions to education delivery to community

Additionally, individuals who were unable to evacuate in time or refused to leave will likely need assistance or rescue from the flooded area. Remaining in or being trapped by flood waters places individuals in significant risk of injury or death. The impacts extend beyond the danger placed upon the affected individual and places greater resource demands on agencies and organizations making efforts to rescue trapped individuals.

**Probability of Future Occurrence of the Hazard**

Kern County is determined to be at high risk from flooding. The repeated historic occurrences have shown that the region is subject to a 26.8% chance of flooding in any given year. Given that the location of the CSU Bakersfield campus is in Zone X (area of minimal flooding), the planning committee ranks the annual probability of occurrence as **Unlikely**.

**Vulnerability to the Hazard**

The CSU Bakersfield campus is subject to the effects of limited and isolated flooding or ponding resulting from excessive precipitation, snowmelt, river/levee overflow, or a combination of these. The Isabella Dam upstream from the campus presents the potential for catastrophic flooding and damage through a majority of the Bakersfield area. The Kern River and extending irrigation channels surround the campus and have limited storage or volume capacities.

Vulnerability to flooding on the CSU Bakersfield campus will vary depending on when the flood were to occur and the location of people and assets located within any low lying areas. The risk to the campus population will be lessened during periods when classes are not in session or during periods of breaks. Conversely, during the days and hours that classes are in session and staff are at their workplaces, the human vulnerability increases. However, in region-wide events this vulnerability may be extended to the homes and workplaces of members of the campus community and their families.

During low probability, severe flood events, some campus buildings and infrastructure in low lying areas might be vulnerable to large-scale flooding if it reaches the university.

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Campus utilities and communication capabilities could be impacted by flood waters rendering them disabled. A rare flood covering a large portion of the city might affect communication capabilities well beyond the boundaries of the campus. Remaining flood waters will leave behind molds and other health concerns in affected campus buildings and facilities likely requiring extensive restoration or demolishing.

Certain campus populations will experience greater challenges to a post-flood / failure environment. Vulnerable populations will likely need to navigate through flood generated debris, face extreme health safety issues from flood waters, experience extreme stresses of a disaster, an inability to communicate to or gain access to support networks, and find difficulty in accessing equipment or supplies to aid in a specific need. Students remaining on campus such as those residing in low lying residence halls would be particularly vulnerable especially those without access to adequate transportation.

**Estimate of Potential Losses**

Estimates of potential losses will be influenced by a variety of factors. The volume and force of the water will determine the scale of damages affecting campus infrastructure, equipment, and other impacted features. The location and elevation above flood waters will affect the level of damage and individuals exposed. The time of the academic year, the day of week, and hour in which the flooding was to occur will influence the number of people on campus and potential casualties. The severity of the storms producing precipitation, the speed of the storms moving across the area, the level of snowpack in the higher elevations, and amount of resulting snowmelt will produce varying effects on damages produced and costs incurred. Losses will be generated by the physical damages, the loss of revenue, loss of academic research, loss of building contents, and community wide economic reductions.

**Vulnerability Assessment Conclusions**

While the campus is located in an area of minimal flood potential (Zone X), the primary vulnerabilities to flood on campus are people and assets in low lying areas exposed to mostly localized flooding and ponding from low probability, large-scale storms that produce heavy amounts of precipitation directly over the campus and surrounding neighborhoods. While the degree of campus vulnerability overall is minimal due to its location, low probability, severe flooding on the CSU-Bakersfield campus and surrounding area generates the potential for a number of cascading effects such as disruptions to the local economy, utility failures, disruptions to providing for the needs of the campus and the community, and development of public health hazards. These effects would be exacerbated by effects of seasonal flooding, ongoing heavy precipitation, or excessive run-off from the watershed contributing to the river system. The potential for widespread flooding and damage of structures due to the force of water, while unlikely, has exponentially powerful impacts on particular segments of the campus community including those with access or functional needs, international students, the homeless, and students residing in the residence halls.
Identified Data Limitations

Missing campus structural replacement costs and complete inventory of building construction features or mitigation efforts to lessen the impact due to flood inundation.


**Hazardous Materials**

Description of the Hazard

A hazardous material is defined in California’s State Hazardous Materials Incident Contingency Plan (1991) as “a substance or combination of substances which, because of quantity, concentration, physical, chemical, or infectious characteristics may: cause, or significantly contribute to an increase in deaths or serious illnesses; and/or pose a substantial present or potential hazard to humans or the environment.” Hazardous materials are one or more of the following: flammable, corrosive or an irritant, oxidizing, explosive, toxic (poisonous or infectious), thermally unstable or reactive, or radioactive. Hazardous materials are ubiquitous in modern society and may be found at all stages of production, consumption, and disposal.

Federal and state laws permit the intentional release of some hazardous materials into the environment such that the risk to human health and the environment is thought to be acceptable. However, sometimes releases are unintentional, resulting from leaks, accidents, or natural hazards. This section focuses on such accidental releases and fall into the following key categories:

**Fixed Hazardous Materials Incident**

A fixed hazardous materials incident is the accidental release of chemical substances or mixtures during production or handling at a fixed facility.

**Transportation Hazardous Materials Incident**

A transportation hazardous materials incident is the accidental release of chemical substances or mixtures during highway, waterway or air transport. Populations, built and natural environments are potentially impacted.

**Pipeline Incident**

A pipeline transportation incident occurs when a break in a pipeline creates the potential for an explosion or leak of a dangerous substance (oil, gas, etc.) possibly requiring evacuation. An underground pipeline incident can be caused by environmental disruption, accidental damage, or sabotage. Incidents can range from a small, slow leak to a large rupture where an explosion is possible. Inspection and maintenance of the pipeline system along with marked gas line locations and an early warning and response procedure can lessen the risk to those near the pipelines.

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Hazardous materials can also be classified according to worker safety and health. Information provided by California Division of Safety and Health includes guidelines related to:

- **Safety hazards** (fire and fire byproducts, electricity, flammable gases, unstable structures, demolition, sharp or flying objects, excavations)
- **Health hazards** (carbon monoxide ash, soot and dust; asbestos; hazardous liquids; other hazardous substances; heat illness)

### Natural-Technological Incidents (Natechs)

During the past two decades, increasing attention has been given to hazardous materials releases resulting from Natechs or a natural disaster event that triggers a technological hazard event. Natechs are of particular concern for the following reasons:

- They can produce a simultaneous effect on many industrial facilities
- Can overwhelm response capacity
- Containment systems may fail
- May produce cascading disasters
- Response may be hindered by a disaster’s impact on the physical environment

### Location of the Hazard

Hazardous materials and infrastructure such as fuel, chemicals, hazardous waste sites and gas pipelines are located on each campus. At larger scales (beyond the campus planning area) hazardous materials are located throughout Bakersfield and Kern County, and reflect different types, configurations and scales dispersed across these geographic areas.

### Extent of the Hazard

There is no comprehensive statewide vulnerability assessment available at this time. As such, the true extent of the hazardous materials risk in California and its communities is not known, meaning no overarching conclusions have been reached which have been able to integrate all qualitative and quantitative risk factors to produce a comprehensive measure of the extent of the hazard. However, for the CSU – Bakersfield planning committee, based on the degree of hazardous materials (identified through mapping), the history of hazmat events on campus, and because the assessment of risk is so complex, it is prudent to rank the extent of the hazard for the CSU – Bakersfield campus as High and

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to consider worst case scenarios as the main driver of policy in order to fully mitigate all possible hazardous materials event outcomes.

For example, according to the 2018 CA State Hazard Mitigation Plan, 400 hazardous materials problems are tied to 32 past earthquakes, including more than 495 documented hazardous materials releases due to the Loma Prieta Earthquake alone (this number excludes innumerable leaks in Pacific Gas & Electric’s natural gas distribution system). That said, it is likely that many such hazardous materials releases have received little attention in the past because public authorities, the media, and the public have overlooked them in the rush to address and recover from immediate disaster threats, and that responsible parties may have an incentive to understate the extent of releases or not to report them at all.

History of the Hazard

According to the CA Governor’s Office of Emergency Services’ Hazardous Materials Spill Report, the state experiences from 10 to 30 spill events daily. As of April 20th, 2021 already 2096 spill events had occurred. Such events have occurred in all the cities and/or counties where CSU campuses are located.

With regard to hazmat incidents at CSU - Bakersfield, one chemical spill took place in the science lab in 2015 which resulted in evacuation of the building and spill remediation.

Potential Impacts of the Hazard

A large hazardous materials release could affect an entire community or city under certain conditions related to direction of air flow (air-based chemical release) and population density or the contamination of a community’s main water supply. Either type of release could necessitate large scale evacuation. By contrast, in the rural unincorporated areas where population densities are low, even in the event of a large release, the number of homes that may need to be evacuated would be significantly lower than in an urban environment. The occurrence of a hazmat incident can also result in the shut-down of transportation corridors which can last for hours at a time while the impacted area is stabilized.

The release of some toxic gases may cause immediate death, disablement, or sickness if absorbed through the skin, injected, ingested, or inhaled. Contaminated water resources become unsafe and unusable, depending on the amount of contaminant. Some chemicals cause painful and damaging burns if they come in direct contact with skin.

66 Source: 2018 California State Hazard Mitigation Plan, Section 9.2.
Prolonged and concentrated exposure to such chemicals can produce severe long-term impacts to respiratory, endocrine and nervous systems, heart and brain health.

On the CSU-Bakersfield campus, hazardous chemicals are stored at the south end of campus, while a gas pipeline runs through the north side. The potential impacts of chemicals and toxic gases discussed above also apply to the students, staff and environment on campus.

With regard to the natural environment overall, contamination of air, ground, or water may result in harm to fish, wildlife, livestock, and crops. The release of hazardous materials into the environment may cause debilitation, disease, or birth defects over a long period of time. Loss of livestock and crops may lead to economic hardships within the community.

Recent California examples include the 2016 Aliso Canyon methane gas leak⁶⁸, which caused evacuation of nearby residents, many of whom experienced temporary health problems such as difficulty breathing and eye irritation; and the 2016 Fruitland metal recycle plant fire in Maywood, which released heavy metals such as lead, magnesium, copper, aluminum, antimony, calcium, iron, sulfur, tin, potassium, and zinc which pose severe risks to public health.⁶⁹ Health effects from exposure to these metals included short-term symptoms such as irritation to the eyes, nose, throat, and lungs.

**Potential Impact of the Hazard (Natechs)**

Natural disasters, including earthquake, flood, and fire also pose risks to public health and the environment. For example, following the Northridge Earthquake, California State University (CSU) Northridge laboratories and chemical storage rooms experienced multiple chemical spills. Such incidents, triggered by a natural disaster, pose a significant risk to students, faculty, staff, and first responders. Any CSU campus with a science lab (such as CSU – Bakersfield) is at risk of potential impact from a natural-technological (combined impact) event.

In a severe flood event, floodwaters are often contaminated with hazardous materials posing a threat to public and animal health, groundwater, and other parts of the environment. These hazardous materials may be released from damaged or flooded underground tank sites (e.g., gas stations or chemical storage facilities), propane tanks, manure or human waste handling facilities, fertilizer and pesticide storage, agricultural sites, and household hazardous waste.

In a fire event, (such as the October 2017 Northern California firestorms which destroyed approximately 6,000 residences) entire neighborhoods can be burned to the ground. Hazardous material release creates public health concerns which can delay the initial steps of fire recovery, including reopening burned areas to residents and initiating debris

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removal activities. The post-fire “toxic sweep” poses a risk of coming into contact with toxic substances due to the presence of synthetic and hazardous materials.

Probability of Future Occurrence of the Hazard

The probability of occurrence for a hazmat release on the CSU – Bakersfield campus can be viewed in two different ways: first, is that the history of occurrence serves as a sound predictor of future probability assuming current risk and vulnerability factors remain somewhat constant. For the purposes of the current estimate, no current data clearly indicates otherwise. As such, CSU – Bakersfield has experienced 1 hazmat event. That said, hazmat occurrences are largely based on human error, and changes in risk and vulnerability factors such as a decreased vigilance in materials oversight and handling practices or changes in the amount of chemicals or exposure will likely affect future probability on campus.

Vulnerability to the Hazard

Hazardous materials pose a risk to the CSU – Bakersfield campus. As identified by the campus planning committee and on the hazmat map, the following vulnerabilities are present on campus: a gas pipeline runs through the north side of campus; hazardous materials are stored at the south end of campus; the science lab conducts experiments with chemicals (and a chemical spill resulted in the evacuation of the science building).

Although it is quite difficult to produce a quantitative measure of vulnerability because (unlike natural hazards) the probability of occurrence is dependent on human error, which itself is variable based upon a fluctuating set of interrelated factors, some of which lack prediction or control, given the complexity of how all natural and built environments and hazmat risks factors interrelate at the local or campus level, it is prudent to assume for planning purposes that the campus’ vulnerability is a sub-set of the larger community’s vulnerability. As such, CSU – Bakersfield leadership maintains vigilance to mitigate the campus’ vulnerabilities identified above at a minimum.

Estimate of Potential Losses

As discussed previously, it is difficult if not impossible to produce an accurate quantitative measure of vulnerability because of the variable nature of a hazardous materials spill. For example, the release of a toxic airborne chemical in a populated area has severe impact potential, whereas the impact potential of a small chemical spill in a remote or rural area is most likely limited to remediation of soil. And, in both cases, the probability of occurrence is dependent on human error, which itself is variable based upon a fluctuating set of interrelated factors, some of which lack prediction or control. In all cases, different types and amounts of hazardous materials interact with fluctuating combinations of human error to produce different event outcomes with variable impact costs.

Vulnerability Assessment Conclusions
It is well understood that with regards to hazmat vulnerability, each campus and its surrounding community (including CSU - Bakersfield) operates through a complex and dynamic interaction between industrial and commercial inputs and outputs and the natural and built environment. Such activity produces hazardous materials that move through the environment along both convergent and divergent routes and across all levels of land-use from site to campus to city and county and beyond. It is also clear from a review of the Kern County hazard mitigation plan and Cal OES’ records of hazardous material spills, that such events occur with great frequency and varying degrees of severity across jurisdictions statewide. As such, in assessing the vulnerability of the CSU - Bakersfield campus, campus-level risks and vulnerabilities are not discreet or isolated but can become exacerbated or augmented through connections to broader community-level hazmat risks and vulnerabilities.

Finally, in order to draw conclusions on vulnerability, it should be noted that any identified vulnerabilities at the campus level and/or community level are circumscribed and potentially reduced by targeted policy and program interventions. Numerous policies and programs have been established in recent years in response to California’s widespread and complex and integrated hazardous materials risks - California established the Unified Program which consolidates and integrates the administrative requirements, permits, inspections, and enforcement activities of the following environmental and emergency response programs: the Aboveground Petroleum Storage Act (APSA) Program, Area Plans for Hazardous Materials Emergencies, the California Accidental Release Prevention (CalARP) Program, the Hazardous Materials Release Response Plans and Inventories (Business Plans), Hazardous Material Management Plan (HMMP) and Hazardous Material Inventory Statement (HMIS) requirements (California Fire Code), the Hazardous Waste Generator and Onsite Hazardous Waste Treatment (tiered permitting) Programs, and the Underground Storage Tank Program.

Identified Data Limitations

The CSU - Bakersfield planning committee has provided information on campus-level hazmat materials and risks. Data limitations pertain to a comprehensive understanding of human activity and error related to materials control over the long term.
**Landslide**

Description of the Hazard

A landslide is a down-slope movement of soil, rock, or other debris, and can also be referred to as a mass movement or slope failure. These geological hazards can range in size from a few feet to over a mile in length and width and, when heavy and rapidly moving, can cause serious damage and loss of life.

Landslides are classified based on the type of material and type of movement involved. They can range from slow-moving earth flows to fast-moving debris flows, though many large slope failures involve more than one type of movement. The primary natural triggers of slope failures are water, seismic activity, and volcanic activity. Slope saturation by water can occur from intense rainfall, snowmelt, changes in ground-water levels, and surface-water level changes along coastlines. In winter months, El Niño storms or other high rainfall events may saturate soils and trigger slope failure.

Deep-Seated Landslides

Deep-seated landslides, ranging in depth from ten to several hundred feet, occur as a result of geologic and hydraulic changes, such as earthquakes or increased levels of groundwater. These landslides can move slowly or quickly and can cause extensive property damage, but rarely result in loss of life.

Debris Flows Related to Shallow Landslides

Shallow landslides may mobilize into rapidly moving debris flows and typically occur after sudden saturation of the ground. These types of debris flows are typically more dangerous because they move rapidly, causing both property damage and loss of life.

Debris flows may also occur as a result of post-fire conditions, where wildfires have left barren ground exposed to heavy rainfall. Intense rainfall, generally greater than .5 inch per hour, has the potential to trigger a post-fire debris flow. These landslides may impact lives and properties within the deposition zone and can result in downstream flooding. Post-fire debris flows often occur during the fall and winter following major

Location of the Hazard

The susceptibility of an area to landslides depends on several variables, including magnitude of slope gradients, water content, ground cover, presence of erosion, and slope material and structure. However, landslides are most prevalent in terrain with weak material and steep slopes, and the highest risk is found in areas with high rainfall or high earthquake potential. Slope failures are also most likely to occur in areas where they have

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occurred in the past. In California, the most landslide-prone areas are found along the coast and in the northern Franciscan Formation.

General landslide vulnerability can be estimated from the distribution of weak rocks and steep slopes as seen in Figure 4-12 (below). Based on Figure 4-12, the CSU-Bakersfield campus is not located in an area susceptible to landslides.

Figure 4-16: CSU-Bakersfield Landslide Susceptibility

Extent of the Hazard

The City of Bakersfield is susceptible to seismic activity from several faults in the region. A strong earthquake or intense rainfall could trigger slope failures in the Greenhorn Mountain foothills and along the Kern River Canyon and floodplain. As these areas are

primarily used for agriculture and open space, people or structures are not likely to be significantly exposed to the impacts of seismically induced landslides. However, the indirect impacts of landslides in the region may cover a larger geographical extent. Based on the campus’ distance from all landslide susceptibility zones, the planning committee ranks the extent of the hazard on campus as **Low**.

**History of the Hazard**

FEMA has declared nine major disasters involving landslides, mudslides, debris flows, or mud flows in Kern County since 1978. NOAA has recorded forty-three debris flow events in the County since 2003, most of which occurred in the Greenhorn Mountains to the east and the San Emigdio Mountains to the south. However, there have been several historic occurrences proximal to or within Bakersfield city limits. On September 3, 2017, strong thunderstorms produced a debris flow in southern Bakersfield that resulted in $50,000 of damage.

**Potential Impacts of the Hazard**

CSU Bakersfield may be impacted by the disruption of services as a result of landslides in the region. Landslides can result in physical damage to buildings and property and have the potential to significantly effect infrastructure. As a landslide moves, it distresses structural foundations by settlement, cracking, and tilting. Fast-moving flows can remove entire structures in one instance, while other types of flows can cause damage gradually. Transportation and utility infrastructure are particularly vulnerable to landslides, since the failure of any component can disrupt service over a large area. The loss of power and communication and disruption of transportation can have cascading effects throughout an area, including impaired disposal of sewage, contamination of water supplies, and the release of flammable fuels. Transportation routes are also often expensive to clean up, and prolonged obstruction can disrupt the movement of people and goods for long periods of time.

**Probability of Future Occurrence of the Hazard**

Slope failures are often triggered by other natural hazards such as heavy rainfall and earthquakes, so landslide frequency is often related to the frequency of these other hazards. As climate change impacts the frequency and intensity of triggers such as rain events and fires, landslides may generally occur more often. Historically, landslides have occurred frequently in the mountains surrounding the San Joaquin Valley and therefore are likely to occur in this area in the future. However, given the location of the campus well beyond landslide risk zones, the planning committee ranks the probability of the landslide hazard for the campus as **Unlikely**. That said, based on the occasional

occurrence of landslides to the east, the probability of experiencing secondary effects of a landslide such as loss of power or transportation disruption is **Possible**.

**Vulnerability to the Hazard**

The vulnerability of the built environment to landslides depends on exposure and is more likely to incur damage as a result of proximity, rather than inferior structural design. The structures most vulnerable to landslides are buildings and utility/transportation lifelines, which can be impacted by either impact or ground deformation. Utilities and transportation infrastructure are particularly vulnerable, due to their geographic extent and susceptibility to physical distress. Any population proximal to a landslide when it occurs is vulnerable to its impacts. That said, the CSU Bakersfield campus’ vulnerability is limited to secondary effects of a landslide such as power outage or transportation disruption.

**Estimate of Potential Losses**

There are no current models for estimating potential losses from a landslide directly impacting the campus.

Although the economic impact of landslide damage can exceed that of the direct repair costs, there are currently no applicable methods for estimating indirect costs related to CSU Bakersfield.

**Vulnerability Assessment Conclusions**

Community exposure to landslides varies depending on their physical locations – whether in flat plains or on steep hillsides – and on their dependence on critical infrastructure located in landslide hazard zones.

Landslides could impact the campus in a variety of ways, primarily related to indirect impacts to transportation and utilities. Utility outages can impact health, particularly for vulnerable populations, and can cause interruptions in operations. Interruptions may impact student and employee’s ability to travel to campus and the delivery of classes and events.

**Identified Data Limitations**

The ability to predict future landslides at the CSU Bakersfield campus is limited. However, the USGS estimates that climate change-induced shifts in weather will increase the frequency of post-wildfire landslides, which are expected to occur almost every year in California.75

**Power Outage**

Description of the Hazard

Bakersfield is a charter city in Kern County, California. It is the county seat and largest city of Kern County, covering about 151 square miles near the southern end of the San Joaquin Valley and the Central Valley region. It is also the home of CSU Bakersfield.

Most aspects of modern life, and almost all aspects of urban life, rely on the availability of reliable utilities, such as electricity, water, and natural gas. An interruption in the supply or distribution of these commodities can leave highly populated areas like Bakersfield without basic services, such as electricity or sanitation. These interruptions can be cascading effects from other hazard events, such as windstorms, floods, wildfires and earthquakes, or they can be caused by intentional disruptions of transmission lines.

A power outage event can interrupt day-to-day operations of the CSU Bakersfield campus, like in-person classes, impede, or limit digital, telephonic or radio communications, create traffic jams around the busy avenues and boulevards surrounding the campus, close the student health center and close restaurants around campus and outside the campus. Additionally, thousands of CSU Bakersfield student residents in on-campus housing would also be affected by a power outage on campus and in the surrounding area. Additionally, a severe outage to the City of Bakersfield or to Kern County would directly affect the campus and the community.

Electric power disruptions and outages fall into two categories: intentional and unintentional.

The four types of **intentional** disruptions are:

- **Planned**: Some disruptions are intentional and can be scheduled based on maintenance or upgrading needs.
- **Unscheduled**: Some intentional disruptions must be done "on the spot" in response to an emergency.
- **Demand-Side Management**: Some customers (i.e., on the demand side) have entered into an agreement with their utility provider to curtail their demand for electricity during periods of peak system loads.
- **Load Shedding**: When the power system is under extreme stress due to heavy demand and/or failure of critical components, it is sometimes necessary to intentionally interrupt the service to selected customers to prevent the entire system from collapsing. These intentional interruptions result in rolling blackouts.

**Unintentional** or unplanned disruptions are outages that come with essentially no advance notice or warning. This type of disruption is the most problematic. The following are categories of unplanned disruptions:

- Accident by the utility, utility contractor, or others.
- Malfunction or equipment failure.
- Equipment overload (utility company or customer).
- Reduced capability (equipment that cannot operate within its design criteria).
- Tree contact other than from storms.
- Vandalism or intentional damage.
- Weather, including lightning, wind, earthquake, flood, and broken tree limbs taking down power lines.
- Wildfire that damages transmission lines.

Location of the Hazard

Although power outages can take place within a certain area, it has the potential to affect the entire planning area equally.

Extent of the Hazard

In order to anticipate outage conditions and reduce impacts, campus facility managers and others keep track of conditions and data provided by the media, municipal utilities and the California Independent System Operator (CAISO). CAISO is tasked with managing the power distribution grid that supplies most of California, except in areas served by municipal utilities and is thus the entity that coordinates statewide flow of electrical supply. CAISO uses a series of stage alerts to the media based on system conditions. The alerts are:

- Stage 1 - reserve margin falls below 7 percent.
- Stage 2 - reserve margin falls below 5 percent.
- Stage 3 - reserve margin falls below 1.5 percent.

Rotating blackouts become a possibility when Stage 3 is reached. Utility agencies aim to advise affected areas approximately 48 hours in advance of a potential Public Safety Power Shutoff (PSPS) event and will attempt notification again approximately 24 hours before power is shut off. Campus staff respond accordingly.

Given the prevalence of rolling blackouts and other power outages in California, the campus maintains safety precautions, situational awareness, access to emergency power generators and other protocols for managing campus power outages. Given that recorded outages have taken place on campus, the planning committee ranks the extent of the power outage hazard as Moderate.

History of the Hazard

CSU Bakersfield has experienced power outages for various reasons. The university worked with the community’s local electric utility company, Southern California Edison (SCE), to restore energy to the campus for its facilities, assets, resident halls, and classrooms. The following are examples of power outage events experienced over recent years:

- July 21, 2020: 1,255 PG&E customers lost power. The outage is impacting areas of Haggin Oaks and Seven Oaks south and southwest of the Cal State Bakersfield campus.

Power outages affecting Bakersfield and Kern County.
February 14, 2019: Two major power outages affecting Kern County. The outages affected approximately 1,500 residents.

October 10, 2019: Pacific Gas & Electric performed a PSPS for approximately 426,000 homes and businesses as red flag warnings were issued across most of California, including Bakersfield, clearing the way for the state’s largest power company to end a preventive outage aimed at reducing wildfire risk.

September 7, 2020: Bakersfield and other Kern County communities were affected by PSPS affecting thousands of county residents.

Potential Impacts of the Hazard

Instructors, campus residents, staff and administration rely on electricity for basic survival and operations. During a widespread power failure, it may take days to restore operations. Electrical power may be the only cooling source for many individuals around the campus and its community, and long-term outages can potentially put people’s health and life at risk. Disruptions in the supply of heating fuel may put people and property at risk during extremely cold weather if it relies on electric generation or heating mechanisms instead of gas. Additionally, many medical devices, communications devices, and security rely on power to maintain their functions.

Climate Change and Energy Shortage

Climate change is expected to bring more frequent and intense natural disasters. Over the years, what was once a disaster uncharacteristic to landscape is now occurring outside of historical areas. These changes have created a variability at a rate that makes historical data a poor predictor of future climate. For example, the warmest years on record in California occurred in 2014, 2015, and 2016. The 2016-2017 year broke the record as the wettest ever recorded in the northern Sierra Nevada Mountains.

Changes in temperatures, precipitation patterns, extreme events, and sea-level rise have the potential to decrease the efficiency of thermal power plants and substations, decrease the capacity of transmission lines, render hydropower less reliable, spur an increase in electricity demand, and put energy infrastructure at risk of flooding.

With climate warming, higher costs from increased demand for cooling in the summer are expected to outweigh the decreases in heating costs in the cooler seasons. Hotter temperatures in California will mean more energy (typically measured in “cooling-degree days”) needed to cool homes and businesses both during heat waves and on a daily basis, during the daytime peak of the diurnal temperature cycle. During future heat waves, historically cooler coastal cities (e.g., San Francisco and Bakersfield) are projected to experience greater relative increases in temperature, such that areas that never before relied on air conditioning will experience new cooling demands.

Secondary impacts of energy shortages are most often felt by vulnerable populations. For example, those who rely on electric power for life-saving medical equipment, such as respirators, are extremely vulnerable to power outages. Also, during periods of extreme heat emergencies, the elderly and the very young are more vulnerable to the loss of cooling systems requiring power sources.
Probability of Future Occurrence of the Hazard

The probability of California experiencing a power outage can be difficult to quantify but is a hazard that occurs annually during the same seasonal periods of temperature variance throughout the calendar year. The City of Bakersfield and Kern County experience such outages. As such, the probability ranking for the Bakersfield area is Likely. Although the CSU Bakersfield campus has recorded fewer events than the surrounding area, it is prudent to assign this same ranking for the campus.

Climate models suggest summer global temperatures are likely to increase while changes between temperature extremes would be more pronounced. As such, it is expected that power outages will occur more frequently in the future.

Vulnerability to the Hazard

Based on the data available, and in consideration of the increasing effects of climate change, the campus remains vulnerable to power outages in terms of impacts to people, power infrastructure and campus operations. Nonetheless, campus leadership works to reduce vulnerabilities through consistent use of safety and operational protocols and emergency power sources to ensure it is able to mitigate an interruption to electrical power.

Estimate of Potential Losses

The data provided by CSU Bakersfield do not report any value for potential losses due to power outage.

Vulnerability Assessment Conclusions

The primary concern for campus leadership is that a loss of power creates potential hazards to students, faculty, and staff at CSU - Bakersfield. Safety and operations protocols center on the following “direct impact” set of concerns:

Elevators, entry ways, air filtration systems and lighting provide the campus community with the necessary infrastructure and systems to function and navigate through the campus and, to maintain a safe campus environment and visibility during nighttime hours. The vulnerable population (especially students with physical disabilities) may be the most heavily affected by loss of power as they rely on elevators, entry ways with automatic doors, and locks and lights may impede on a disabled student’s ability to travel and utilize the campus and its structures safely.

The use of communication devices, billing, records, and electrical tools may also become unusable due to a loss of electricity. Many records and billing items may have to revert to “by-hand” procedures and paper copies may be needed for continuity of operations. Additionally, classrooms may not be usable if lighting equipment is not functioning impacting a semester or quarter’s progress for the academic year.

Identified Data Limitations
CSU Bakersfield did not report any monetary or life losses due to a power outage. Also, the campus did not report any incidents involving a power outage directly affecting the campus community and operations.
Volcano (Associated Air Quality)

Description of the Hazard

The US Geological Service defines volcanoes as “openings or vents where lava, tephra (small rocks), and steam erupt on to the Earth’s surface. Through a series of cracks within and beneath the volcano, the vent connects to one or more linked storage areas of molten or partially molten rock (magma). This connection to fresh magma allows the volcano to erupt over and over again in the same location.”

A volcanic eruption occurs when magma, lighter than surrounding rock, is driven upwards by its buoyancy and by pressure from the dissolved gases contained within it. Gases are released from magma as it reaches the surface and pressure decreases. Magma can be erupted in several ways and violent eruptions typically cause tiny pieces of tephra (ash) to be carried away by the wind. This ash is hard, does not dissolve in water, is extremely abrasive and mildly corrosive, and conducts electricity when wet.

The gases released in an eruption include carbon dioxide, sulfur dioxide, hydrogen sulfide, and hydrogen halides. Depending on their concentration, these gases are potentially hazardous to people, animals, agriculture, and property.

Location of the Hazard

There are eight volcanic areas located throughout California. Seven of these - Medicine Lake Volcano, Mount Shasta, Lassen Volcanic Center, Clear Lake Volcanic Field, Long Valley Volcanic Region, Coso Volcanic Field, and Salton Buttes – are considered active volcanoes. No portion of CSU Bakersfield or Kern County is located within a volcano hazard zone.

Extent of the Hazard

Volcanic hazards are most severe within a few miles of the volcano vent and the severity generally decreases with distance. Ash impact zones can range from tens to hundreds of miles from the vent source. The US Geological Survey has estimated zones surrounding active volcanoes wherein two (2) inches or more of ashfall following an eruption is possible. While CSU Bakersfield does not fall within an estimated ashfall zone, lighter dustings of ash outside of those areas may directly or indirectly impact the campus. As such, the planning committee ranks the extent of the hazard for the campus as Low.

History of the Hazard

No historical eruption events in California have affected the campus. Over the last 1,000 years, there have been at least 12 volcanic eruptions in California. The most recent

volcanic eruption in California occurred at Lassen Peak about 100 years ago, when a major explosion delivered windborne ash over 275 miles away.\textsuperscript{79}

**Potential Impacts of the Hazard**

The specific impacts of the hazard vary widely and depend on which type of volcano erupts, the style of explosion, the volume of lava, the eruption duration, and the local water conditions. As CSU Bakersfield is not proximal to an active volcano, only the potential impacts of ashfall and gases have been detailed herein. While both these hazards can be widespread, their most severe impacts are generally seen closer to the volcanic source.

Although ashfall is typically a nonlethal volcanic hazard, it is the most widespread and disruptive. Falling ash can damage crops, electronics, and machinery. It can also impact human health by irritating the respiratory tract, eyes, and skin. The particles may enter drinking water and structures and may cause structure failure if it is thick and heavy enough. Even a fine layer of ash can disrupt utilities. A portion of California’s major electric transmission lines, aerial telecommunication lifelines, transportation corridors, and water storage and conveyance lie within the state’s volcano hazard zones. Impacts to any of these can impact operations at CSU Bakersfield.

The potential impacts of gases released during volcanic eruptions are as follows:

- Carbon dioxide typically becomes diluted very quickly and is not life threatening. However, it can become trapped in higher concentrations in low-lying areas and has the potential to be fatal.
- Sulfur dioxide can cause acid rain and air pollution downwind of a volcano.
- Hydrogen sulfide can cause irritation of the upper respiratory tract. At high concentrations it can cause unconsciousness and death.
- Hydrogen halides can coat ash particles and once deposited, poison drinking water, agricultural crops, and grazing land.

**Probability of Future Occurrence of the Hazard**

The US Geological Survey, based on the record of volcanic activity in California, estimates that the probability of another small- to moderate-sized eruption in the next thirty years is about 16 percent. Considering this low probability and CSU Bakerfield’s location, any future eruption is unlikely to have a severe impact on the campus. As such, the annual probability of future occurrence for the campus is ranked by the committee as **Unlikely.**

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Vulnerability to the Hazard

Populations living near volcanoes are the most vulnerable to eruptions and lava flows. However, volcanic ash can travel and affect populations miles away. The location and thickness of ash in any given area is a function of the severity of the eruption and wind speed and direction. For CSU Bakersfield, there is low vulnerability to the immediate impacts of volcanic eruptions due to the limited area affected and remote potential of an eruption. In the event of a widespread ashfall event, the elderly, infants, and populations with existing respiratory disease will be at higher risk.

Estimate of Potential Losses

Impacts to critical infrastructure, agriculture, and property from ashfall have the potential to cause widespread disruption, damage, and economic loss throughout the state. In the event of a widespread ashfall event, impacts will be immediate.

Current modeling is not precise enough to allow for an assessment of potential losses from ashfall to structures or infrastructure on or surrounding the campus.

Vulnerability Assessment Conclusions

CSU Bakersfield is unlikely to experience the direct impacts of a volcanic event. While the campus may be indirectly impacted by ashfall elsewhere in the state, direct ashfall impacts are generally unlikely but possible in a widespread event. However, the likelihood of any volcanic eruption in the state impacting the campus is very low.

Identified Data Limitations

Not all active volcanoes in California have been zoned for hazards by the US Geological Survey. This, together with the infrequent occurrence of volcanic explosions and number of factors determining type and extent of impacts, make the quantification of potential loss difficult.
**Wildfire**

Description of the Hazard

While wildfires are a natural part of California’s ecosystem, wildfires in California represent a hazard that presents one of the greatest probabilities of destruction along with a demonstrated history of catastrophic fire events in recent years. The destructive fire seasons of 2017 to 2020 illustrated the destructive forces fire presents to communities across the state. Wildfires may result in the structural loss, infrastructure loss, dangerous air quality, environmental damages, economic impacts, injuries, and loss of life. In many communities throughout California, wildfire presents greatest risk to human life and property.

Wildfires have been defined as any free burning vegetation fire that initiates from an unplanned ignition, whether natural or human caused demanding fire suppression actions to contain.\(^8^0\) These fires are prone to become uncontrolled, spreading through vegetative fuels rapidly exposing people and structures to harm. Wildfires present a significant risk to communities across the state, as evidenced by increasing trends of structural losses from wildland fires. This risk is elevated in areas where development and community growth has intersected, also known as the wildland-urban interface (WUI). In the interface setting, development itself can provide additional fuel for large fires. Recent fires have also demonstrated the ability of fire to consume populated areas in extreme conditions.

California’s Mediterranean climate in combination with its geography and vast population create a combination of factors that promotes an optimal environment for large fire growth and consequences. As there is great diversity of geographic characteristics across the state, the risks and potential consequences of wildfire must be assessed locally. The physical location, weather patterns, local fuel types and volume, extent of the WUI, topography, and additional factors will factor differently from part of the state to another.

The behavior of wildfires in California is significantly influenced by three distinct geographic factors. These factors will help shape the size, direction of spread, rate of combustion, fire intensity, and ability to pre-heat fuels. The physical factors contributing to wildfire behavior include:

- **Topography** – The rate in which wildfires spread increases with greater slopes in topography. The greater the slope will result in more pre-heating of fuel above the advancing fire. The direction that a slope faces will also influence fire behavior as south facing slopes receive greater solar radiation and thus drier vegetation that is more susceptible to combustion. Ridgetops often denote the end of fire spread as fire has greater difficulty spreading downhill.

- **Weather** – Weather factors substantially in influencing the behavior of wildfires. Wind, temperature, humidity, lightning, and lack of precipitation all contribute to a

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fire’s ability or inability to spread and intensify. California routinely experiences conditions in which these factors are in alignment to contribute to extreme fire behavior during the summer and fall seasons. High winds, low humidity, and high temperatures provide an environment promoting extreme fire activity.

- **Fuels** – Certain types of vegetation are increasingly prone to igniting and promote more intense burning. Areas with greater “fuel loading” (amount of fuel present in terms of weight of fuel per unit of area) increases the amount of fuel to fuel a fire. Greater volumes of dead or dry vegetation compared to live plants is a critical factor. Vegetation during drought conditions will experience decrease in moisture content increasing the conditions for combustion. Fuels close proximity to one another allows for rapid spread through contact or radiant exposures.

A risk assessment for wildfires should be implemented within a geospatial context focusing on the specific location features and incorporates the three components of the wildfire risk triangle – likelihood, intensity, and susceptibility.

**Location of the Hazard**

Substantial portions of the State of California are exceptionally vulnerable to wildfire activity or reside in a wildland-urban interface (WUI) area due to the vast open spaces, rangelands, forests and other lands with high susceptibility to fire occurring throughout the state. Bakersfield is located in the southern end of the San Joaquin Valley along the eastern edge at the base of the Sierra Nevada Mountains. In general, areas considered to be within Fire Hazard Severity Zones defined by the Fire and Resource Assessment Program (FRAP) within the California Department of Forestry and Fire Protection (CalFire) occur to the west, east, and south of Bakersfield. These areas surrounding the valley are topographically diverse, contain heavier vegetative fuels, and often have residential development interspersed. The land in the San Joaquin Valley where the CSU Bakersfield campus is located, is largely agricultural, developed, or open grasslands. The CSU Bakersfield campus is situated near the southern bank of the Kern River.

The CSU Bakersfield campus is located in the western portion of the City of Bakersfield. The area immediately surrounding the campus is predominately developed with residential and commercial land uses. The campus has a number of open fields containing short grasses surrounding the main campus. The campus is additionally immediately across Stockdale Highway from the Kern River and the open grassy fields running along the river. To the west of the campus separated by residential neighborhoods and rangeland are areas classified as Moderate Fire Hazard Severity Zones 12 miles away along the California Aqueduct. To the east of the campus, on the opposite side of central Bakersfield along the foothills to the Sierra Nevada Mountains are areas classified as Moderate Fire Hazard Severity Zones. To the southeast of the campus are areas of the Tehachapi Mountains where High Fire Hazard Severity Zones reside 22 miles away but separated by 13 miles of agricultural lands.
Extent of the Hazard

The area immediately surrounding the CSU Bakersfield campus is not in proximity to fire hazard zones designated as a High Fire Hazard Severity Zones, and the campus does not have a history of wildfire activity occurring within proximity to the campus. Although the campus is not surrounded by High Fire Severity Zones, it is surrounded by mountain ranges containing forests with an extensive history of large wildfire development and smoke generation. The campus also contains, within its boundaries, fields composed of light and flashy fuels that could lead to grass fires. However, there is no reported history of grass fires on campus. As a result, the planning committee ranks the extent of the wildfire hazard for the CSU Bakersfield campus as Moderate.

The National Fire Danger Rating System (NFDRS) is the current system in use for rating and classifying the potential danger of fire. The NFDRS tracks the effects of previous weather events on both dead and live fuel loads and adjusts accordingly based on future or predicted weather conditions. These complex relationships and equations are computed, and the outputs are expressed in terms that users can quickly and easily
understand. The current NFDRS is used by all federal and most state agencies to assess fire danger conditions.

The following table depicts the NFDRS, from the US Forest Service’s Wildland Fire Assessment System.

Table 4-20: National Fire Danger Rating System

<table>
<thead>
<tr>
<th>Rating</th>
<th>Basic Description</th>
<th>Detailed Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>CLASS 1: Low Danger (L)</td>
<td>Fires not easily started</td>
<td>Fuels do not ignite readily from small firebrands. Fires in open or cured grassland may burn freely a few hours after rain, but wood fires spread slowly by creeping or smoldering and burn in irregular fingers. There is little danger of spotting.</td>
</tr>
<tr>
<td>COLOR CODE: Green</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CLASS 2: Moderate Danger (M)</td>
<td>Fires start easily and spread at a moderate rate</td>
<td>Fires can start from most accidental causes. Fires in open cured grassland will burn briskly and spread rapidly on windy days. Woods fires spread slowly to moderately fast. The average fire is of moderate intensity, although heavy concentrations of fuel – especially draped fuel -- may burn hot. Short-distance spotting may occur but is not persistent. Fires are not likely to become serious and control is relatively easy.</td>
</tr>
<tr>
<td>COLOR CODE: Blue</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CLASS 3: High Danger (H)</td>
<td>Fires start easily and spread at a rapid rate</td>
<td>All fine dead fuels ignite readily, and fires start easily from most causes. Unattended brush and campfires are likely to escape. Fires spread rapidly and short-distance spotting is common. High intensity burning may develop on slopes or in concentrations of fine fuel. Fires may become serious and their control difficult, unless they are hit hard and fast while small.</td>
</tr>
<tr>
<td>COLOR CODE: Yellow</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CLASS 4: Very High Danger (VH)</td>
<td>Fires start very easily and spread at a very fast rate</td>
<td>Fires start easily from all causes and immediately after ignition, spread rapidly and increase quickly in intensity. Spot fires are a constant danger. Fires burning in light fuels may quickly develop high-intensity characteristics - such as long-distance spotting - and fire whirlwinds when they burn into heavier fuels. Direct attack at the head of such fires is</td>
</tr>
<tr>
<td>COLOR CODE: Orange</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

rarely possible after they have been burning more than a few minutes.

<table>
<thead>
<tr>
<th>CLASS 5: Extreme (E)</th>
<th>Fire situation is explosive and can result in extensive property damage</th>
</tr>
</thead>
<tbody>
<tr>
<td>COLOR CODE: Red</td>
<td>Fires under extreme conditions start quickly, spread furiously, and burn intensely. All fires are potentially serious. Development into high intensity burning will usually be faster and occur from smaller fires than in the Very High Danger class (4). Direct attack is rarely possible and may be dangerous, except immediately after ignition. Fires that develop headway in heavy slash or in conifer stands may be unmanageable while the extreme burning condition lasts. Under these conditions, the only effective and safe control action is on the flanks, until the weather changes or the fuel supply lessens.</td>
</tr>
</tbody>
</table>

Due to the impacts of wildfires on public health, agencies across the nation have adopted the use of the Air Quality Index (AQI) to communicate and provide a consistent approach to air quality measurements and categorization. The AQI primarily focuses on the health effects caused by pollutants in the air such as smoke. The goal of the AQI is to provide advisories to assist the public in determining when to reduce exposures to inhalation of air pollution as pollution levels rise.

Table 4-21: Air Quality Index for Ozone and Particulate Pollution

History of the Hazard

The State of California has a long history of chronic and destructive wildfires throughout the state. On average, 8,300 wildfires have caused burnt 928,245 acres across the state over the 20-year period between 2000 and 2020. Kern County also has a long history of wildfire activity primarily in the foothills and mountains surrounding the southern San Joaquin Valley. Wildfires occurring in Kern County have resulted in hundreds of thousands of acres burned and hundreds of millions of dollars in damages.

The area immediately surrounding the CSU Bakersfield campus is not in proximity to high fire hazard zones. Though no wildfires have reached the campus footprint, Kern County contains and is surrounded by areas that are considered to be of high fire threat that would produce vast quantities of smoke and particulates into the air. As a result, the CSU Bakersfield campus has experienced multiple days of poor air quality due to fires burning in Kern County and neighboring counties. The 2017, 2018, and 2020 fire seasons in particular illustrated the increase in wildfire generated smoke saturating the air of communities throughout the state including Bakersfield. CSU Bakersfield personnel reported the ongoing development of policies and procedures to address the response to poor air quality days.

Table 4-22: Historic Large-Scale Fires near Bakersfield, California, 1970 – 2016

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83 California Department of Forestry and Fire Protection. Stats and Events. Retrieved 02.08.2021 from: https://www.fire.ca.gov/stats-events/
<table>
<thead>
<tr>
<th>Date</th>
<th>Fire Name</th>
<th>County</th>
<th>Federal/State</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>9/29/1970</td>
<td></td>
<td>Kern County</td>
<td>Federal</td>
<td>2 fatalities, $29 million</td>
</tr>
<tr>
<td>9/10/1987</td>
<td></td>
<td>Kern County</td>
<td>State</td>
<td>3 fatalities, $18 million</td>
</tr>
<tr>
<td>7/21/2002</td>
<td>Deer Fire</td>
<td>Kern County</td>
<td>Federal</td>
<td>$3.8 million</td>
</tr>
<tr>
<td>9/1/2002</td>
<td>Curve Fire</td>
<td>Ventura County</td>
<td>Federal</td>
<td></td>
</tr>
<tr>
<td>9/22/2002</td>
<td>Williams Fire</td>
<td>Los Angeles County</td>
<td>Federal</td>
<td></td>
</tr>
<tr>
<td>6/29/2003</td>
<td>Tejon Fire</td>
<td>Kern County</td>
<td>Federal</td>
<td>$1.6 million</td>
</tr>
<tr>
<td>6/28/2008</td>
<td>Mid-Year Fires</td>
<td>Kern County</td>
<td>Federal</td>
<td>$25 million</td>
</tr>
<tr>
<td>11/13/2008</td>
<td></td>
<td>Kern County</td>
<td>Federal</td>
<td></td>
</tr>
<tr>
<td>7/26/2010</td>
<td>Bull Fire</td>
<td>Kern County</td>
<td>Federal</td>
<td>$11.2 million</td>
</tr>
<tr>
<td>8/24/2010</td>
<td>Post Fire</td>
<td>Kern County</td>
<td>Federal</td>
<td>$5.2 million</td>
</tr>
<tr>
<td>9/12/2010</td>
<td>Canyon Fire</td>
<td>Kern County</td>
<td>Federal</td>
<td>$11.2 million</td>
</tr>
<tr>
<td>9/11/2011</td>
<td>Comanche Complex</td>
<td>Kern County</td>
<td>Federal</td>
<td>29.338 acres</td>
</tr>
<tr>
<td>6/23/2016</td>
<td>Erskine</td>
<td>Kern County</td>
<td>Federal</td>
<td>2 fatalities, $19.3 million</td>
</tr>
</tbody>
</table>

The September 4, 2006 Day Fire in northern Ventura County and southern Kern County burned a total of 167,000 acres mostly in Ventura County. The fire demonstrated extreme fire behavior during red flag fire warning conditions. The communities of Pinion Pines, Lake of the Woods, and Pine Mountain were threatened and evacuated. The fire was moving rapidly towards the direction of Kern County. The fire ultimately caused $78 million in damages.

The 2008 Piute Fire burned over 37,000 acres of land in the Walker Basin and Lake Isabella area of Kern County. The fire burned over 45 structures including homes and businesses. The final cost of the fire was $25 million in damages. Severe thunderstorms combined with the destruction of stabilizing vegetation following the fire resulted in flash flooding in the watershed areas near Lake Isabella.

The Erskine Fire ignited on June 23, 2016 in the Lake Isabella area of Kern County consuming 47,864 acres of land and resulted in two fatalities. The fast-moving fire destroyed over 250 homes, another 100 structures, damaged Kern River watershed lands. The fire remains as one the most destructive fires in state history and generated $19.3 million in damages.

Potential Impacts of the Hazard

The location of the CSU Bakersfield campus surrounded by residential and commercial development removed from fire hazard areas places a minimal direct threat from wildfire to the campus. There is potential for grass fires to occur in the surrounding fields.
composed of light and flashy fuels that are within the campus boundaries. The threat of these fields on campus structures is minimal.

Potential impacts to the campus community resulting from wildfires include:

- Injuries or loss of life
- Campus property destruction or damage
- Residential property destruction or damage
- Commercial property destruction or damage
- Loss of property contents
- Infrastructure damage
- Damaged or destroyed lifelines/supply routes
- Damaged or destroyed utilities
- Damaged or destroyed critical facilities supporting campus emergency support needs
- Loss of community economic base
- Employment losses
- Loss to ground supporting vegetation on hillsides resulting in erosion or landslides in future precipitation events
- Agricultural (crops and livestock) damages or destruction
- Environmental damage
- Societal and community impacts
- Damage to organizations and facilities providing support services to vulnerable populations
- Greater evacuation challenges for those most vulnerable
- Psychological impacts of impacted populations
- Disruptions to education delivery to community

Potential impacts to the campus resulting from wildfire generated smoke include:

- Dangerous levels of air pollution
- Human Health Effects
  - Similar health impacts to pets
- Air conditioning systems overwhelmed
- Greater demands on air filtration systems
- Greater demands on healthcare systems
- Reduced outdoor work productivity
- Closures of academic sessions

Additionally, there remains a number of secondary impacts from wildfires that could affect the campus community. Utilities feeding areas of Bakersfield including the campus may be damaged resulting in power outages. Fire-related damage in the watersheds will likely cause future landslides, degradation to plants supporting hillsides, and impact the hydroelectric power capabilities. Fires may present threats to areas of recreation, scenic
value, and wildlife that are a part of the culture of the campus community. Finally, the campus may experience effects of evacuated individuals arriving on campus from other areas as a location of refuge.

Probability of Future Occurrence of the Hazard

Based on the wildfire threat potential in the area surrounding the CSU Bakersfield campus, including the distance to Fire Hazard Severity Zones and density of residential and commercial development, the probability of wildfire related damage is considered **Unlikely**.

Based on the wildfire threat potential in the area surrounding the Bakersfield region, including the volume of areas in elevated Fire Hazard Severity Zones surrounding the San Joaquin Valley, the probability of wildfire generated smoke impacts to air quality is considered **Possible**.

Vulnerability to the Hazard

The CSU Bakersfield campus is not likely to be subject to direct impact from wildfire due to the campus location in an urban/suburban area of Bakersfield. The vulnerabilities to the effects of wildfire would largely lie within the campus community who may reside or work in locations that are exposed to the Fire Hazard Severity Zones outside of the Bakersfield core and within the agricultural areas surrounding the city. Wildfires occurring in other areas of the region may result in the displacement of large numbers of people or the generation of smoke. These effects may spill onto the campus in the form of evacuees or facility support to emergency resources.

Fire directly threatening the campus would likely take the form of localized fires involving single structures or small areas. Smaller vegetation fires are possible surrounding the campus in the urban forest or fields surrounding the city. These incidents would likely have little impact to the campus.

The primary basis of vulnerability is based on the population affected and the built environment exposed. In general, newer construction will be more fire resistant than older buildings as building and fire codes and construction technology have improved. Density of buildings and proximity of fuels to buildings or equipment at risk of combustion would additionally influence the fire’s ability to spread to structures.

The greater concerns regarding vulnerabilities to wildfire are related to the smoke that fires in the area would produce. The past few summer seasons have clearly demonstrated the reality of large wildfires producing enough smoke to fill the San Joaquin Valley even from substantial distances away. These recent fires have displayed how the effects of this smoke impact the general population and especially vulnerable populations. CSU Bakersfield students, faculty, and staff both on campus and off campus face these same vulnerabilities related to smoke filled air.
Smoke generated from large wildfires pose a threat in terms of diminished air quality that would be exposed to the population within the area of smoke distribution. Individuals with existing health problems such as respiratory or cardiac illnesses are increasingly vulnerable to wildfire generated smoke. Staff who work in roles requiring outdoor activity will be increasingly exposed during days where the air quality index is considered unhealthy or worse. Student athletes participating in outdoor sports and engaging in aerobic activities are increasingly vulnerable to the effects of wildfire.

The vulnerability to members of the campus community in which wildfire generated smoke on the CSU Bakersfield campus will vary depending on when the air quality was to reach unhealthy levels. The risk to the campus population will be lessened during periods when classes are not in session or during periods of breaks. Conversely, during the days and hours that classes are in session and staff are at their workplaces, the human vulnerability increases. However, in region-wide events this vulnerability may be shared with the homes and workplaces of members of the campus community and their families.

Certain campus populations will experience greater challenges to a post-flood / failure environment. Vulnerable populations will likely face disproportionate health safety issues from smoke filled air, experience increased stresses, may require the need to remain away from the campus enclosed at home, and may find difficulty in accessing equipment or supplies to aid in a specific need.

**Estimate of Potential Losses**

Estimates of potential losses will be influenced by a variety of factors. The risk to wildfire directly impacting the campus is minimal. Costs would be likely be limited to mitigation or repairs of HVAC systems, sealing of doors and windows, and other methods of keeping smoke from entering buildings. Secondary costs would include lost academic days during campus closures, lost staff on campus productivity, and health and medical interventions for affected members of the campus community. No wildfire hazard potential loss estimates for CSU Bakersfield are currently available.

**Vulnerability Assessment Conclusions**

While the occurrence of wildfires has been more frequent in Kern County, historically there have not been wildfire incidents that cause damages near the CSU Bakersfield campus. The location of the CSU Bakersfield campus surrounded by residential and commercial developed neighborhoods limits the ability for wildfire to threaten the campus. The foothills and mountains surrounding the southern San Joaquin Valley host environments that are ideal for the development of wildfire activity. The consequences of fires in these areas would present primary and secondary consequences to the CSU Bakersfield campus and expose vulnerabilities on the campus and to the campus community.

The topography of the valley surrounded by mountains allows for smoke filled air to linger in the Bakersfield area with the potential for unhealthy air quality. Fires in the watersheds of the Kern River and tributaries may damage vegetation stabilizing hillsides.
and result in increased sediments to be discharged into the river system and reservoirs reducing their capacity and effectiveness. Communities located within or near the Wildland Urban Interface may be subject to damaging fires. These same communities may be home to members of the campus community. The potential for large-scale wildfires in the region further generates the added potential for a number of cascading effects such as disruptions to the local economy, utility failures, disruptions to providing for the needs of the community, and development of public health hazards. The potential for large-scale wildfires and resulting damage of homes and businesses has exponentially powerful impacts on particular populations among the campus community including those with access or functional needs, international students, the homeless, and students residing in the residence halls.

**Identified Data Limitations**

Data limitations include missing campus structural replacement costs, and lack of both a complete inventory of building construction types and mitigation efforts to lessen the impact due to fire activity. HAZUS generated analysis is focused on the broader community level versus fine-tuning the analysis to the micro-level for facilities such as a university campus.

*Severe Weather (Wind, Tornado, Hail, and Lightning)*

**Description of the Hazard**

Severe weather can be described as a variety of weather or climate events that are beyond or near the ends of the range of observed weather patterns and behavior. These events can include high or extreme winds, storms, lightning, hail, tornadoes, heat waves, unusually cold temperatures, extreme rainfall, and flooding.85 According to the Intergovernmental Panel on Climate Change (IPCC), to be classified as severe (or extreme), the occurrence of each value of a climate or weather variable (e.g., wind, hail, lightning, tornado, etc.) must be “above (or below) a threshold value near the upper (or lower) ends of the range of observed values of the variable.”86

Severe weather in California can be generated by local, regional, and/or global weather and climate influences. From the individual thunderstorm to the Santa Ana wind event to the strong El Niño, damaging weather elements that are produced by and accompany

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severe weather and climate phenomena (e.g., damaging winds, hail, lightning, and tornadoes) occur throughout California and the California State University (CSU) system.

**Global Scale Influences on Severe Weather in California: El Niño, La Niña, and ENSO**

The El Niño-Southern Oscillation (ENSO) is a recurring climate pattern involving changes in the temperature of waters in the central and eastern tropical Pacific Ocean. On periods ranging from about three (3) to seven (7) years, the surface waters across a large swath of the tropical Pacific Ocean warm or cool by anywhere from 1°C to 3°C, compared to normal. This oscillating warming and cooling pattern, referred to as the ENSO cycle, directly affects rainfall distribution in the tropics and can have a strong influence on weather across the United States and other parts of the world.

El Niño and La Niña are extreme phases of the ENSO cycle, with a third phase occurring between them called the Neutral phase. The El Niño phase is characterized by unusually warm ocean temperatures and weaker-than-normal east winds in the Equatorial Pacific, while the La Niña phase is characterized by unusually cold ocean temperatures and stronger-than-normal east winds in the Equatorial Pacific. Both extreme ENSO phases lead to significant differences from the average ocean temperatures, winds, surface pressure, and rainfall across parts of the tropical Pacific. The Neutral phase indicates that conditions are near their long-term average.

The extreme ENSO phases affect the frequency and intensity of weather events across the world, including in California. On average, areas across California experience exceptionally stormy winters with increased precipitation under El Niño conditions, but experience less stormy and drier winters under La Niña conditions. This variability in storminess and precipitation brought on by El Niño and La Niña events affects the both the frequency and intensity of severe weather conditions experienced by all CSU campuses, including CSU Bakersfield.

**Regional Climate Influences on Severe Weather across California**

Most of the weather in California is influenced by the wet-winter/ dry-summer Mediterranean climate pattern. In the summer months, Pacific storm tracks are deflected north due to the position of the Pacific High (i.e., a large-scale atmospheric circulation over the Northeast Pacific Ocean), preventing Pacific storms from reaching California. As a result, most summer storms are generated due to the incursion of moist air from the Gulf of Mexico or the Gulf of California, and occur as scattered, locally heavy showers in the desert and mountain regions of the state. In the winter months, the Pacific High

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87 Retrieved on 07.18.2021 from [https://www.weather.gov/mhx/ensowhat](https://www.weather.gov/mhx/ensowhat)
89 Retrieved on 07.17.2021 from [https://www.climate.gov/news-features/understanding-climate/el-ni%C3%B1o-and-la-ni%C3%B1a-a-frequently-asked-questions](https://www.climate.gov/news-features/understanding-climate/el-ni%C3%B1o-and-la-ni%C3%B1a-a-frequently-asked-questions)
90 Retrieved on 07.16.2021 from [https://www.pmel.noaa.gov/elnino/what-is-el-nino](https://www.pmel.noaa.gov/elnino/what-is-el-nino)
decreases in intensity and moves south, permitting powerful Pacific storms to move into
and across the state; these storms can produce extreme winds, heavy rains (including
“atmospheric river” events), and widespread coastal and inland flooding. (Please see the
Flood Hazard profile in this document for information on Floods.) As a result, storm
events accompanied by precipitation in California are far more frequent in the winter
months than they are in the summer months.92

While the Mediterranean climate pattern influences the seasonal frequency, intensity,
geographic spread, and type of some severe weather events CSU campuses experience
(including CSU Bakersfield), other severe weather phenomena may occur in California at
any time of the year. For example, near the coast and over the Central Valley, there
appears to be no defined seasonality to thunderstorms, and these storms are usually light
and infrequent. Thunderstorms are more intense and more frequent in the intermediate
and higher elevations of the Sierra Nevada, and occur with greater frequency during the
summer months.93

Types of Storms in California

The 2018 California State Hazard Mitigation Plan (SHMP) defines a storm as a violent
atmospheric disturbance occurring over land and/or water that is distinguished by its
strength, characteristics, and the scale of the resulting damage.94 The SHMP also lists the
following types of storms that produce hazardous conditions and potential damage
throughout the state of California.95 These storms affect (in varying degrees) all CSU
campuses, including CSU Bakersfield.

- **Thunderstorm**: A rain-bearing cloud that also produces lightning. Thunderstorms
can produce some of nature’s most destructive and deadly weather including
tornadoes, hail, strong winds, lightning and flooding.96 Thunderstorms are caused
by an atmospheric imbalance from warm unstable air rising rapidly into the
atmosphere. Lightning, which occurs during all thunderstorms, can strike
anywhere.97 Thunderstorms can produce some of nature’s most destructive and
deadly weather including tornadoes, hail, strong winds, lightning and flooding.98

*Severe thunderstorms* are more intense, violent, and dangerous thunderstorms.
The National Oceanic and Atmospheric Administration (NOAA) defines a severe

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92 Retrieved on 07.17.2021 from [https://wrcc.dri.edu/Climate/narrative_ca.php](https://wrcc.dri.edu/Climate/narrative_ca.php)
93 Retrieved on 07.17.2021 from [https://wrcc.dri.edu/Climate/narrative_ca.php](https://wrcc.dri.edu/Climate/narrative_ca.php)
Thunderstorm as any storm that produces one or more of the following elements: Damaging winds or speeds of 58 mph (50 knots) or greater, hail 1 inch in diameter or larger, and/or a tornado.  

- **Hailstorm**: a type of storm that precipitates round chunks of ice. Hailstorms usually occur during regular thunderstorms.

- **Wind storm**: marked by high wind with little or no precipitation.

- **Winter storm**: A storm that can produce a combination of freezing rain, sleet, heavy snow, and/or strong winds.

- **Coastal storm**: large wind-driven waves and/or storm surge that strike the coastal zone.

- **Ice storm**: Ice storms are one of the most dangerous forms of winter storms. When surface temperatures are below freezing, but a thick layer of above-freezing air remains aloft, rain can fall into the freezing layer and freeze upon impact into a glaze of ice. In general, 8 millimeters (0.31 inch) of accumulation is all that is required, especially in combination with breezy conditions, to start downing power lines as well as tree limbs. Ice storms also make unheated road surfaces too slick to drive on. Ice storms can vary in time range from hours to days and can cripple small towns and large urban centers alike.

- **Snowstorm**: A heavy fall of snow accumulating at a rate of more than 5 centimeters (2 inches) per hour that lasts several hours. Snowstorms, especially ones with a high liquid equivalent and breezy conditions, can down tree limbs, cut off power, and paralyze travel over a large region.

**Severe Weather Hazard Elements: Wind Hazards, Hail, and Lightning**

99 Retrieved on 07.15.2021 from https://www.noaa.gov/explainers/severe-storms
100 Retrieved on 07.15.2021 from https://www.weather.gov/safety/thunderstorm
This hazard profile concentrates on the following types of severe weather hazards: wind hazards (including tornadoes), hail, and lightning. These hazards are produced by a variety of weather phenomena, including thunderstorms, coastal storms, winter storms, and topographically-enhanced downslope winds. While storm and downslope wind hazards are responsible for severe weather events across the CSU system, only the wind, tornado, hail, and lightning elements generated by these hazards are covered in this profile. (Storm-related hazards such as flooding and extreme temperatures are covered in other sections of this document.)

**Wind Hazards**

**Wind** is the horizontal movement of air past any given point. Wind begins with differences in air pressures; pressure that is higher at one point than another sets up a force, pushing the high towards the low pressure.\(^{107}\) Wind gusts are defined as “rapid fluctuations in the wind speed with a variation of 10 knots or more between peaks and lulls.” \(^{108}\)

Wind hazards in California take several forms: High Wind, Strong Winds, Thunderstorm Winds, Mountain-Valley (Downslope) Winds, and Tornadoes. These hazards are encountered across California, and have the potential to cause harm to or loss of life and/or property throughout California and the CSU system (including CSU Bakersfield).

**High Winds, Strong Winds, and Thunderstorm Winds**

The National Weather Service reports three (3) types of wind events that occur areas over land: High Winds, Strong Winds, and Thunderstorm Winds. Collectively, these reports are used to determine the frequency with which wind hazard events have affected areas across the U.S., including California.

**High Winds**

High winds are defined as sustained non-convective winds of 35 knots (40 mph) or greater lasting for 1 hour or longer, or gusts of 50 knots (58 mph) or greater for any duration (or otherwise locally/regionally defined). In some mountainous areas, the above numerical values are 43 knots (50 mph) and 65 knots (75 mph), respectively.\(^{109}\)

**Strong Winds**

Strong winds are defined as non-convective winds gusting less than 50 knots (58 mph), or sustained winds less than 35 knots (40 mph), resulting in a fatality, injury, or damage.\(^{110}\)

**Thunderstorm Winds**

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Thunderstorm winds are winds that arise from thunderstorm convection (occurring within 30 minutes of lightning being observed or detected), with speeds of at least 50 knots (58 mph). They can also be winds of any speed (non-severe thunderstorm winds below 50 knots (58 mph)) producing a fatality, injury, or damage.\footnote{NWS Directive 10-1605, July 16, 2018. Retrieved on 07.15.2021 from https://www.nws.noaa.gov/directives/sym/pd01016005curr.pdf}

Please note: \textit{Straight-line wind} is a term used to define any thunderstorm wind that is not associated with rotation. It is used mainly to differentiate from the rotational winds found in tornado-producing storms.\footnote{Retrieved on 07.15.2021 from https://www.nssl.noaa.gov/education/svrwx101/wind/types/} However, it is not a term used in the NCEI Storm Events Database, and therefore cannot be used to determine severe weather history of or potential impacts to CSU campuses.

\textbf{Tornadoes}

A tornado is an extreme severe weather wind hazard. A tornado is a rapidly rotating column of air extending from a thunderstorm to the surface of the Earth.\footnote{Retrieved on 07.15.2021 from https://www.nssl.noaa.gov/education/svrwx101/tornadoes/faq/} This column extends between cloud and the Earth’s surface. The damage from tornadoes comes from the strong winds they contain and the flying debris they create. It is generally believed that rotational wind speeds can be as high as 300 mph in the most violent tornadoes.\footnote{Retrieved on 07.15.2021 from https://www.weather.gov/bgm/severedefinitions} On a local scale, tornadoes are the most violent and most destructive of all atmospheric phenomena.\footnote{Bytnerowicz, Andrzej, Fenn, Mark, Allen, Edith B. and Cisneros, Ricardo. "SEVEN. Atmospheric Chemistry". Ecosystems of California, edited by Harold Mooney and Erika Zavaleta, Berkeley: University of California Press, 2016, pp. 107-128. https://doi.org/10.1525/9780520962170-011. Retrieved on 07.16.2021 from https://www.fs.fed.us/psw/publications/bytnerowicz/psw_2016_bytnerowicz001.pdf}

\textbf{Mountain-Valley (Downslope) Wind Systems: Santa Ana, Diablo, and Sundowner Winds.}

\textbf{Santa Ana Winds}. A type of wind hazard that is peculiar to Southern California is called a \textit{Santa Ana Wind}. Santa Ana winds are strong, topographically-enhanced, extremely dry downslope winds that originate inland and affect coastal southern California and northern Baja California (Mexico).\footnote{Retrieved on 07.15.2021 from https://www.nssl.noaa.gov/education/svrwx101/wind/types/} They occur when air from a region of high pressure over the dry, desert region of the southwestern U.S. flows westward towards low pressure located off the California coast. This creates dry winds that flow east to west through the mountain passages in Southern California. These winds have a strong seasonal component; they are most common during the cooler months of the year, occurring from September through May. Santa Ana winds typically feel warm (or even hot) because as the cool desert air moves down the side of the mountain, it is compressed, which causes the temperature of the air to rise. If strong enough, Santa Ana winds can cause major property damage, and may present difficulties for airborne and seagoing transportation. They also may increase wildfire risk because of the dryness of the winds and the speed at
which they can spread a flame across the landscape.¹¹⁷ (Note: The Wildfire hazard is profiled elsewhere in this document.)

Figure below illustrates the mechanisms involved in the generation of Santa Ana winds across Southern California.

**Diablo Winds.** The Diablo wind is another type of topographically-enhanced downslope wind phenomenon that occurs in the North-Central areas of California. Diablo winds are offshore wind events that flow northeasterly over Northern California’s Coast Ranges, often creating high wind speeds downwind of major canyons and over ridges, and extreme fire danger for the San Francisco Bay Area. Diablo winds are driven by a surface pressure gradient that forms in response to an inverted pressure trough that develops over California.119

**Sundowner Winds.** Sundowner winds are significant and potentially damaging downslope wind and warming events that periodically occur along a short segment of the southern California coast in the vicinity of Santa Barbara, CA. The unique topography of this coastal region promotes the development of Sundowner wind events: over a length of about 100 km, the coastline is oriented approximately west–east, with the adjoining narrow coastal plain bounded by a steeply rising (to elevations greater than 1200 m) and
coast-parallel mountain range. Called Sundowner winds because they often begin in the late afternoon or early evening, their onset is typically associated with a rapid rise in temperature and decrease in relative humidity, and the winds tend to blow from the north from the Santa Ynez Mountains to the coast of Santa Barbara County, California. During the more intense Sundowner wind events, wind speeds can be of gale force 39-54 miles per hour or higher, and can even reach hurricane force (≥74 miles per hour) in the most extreme cases. Temperatures over the coastal plain, and even at the coast itself, can rise significantly above 37.8°C (100°F). Seasonally, Sundowner winds peak in March, April, and May, with a minimum during summer and a secondary peak in winter that often corresponds with Santa Ana winds. In addition to causing a dramatic change from the more typical marine-influenced local weather conditions, Sundowner wind episodes have produced significant wind-related property and agricultural damage, as well as conditions of extreme fire danger.\(^{120}\)\(^{121}\)\(^{122}\)

**Hail**

Hail is a form of precipitation consisting of solid ice that forms inside thunderstorm updrafts.\(^ {123}\) It is roughly round in shape and at least 0.2’ in diameter. Hail develops in the upper atmosphere as ice crystals that are bounced about by high velocity updraft winds; the ice crystals accumulate frozen droplets and fall after developing enough weight. The size of hailstones varies and is a direct consequence of the severity and size of the storm that produces them – the higher the temperatures at the Earth’s surface, the greater the strength of the updrafts and the amount of time hailstones are suspended, and therefore the greater the size of the hailstone.\(^ {124}\)

**Lightning**

Lightning is an electrical discharge produced by a thunderstorm. Lightning rapidly heats the air in its immediate vicinity to about 50,000°F - about five times the temperature of the surface of the sun. This compresses the surrounding air and creates a supersonic shock wave, which decays to an acoustic wave that is heard as thunder.\(^ {125}\)

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The discharge may occur within or between clouds, between the cloud and air, between a cloud and the ground, or between the ground and a cloud.\footnote{National Weather Service. Retrieved on 07.14.2021 from: \url{http://w1.weather.gov/glossary/index.php?letter=l}} Lightning that is produced from thunderstorms in which precipitation evaporates before reaching the ground is called “dry lightning.”

**Location of the Hazard**

Severe weather is a non-spatial hazard, and can occur anywhere in the CSU system, including either at the CSU Bakersfield main campus or at satellite campus facilities owned by the school. No one area of the campus – or of the surrounding community – is subject to experiencing severe weather more than any other area.

There is geographic variability among the different types of mountain and valley wind events (as a sub-category of the severe weather hazard). Santa Ana winds occur in Southern California, Diablo winds occur in North-Central California, and Sundowner winds occur almost exclusively in Santa Barbara County, California.

**Extent of the Hazard**

Severe weather hazards are non-spatial hazards that potentially affect all CSU Bakersfield campus areas equally. However, the smallest geographic unit of measurement for almost all official severe weather event data is at the county level. Because the severe weather data used do not exist at the campus level, it is assumed that the same (or similar) severe weather risks to CSU Bakersfield campuses reflect those of the surrounding community and County. As a result, all assets and people at CSU Bakersfield campuses are at risk from the effects of severe weather and can expect to experience at least some (or the complete range of) endemic severe weather hazards. In consideration of the campus’ design, layout, and operations, the severe weather history and degree of severity in the Bakersfield (Kern County) and Lancaster (Los Angeles County) areas, and the history and degree of severity of each severe weather sub-type identified by the extent scales (below), the campus planning committee ranks the overall extent of the Severe Weather hazard as **MODERATE**. See each sub-hazard below for the planning committee’s sub-type extent ranking.

**Wind Hazard: Non-Rotational**

The Beaufort Scale is an empirical measure that relates wind speed to observed conditions at sea or on land. Its full name is the Beaufort wind force scale.\footnote{Retrieved on 07.15.2021 from \url{https://www.rmets.org/resource/beaufort-scale}} First developed in 1805, it is still used today to estimate wind strengths.\footnote{Retrieved on 07.15.2021 from \url{https://www.weather.gov/mfl/beaufort}}
Table 4-23: Beaufort Wind Force Scale\(^{129}\)

<table>
<thead>
<tr>
<th>Force</th>
<th>Speed (mph)</th>
<th>Speed (knots)</th>
<th>Description</th>
<th>Specifications for use at sea</th>
<th>Specifications for use on land</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0-1</td>
<td>0-1</td>
<td>Calm</td>
<td></td>
<td>Sea like a mirror.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Calm; smoke rises vertically.</td>
</tr>
<tr>
<td>1</td>
<td>1-3</td>
<td>1-3</td>
<td>Light Air</td>
<td>Ripples with the appearance of scales are formed, but without foam crests.</td>
<td>Direction of wind shown by smoke drift, but not by wind vanes.</td>
</tr>
<tr>
<td>2</td>
<td>4-7</td>
<td>4-6</td>
<td>Light Breeze</td>
<td>Small wavelets, still short, but more pronounced. Crests have a glassy appearance and do not break.</td>
<td>Wind felt on face; leaves rustle; ordinary vanes moved by wind.</td>
</tr>
<tr>
<td>3</td>
<td>8-12</td>
<td>7-10</td>
<td>Gentle Breeze</td>
<td>Large wavelets. Crests begin to break. Foam of glassy appearance. Perhaps scattered white horses.</td>
<td>Leaves and small twigs in constant motion; wind extends light flag.</td>
</tr>
<tr>
<td>4</td>
<td>13-18</td>
<td>11-16</td>
<td>Moderate Breeze</td>
<td>Small waves, becoming larger; fairly frequent white horses.</td>
<td>Raises dust and loose paper; small branches are moved.</td>
</tr>
<tr>
<td>5</td>
<td>19-24</td>
<td>17-21</td>
<td>Fresh Breeze</td>
<td>Moderate waves, taking a more pronounced long form; many white horses are formed.</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>25-31</td>
<td>22-27</td>
<td>Strong Breeze</td>
<td>Large waves begin to form; the white foam crests are more extensive everywhere.</td>
<td>Large branches in motion; whistling heard in telegraph wires; umbrellas used with difficulty.</td>
</tr>
<tr>
<td>7</td>
<td>32-38</td>
<td>28-33</td>
<td>Near Gale</td>
<td>Sea heaps up and white foam from breaking waves begins to be blown in streaks along the direction of the wind.</td>
<td></td>
</tr>
</tbody>
</table>

\(^{129}\) Retrieved on 07.15.2021 from [https://www.weather.gov/mfl/beaufort](https://www.weather.gov/mfl/beaufort)
<table>
<thead>
<tr>
<th>Rating</th>
<th>Wind Speed</th>
<th>Wind Effects</th>
</tr>
</thead>
<tbody>
<tr>
<td>8</td>
<td>39-46</td>
<td>Gale</td>
</tr>
<tr>
<td></td>
<td>34-40</td>
<td>Whole trees in motion; inconvenience felt when walking against the wind.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Moderately high waves of greater length; edges of crests begin to break into spindrift. The foam is blown in well-marked streaks along the direction of the wind.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Breaks twigs off trees; generally impedes progress.</td>
</tr>
<tr>
<td>9</td>
<td>47-54</td>
<td>Severe Gale</td>
</tr>
<tr>
<td></td>
<td>41-47</td>
<td>High waves. Dense streaks of foam along the direction of the wind. Crests of waves begin to topple, tumble and roll over. Spray may affect visibility.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Slight structural damage occurs (chimney-pots and slates removed).</td>
</tr>
<tr>
<td>10</td>
<td>55-63</td>
<td>Storm</td>
</tr>
<tr>
<td></td>
<td>48-55</td>
<td>Very high waves with long overhanging crests. The resulting foam, in great patches, is blown in dense white streaks along the direction of the wind. On the whole the surface of the sea takes on a white appearance. The tumbling of the sea becomes heavy and shock-like. Visibility affected.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Seldom experienced inland; trees uprooted; considerable structural damage occurs.</td>
</tr>
<tr>
<td>11</td>
<td>64-72</td>
<td>Violent Storm</td>
</tr>
<tr>
<td></td>
<td>56-63</td>
<td>Exceptionally high waves (small and medium-size ships might be for a time lost to view behind the waves). The sea is completely covered with long white patches of foam lying along the direction of the wind. Everywhere the edges of the wave crests are blown into froth. Visibility affected.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Very rarely experienced; accompanied by widespread damage.</td>
</tr>
<tr>
<td>12</td>
<td>73+</td>
<td>Hurricane</td>
</tr>
<tr>
<td></td>
<td>64+</td>
<td>The air is filled with foam and spray. Sea completely white with driving spray; visibility very seriously affected.</td>
</tr>
</tbody>
</table>

Based on those extent ranking factors identified (above), the planning committee ranks the extent of non-rotational wind hazards as **MODERATE**.
**Extent: Tornado**

Tornadoes have their own severity/extent scale. Until 2007, tornadoes were measured and described according to the Fujita Scale.\(^{130}\)

In February 2007, use of the Fujita Scale was discontinued. In its place, the Enhanced Fujita (EF) Scale is used. The Enhanced Fujita scale considers how most structures are designed and is thought to be a much more accurate representation of the surface wind speeds in the most violent tornadoes. Like the original Fujita scale, the Enhanced Fujita scale is a set of wind estimates (not measurements) based on damage.

It is important to note the *date* that a tornado occurred. Tornadoes that occurred prior to February, 2007 are classified using the original Fujita scale and will not be converted to the Enhanced Fujita Scale.

Table below illustrates the Fujita Scale in use prior to February 2007.

Table 4-24: Fujita Tornado Scale (Pre-February 2007)\(^{131}\)

<table>
<thead>
<tr>
<th>F-Scale Number</th>
<th>Intensity Phrase</th>
<th>Wind Speed</th>
<th>Type of Damage</th>
</tr>
</thead>
<tbody>
<tr>
<td>F0</td>
<td>Gale tornado</td>
<td>40-72 mph</td>
<td>Some damage to chimneys; breaks branches off trees; pushes over shallow-rooted trees; damages sign boards.</td>
</tr>
<tr>
<td>F1</td>
<td>Moderate tornado</td>
<td>73-112 mph</td>
<td>The lower limit is the beginning of hurricane wind speed; peels surface off roofs; mobile homes pushed off foundations or overturned; moving autos pushed off the roads; attached garages may be destroyed.</td>
</tr>
<tr>
<td>F2</td>
<td>Significant tornado</td>
<td>113-157 mph</td>
<td>Considerable damage. Roofs torn off frame houses; mobile homes demolished; boxcars pushed over; large trees snapped or uprooted; light object missiles generated.</td>
</tr>
<tr>
<td>F3</td>
<td>Severe tornado</td>
<td>158-206 mph</td>
<td>Roof and some walls torn off well-constructed houses; trains overturned; most trees in forest uprooted.</td>
</tr>
</tbody>
</table>

\(^{130}\) Retrieved on 07.19.2021 from https://www.weather.gov/tae/ef_scale

<table>
<thead>
<tr>
<th>EF</th>
<th>Description</th>
<th>Wind Speed</th>
</tr>
</thead>
<tbody>
<tr>
<td>F4</td>
<td>Devastating tornado</td>
<td>207-260 mph</td>
</tr>
<tr>
<td></td>
<td>Well-constructed houses leveled; structures with weak foundations blown off some distance; cars thrown and large missiles generated.</td>
<td></td>
</tr>
<tr>
<td>F5</td>
<td>Incredible tornado</td>
<td>261-318 mph</td>
</tr>
<tr>
<td></td>
<td>Strong frame houses lifted off foundations and carried considerable distances to disintegrate; automobile sized missiles fly through the air in excess of 100 meters; trees debarked; steel reinforced concrete structures badly damaged.</td>
<td></td>
</tr>
<tr>
<td>F6</td>
<td>Inconceivable tornado</td>
<td>319-379 mph</td>
</tr>
<tr>
<td></td>
<td>These winds are very unlikely. The small area of damage they might produce would probably not be recognizable along with the mess produced by F4 and F5 wind that would surround the F6 winds. Missiles, such as cars and refrigerators would do serious secondary damage that could not be directly identified as F6 damage. If this level is ever achieved, evidence for it might only be found in some manner of ground swirl pattern, for it may never be identifiable through engineering studies.</td>
<td></td>
</tr>
</tbody>
</table>

Table below illustrates the Enhanced Fujita (EF) Scale, currently in use. Tornadoes that have occurred since February, 2007 are classified using the Enhanced Fujita Scale.
Table 4-25: Enhanced Fujita Scale (February 2007 and Later)\textsuperscript{132}

<table>
<thead>
<tr>
<th>Enhanced Fujita Category</th>
<th>Wind Speed</th>
<th>Potential Damage</th>
</tr>
</thead>
<tbody>
<tr>
<td>EF0</td>
<td>65-85 mph</td>
<td>Light damage. Peels surface off some roofs; some damage to gutters or siding; branches broken off trees; shallow-rooted trees pushed over.</td>
</tr>
<tr>
<td>EF1</td>
<td>86-110 mph</td>
<td>Moderate damage. Roofs severely stripped; mobile homes overturned or badly damaged; loss of exterior doors; windows and other glass broken.</td>
</tr>
<tr>
<td>EF2</td>
<td>111-135 mph</td>
<td>Considerable damage. Roofs torn off well-constructed houses; foundations of frame homes shifted; mobile homes completely destroyed; large trees snapped or uprooted; light-object missiles generated; cars lifted off ground.</td>
</tr>
<tr>
<td>EF3</td>
<td>136-165 mph</td>
<td>Severe damage. Entire stories of well-constructed houses destroyed; severe damage to large buildings such as shopping malls; trains overturned; trees debarked; heavy cars lifted off the ground and thrown; structures with weak foundations blown away some distance.</td>
</tr>
<tr>
<td>EF4</td>
<td>166-200 mph</td>
<td>Devastating damage. Well-constructed houses and whole frame houses completely leveled; cars thrown and small missiles generated.</td>
</tr>
<tr>
<td>EF5</td>
<td>&gt;200 mph</td>
<td>Incredible damage. Strong frame houses leveled off foundations and swept away; automobile-sized missiles fly through the air in excess of 100 m (107 yd); high-rise buildings have significant structural deformation; incredible phenomena will occur.</td>
</tr>
</tbody>
</table>

Based on the extent ranking factors identified (above), the planning committee ranks the extent of tornados as **LOW**.

**Extent: Hail**

The National Oceanic and Atmospheric Administration and the Tornado and Storm Research Organization (TORRO) have combined efforts to create the Hailstorm Intensity Scale. Table below provides details of this scale.

Table 4-26: Combined NOAA/TORRO Hailstorm Intensity Scale

<table>
<thead>
<tr>
<th>Size Code</th>
<th>Intensity Category</th>
<th>Typical Hail Diameter</th>
<th>Approximate Size</th>
<th>Typical Damage Impacts</th>
</tr>
</thead>
<tbody>
<tr>
<td>H0</td>
<td>Hard Hail</td>
<td>Up to 0.33”</td>
<td>Pea</td>
<td>No damage</td>
</tr>
<tr>
<td>H1</td>
<td>Potentially Damaging</td>
<td>0.33” – 0.60”</td>
<td>Marble or Mothball</td>
<td>Slight damage to plants and crops</td>
</tr>
<tr>
<td>H2</td>
<td>Potentially Damaging</td>
<td>0.60” – 0.80”</td>
<td>Dime or grape</td>
<td>Significant damage to fruit, crops, and vegetation</td>
</tr>
<tr>
<td>H3</td>
<td>Severe</td>
<td>0.80” – 1.20”</td>
<td>Nickel to Quarter</td>
<td>Severe damage to fruit and crops, damage to glass and plastic structures, paint and wood scored</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>H4</th>
<th>Severe</th>
<th>1.20” – 1.60”</th>
<th>Half Dollar to Ping Pong Ball</th>
<th>Widespread glass damage, vehicle body damage</th>
</tr>
</thead>
<tbody>
<tr>
<td>H5</td>
<td>Destructive</td>
<td>1.60” – 2.0”</td>
<td>Silver Dollar to Golf Ball</td>
<td>Wholesale destruction of glass, damage to tiled roofs, significant risk of injuries</td>
</tr>
<tr>
<td>H6</td>
<td>Destructive</td>
<td>2.0” – 2.4”</td>
<td>Lime or Egg</td>
<td>Aircraft body dented; brick walls pitted</td>
</tr>
<tr>
<td>H7</td>
<td>Very Destructive</td>
<td>2.4” – 3.0”</td>
<td>Tennis Ball</td>
<td>Severe roof damage, risk of serious injuries</td>
</tr>
<tr>
<td>H8</td>
<td>Very Destructive</td>
<td>3.0” – 3.5”</td>
<td>Baseball to Orange</td>
<td>Severe damage to aircraft body</td>
</tr>
<tr>
<td>H9</td>
<td>Super Hailstorms</td>
<td>3.5” – 4.0”</td>
<td>Grapefruit</td>
<td>Extensive structural damage, risk of severe or fatal injuries to persons caught in the open</td>
</tr>
</tbody>
</table>

Based on those extent ranking factors identified (above), the planning committee ranks the extent of the hail hazard as **LOW**.
Extent: Lightning

The National Weather Service (NWS) uses a Lightning Activity Level (LAL) scale to indicate the frequency and character of cloud-to-ground (C/G) lightning. The scale uses a range of 1 – 6, with 6 being the high end of the scale. Table below provides details of the LAL scale.

Table 4-27: Lightning Activity Level (LAL) Scale

<table>
<thead>
<tr>
<th>Rank</th>
<th>Cloud and Storm Development</th>
<th>Areal Coverage</th>
<th>Counts C/G per 5 Minutes</th>
<th>Counts C/G per 15 Minutes</th>
<th>Average C/G per Minute</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>No Thunderstorms</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>2</td>
<td>Cumulus clouds are common but only a few reaches the towering stage. A single thunderstorm must be confirmed in the rating area. The clouds mostly produce virga, but light rain will occasionally reach ground. Lightning is very infrequent.</td>
<td>$&lt;15%$</td>
<td>1-5</td>
<td>1-8</td>
<td>$&lt;1$</td>
</tr>
<tr>
<td>3</td>
<td>Cumulus clouds are common. Swelling and towering cumulus cover less than 2/10 of the sky. Thunderstorms are few, but 2 to 3 occur within the observation area. Light to moderate rain will reach the ground, and lightning is infrequent.</td>
<td>$15%$ to $24%$</td>
<td>6-10</td>
<td>9-15</td>
<td>1-2</td>
</tr>
</tbody>
</table>

Based on those extent ranking factors identified (above), the planning committee ranks the extent of the lightening hazard as **LOW**.

**Extent: Thunderstorms that Generate Wind, Tornado, Hail, and Lightning Hazard Events**

Thunderstorms are not explicitly identified as a severe weather category for this hazard profile. However, they are responsible for most tornado, lightning, and hail hazard events – as well as a significant number of wind hazard events – across California and the CSU system. While individual thunderstorms affect relatively small areas, there are many instances in which thunderstorms can cluster together and/or travel in a line over long distances, producing significant damage over large geographic areas.

A thunderstorm is classified as “severe” when certain meteorological parameters within the thunderstorm are reached (i.e., damaging winds or speeds of 58 mph (50 knots) or greater, hail 1 inch in diameter or larger, and/or a tornado). However, there is currently no
established, objective severity scale for thunderstorms. That said, according to the Glossary of Meteorology published by the American Meteorological Society (AMS), a thunderstorm is reported as light, medium, or heavy according to following five (5) characteristics:

- the nature of the lightning and thunder;
- the type and intensity of the precipitation, if any;
- the speed and gustiness of the wind;
- the appearance of the clouds; and
- the effect upon surface temperature.

A thunderstorm may also be classified by the nature of the overall weather situation in which the thunderstorm is produced, including:

- **Airmass Thunderstorm**: A thunderstorm produced by local convection within an unstable air mass;
- **Frontal Thunderstorm**: An individual thunderstorm the initiation of which results from rising motion associated with a front, or a thunderstorm within a convective system generated and organized by frontal rising motion;
- **Squall-line Thunderstorm**: An individual thunderstorm included within a squall line (i.e., a continuous or broken line of active deep moist convection frequently associated with thunder).

Based on the extent ranking factors identified (above) in relation to campus layout and operations, and past event low degree of severity, the planning committee ranks the extent of the thunderstorm hazard as **LOW**.

**History of the Hazard**

Severe weather hazards have been an annual occurrence in Kern County and Los Angeles County, and on both the CSU Bakersfield main campus in Bakersfield (Kern County) and

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135 Retrieved on 07.15.2021 from https://www.noaa.gov/explainers/severe-storms
136 Retrieved on 07.15.2021 from https://www.weather.gov/safety/thunderstorm
the satellite campus in Lancaster (Los Angeles County). Historical data for these hazards are presented below.

**Historical Storm Data Collection: NCEI Storm Events Database**

Historical information regarding severe weather hazards can be found using The National Centers for Environmental Information (NCEI) Storm Events Database. The Storm Events Database contains searchable, archived National Weather Service (NWS) storm data from January 1950 to April 2021, as entered by NOAA’s National Weather Service (NWS). Due to changes in the data collection and processing procedures over time, there are unique periods of record available depending on the event type.\(^\text{142}\) For example, from 1950 through 1954, only tornado events were recorded; from 1955 through 1995, only tornado, thunderstorm wind, and hail events were introduced into the database; from 1996 to present, 45 additional event types are recorded, including high wind, strong wind, and lightning events.\(^\text{143}\) To obtain the most accurate portrayal of severe weather event frequency, searches of the Storm Events Database are conducted using data collected since 01/01/1996. As a reminder, all official severe weather event data is at the county level. Severe weather data do not exist at the campus level. That said, it may be the case that the campus to some degree experiences the severe weather events reported for the surrounding community and County.

**Kern County**

**Wind Hazards (excluding Tornadoes)**

Information obtained from the NCEI Storm Event Database website shows the number of events (or occurrences) of wind hazard events in Kern County since 1996.\(^\text{144}\) Here, wind hazard events include all “High Wind,” “Strong Wind,” and “Thunderstorm Wind” storm reports.\(^\text{145}\)

- **High Wind:** at least 894 events, or approximately 35.29 events per year
- **Strong Wind:** at least 429 events, or 16.93 events per year
- **Thunderstorm Wind:** at least 54 events, or approximately 2.13 events per year

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- **All Wind Hazard events** (excluding Tornadoes): at least 1,375 events, or approximately 54.27 events per year\(^{146}\) (Note: This was determined by conducting a simultaneous search of the component wind hazards of high wind, strong wind and thunderstorm wind.)

Overall, in Kern County, there have been at least 1,375 wind hazard events since 1996, excluding tornadoes. That translates to an approximate average historical frequency of occurrence of 54.28 wind hazard events per year.

Please note: Differences between the sums of individual component wind hazard event Database searches (i.e., 1,377 events) and simultaneous Database searches of all wind hazard events (i.e., 1,375 events) are due to multiple event types in the same record (e.g., "Thunderstorm Wind/Hail" or "Hail/Tornado").\(^{147}\) When such a discrepancy arises, the more conservative aggregate hazard wind event value (i.e., 1,375 events) is used to determine the historical frequency of occurrence for the severe weather hazard.

Please note: Differences between the sums of individual component severe weather hazard event Database searches (i.e., 1,377 events) and simultaneous Database searches of all severe weather hazard events (i.e., 1,375 events) may be due to the following factors: (1) multiple event types are in the same record (e.g., "Thunderstorm Wind/Hail" or "Hail/Tornado;“ and/or (2) severe weather hazard events such as “Thunderstorm Wind” or “Hail” reported for Kern County have actually taken place hundreds of miles away, but are erroneously recorded as events that have occurred in the County.\(^{148}\) When such a discrepancy arises, the more conservative aggregate hazard wind event value (i.e., 1,377 events) is used to determine the historical frequency of occurrence for the severe weather hazard. The origin of this discrepancy is unknown at this time.

**Historical Wind Hazard Losses for Kern County since 1996**

According to the NCEI Storm Events Database, the wind hazard events that Kern County has experienced since 1996 have been costly. There have been 4 deaths and 12 injuries, and property and crop damage estimates have totaled approximately $15,970,000 and $597,500, respectively.

**Tornado Wind Hazards**

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\(^{146}\) National Climatic Data Center. Storm Events Database. Retrieved on 07.28.2021 from [https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28Z%29+High+Wind&eventType=%28Z%29+Strong+Wind&eventType=%28C%29+Thunderstorm+Wind&beginDate_mm=04&beginDate_dd=09&beginDate_yyyy=2019&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=KERN%3A29&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA


Information from the NCEI Storm Events Database indicates that since 1996, there have been 10 reported events of tornadoes in Kern County, which translates to approximately 0.39 tornado events per year. All tornado reports in Kern County since 1996 have been of tornadoes with a severity rating of F0/EF0.

**Historical Tornado Hazard Losses for Kern County since 1996**

According to the NCEI Storm Events Database, the tornado hazard events that Kern County has experienced since 1996 have been costly. While there have been no deaths, injuries, or crop damages reported, property damage estimates have totaled approximately $189,000.

**Hail**

Information from the NCEI Storm Events Database indicates that since 1996, there have been 35 reported events of hail in Kern County, which translates to approximately 1.38 hail events per year. (Note: The NCEI Storm Event Database search results for hail indicate that there has been a total of 36 reports of hail since 1996. However, one (1) entry is for a hail event in San Diego County, well over 200 miles away from Kern County. The origin of this discrepancy is unknown at this time.)

**Historical Hail Hazard Losses for Kern County since 1996**

According to the NCEI Storm Events Database, the hail hazard events that Kern County has experienced since 1996 have been moderate. There have been no deaths, injuries, or crop damages reported, and property damage estimates have totaled approximately $35,000.149 (Note: The San Diego County hail event that was included erroneously in the search results for hail hazard events in Kern County accounted for all injuries (i.e., 5) and crop damage estimates (i.e., $300,000) presented in the search results.)

**Lightning**

Information from the NCEI Storm Events Database indicates that since 1996, there have been 40 reported events of lightning in Kern County, which translates to approximately 1.58 lightning events per year.150

**Historical Lightning Hazard Losses for Kern County since 1996**

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149 National Climatic Data Center. Storm Events Database. Retrieved on 07.28.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Hail&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=KERN%3A29&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA

150 National Climatic Data Center. Storm Events Database. Retrieved on 07.28.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Lightning&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=KERN%3A29&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA
According to the NCEI Storm Events Database, the lightning hazard events that Kern County has experienced since 1996 have been costly. There has been 1 death and 4 injuries reported due to lightning, and property damage estimates have totaled approximately $355,000; no crop damage estimates have been reported.

**All Severe Weather Hazard Events Recorded by the NCEI Storm Events Database (Kern County)**

Information obtained from the NCEI Storm Events Database indicates that there have been 1,460 occurrences of the severe weather hazards in Kern County. This translates to 57.63 severe weather hazard occurrences per year. 151

Please note: Differences between the sums of individual component severe weather hazard event Database searches (i.e., 1463 events) and simultaneous Database searches of all severe weather hazard events (i.e., 1460 events) may be due to the following factors: (1) multiple event types are in the same record (e.g., "Thunderstorm Wind/Hail" or "Hail/Tornado;” and/or (2) severe weather hazard events such as “Thunderstorm Wind” “Hail” that have been reported for Kern County have actually taken place hundreds of miles away, but are erroneously recorded as events that have occurred in the County. 152

When such a discrepancy arises, the more conservative aggregate hazard wind event value (i.e., 1460 events) is used to determine the historical frequency of occurrence for the severe weather hazard. The origin of this discrepancy is unknown at this time.

**Historical, Aggregated Severe Hazard Losses for Kern County since 1996**

According to the NCEI Storm Events Database, the severe weather events that Kern County has experienced since 1996 have been costly. There have been 5 deaths and 21 injuries, and property and crop damage estimates have totaled approximately $16,549,000 and $597,500, respectively. However, it is important to note that for all Kern County severe weather hazard events recorded on the Storm Events Database, almost all deaths, the majority of injuries, all estimated crop damages, and approximately 96.5% of all estimated property damages have been caused by wind hazard events alone.

**Los Angeles County**

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151 National Climatic Data Center. Storm Events Database. Retrieved on 07.28.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Hail&eventType=%28Z%29+High%20Wind&eventType=%28C%29+Lightning&eventType=%28Z%29+Strong+Wind&eventType=%28C%29+Thunderstorm+Wind&eventType=%28Z%29+Tornado&beginDate_mm=11&beginDate_dd=30&beginDate_yyyy=2018&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=KERN%3A29&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA


153 National Climatic Data Center. Storm Events Database. Retrieved on 07.28.2021 from
Wind Hazards (excluding Tornadoes)

Information obtained from the NCEI Storm Event Database website shows the number of events (or occurrences) of wind hazard events in Los Angeles County since 1996. Here, wind hazard events include all “High Wind,” “Strong Wind,” and “Thunderstorm Wind” storm reports.

- **High Wind**: at least 387 events, or approximately 15.28 events per year
- **Strong Wind**: at least 3 events, or 0.12 events per year
- **Thunderstorm Wind**: at least 43 events, or approximately 1.70 events per year
- **All Wind Hazard events** (excluding Tornadoes): at least 427 events, or approximately 16.86 events per year. (Note: This was determined by conducting a simultaneous search of the component wind hazards of high wind, strong wind and thunderstorm wind.)

Overall, in Los Angeles County, there have been at least 427 wind hazard events since 1996, excluding tornadoes. That translates to an approximate average historical frequency of occurrence of 16.86 wind hazard events per year.

Please note: Differences between the sums of individual component severe weather hazard event Database searches (i.e., 433 events) and simultaneous Database searches of all severe weather hazard events (i.e., 427 events) may be due to the following factors: (1) multiple event types are in the same record (e.g., ”Thunderstorm Wind/Hail” or ”Hail/Tornado,” and/or (2) severe weather hazard events such as “Thunderstorm Wind” or “Hail” that are reported for Los Angeles County have actually taken place hundreds of miles away, but are erroneously recorded as events that have occurred in the County.

When such a discrepancy arises, the more conservative aggregate hazard wind event value (i.e., 427 events) is used to determine the historical frequency of occurrence for the severe weather hazard. The origin of this discrepancy is unknown at this time.

**Historical Wind Hazard Losses for Los Angeles County since 1996**

According to the NCEI Storm Events Database, the wind hazard events that Los Angeles County has experienced since 1996 have been costly. There have been 2 deaths and 4

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156 National Climatic Data Center. Storm Events Database. Retrieved 07.29.2021 from [https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28Z%29+High+Wind&eventType=%28Z%29+Strong+Wind&eventType=%28C%29+Thunderstorm+Wind&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=LOS%2BANGELES%3A37&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA

injuries reported from wind hazard events (excluding tornadoes) in Los Angeles County; no property or crop damage has been reported.

**Tornado Wind Hazards**

Information from the NCEI Storm Events Database indicates that since 1996, there have been 12 reported events of tornadoes in Los Angeles County, which translates to approximately 0.47 tornado events per year.

The vast majority of tornado reports in Los Angeles County since 1996 have been of tornadoes with a severity rating of F0/EF0. Only one (1) or 12 of the tornadoes reported in has been rated F1/EF1 or higher (it was an F1 tornado that occurred in 1998); that translates to approximately 0.04 events of F1/EF1 tornadoes have occurred per year in Los Angeles County.

**Historical Tornado Hazard Losses for Los Angeles County since 1996**

According to the NCEI Storm Events Database, the tornado hazard events that Los Angeles County has experienced since 1996 have been minimal. There have been no deaths, or property or crop damage reported; however, 1 injury has been reported.(Note: An F1/EF1 tornado that occurred in Los Angeles County in 1998 was responsible for the one (1) reported injury.)

**Hail**

Information from the NCEI Storm Events Database indicates that since 1996, there have been 18 reported events of hail in Los Angeles County, which translates to approximately 0.71 hail events per year. (Note: The NCEI Storm Event Database search results for hail indicate that there has been a total of 19 reports of hail since 1996. However, one (1) entry is for a hail event in San Diego County, over 100 miles away from Los Angeles County. The origin of this error is unknown at this time.)

**Historical Hail Hazard Losses for Los Angeles County since 1996**

According to the NCEI Storm Events Database, the hail hazard events that Los Angeles County has experienced since 1996 have been costly. While there have been no deaths, injuries, or crop damages reported, there have been property damage estimates that have totaled approximately $3,500,000; the property damage estimate reflects one (1) hail hazard event that occurred in 2003. (Note: The San Diego County hail event that was

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158 National Climatic Data Center. Storm Events Database. Retrieved 07.29.2021 from [https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29%20Hail&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=LOS%2BANGELES%3A37&hailfilter=0.00&tornfilter=0&windfilter=0&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA](https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29%20Hail&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=LOS%2BANGELES%3A37&hailfilter=0.00&tornfilter=0&windfilter=0&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA)

159 National Climatic Data Center. Storm Events Database. Retrieved 07.29.2021 from [https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29%20Hail&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=LOS%2BANGELES%3A37&hailfilter=0.00&tornfilter=0&windfilter=0&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA](https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29%20Hail&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=LOS%2BANGELES%3A37&hailfilter=0.00&tornfilter=0&windfilter=0&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA)
included erroneously in the search results for hail hazard events in Los Angeles County accounted for all injuries (i.e., 5) and crop damage estimates (i.e., $300,000) presented in the search results.)

Lightning

Information from the NCEI Storm Events Database indicates that since 1996, there have been 9 reported events of lightning in Los Angeles County, which translates to approximately 0.36 lightning events per year.160

Historical Lightning Hazard Losses for Los Angeles County since 1996

According to the NCEI Storm Events Database, the lightning hazard events that Los Angeles County has experienced since 1996 have been costly. While no property or crop damages have been reported, there have been 2 deaths and 13 injuries attributed to lightning hazard events.161

All Severe Weather Hazard Events Recorded by the NCEI Storm Events Database

(Los Angeles County)

Information obtained from the NCEI Storm Events Database indicates that there have been 466 occurrences of the severe weather hazard in Los Angeles County. This translates to 18.39 severe weather hazard occurrences per year.162

Please note: Differences between the sums of individual component severe weather hazard event Database searches (i.e., 472 events) and simultaneous Database searches of all severe weather hazard events (i.e., 466 events) may be due to the following factors: (1) multiple event types are in the same record (e.g., "Thunderstorm Wind/Hail" or "Hail/Tornado;" and/or (2) severe weather hazard events such as “Thunderstorm Wind” or “Hail” that are reported for Los Angeles County have actually taken place hundreds of

160 National Climatic Data Center. Storm Events Database. Retrieved 07.29.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Lightning&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=LOS%2BANGELES%3A37&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA

161 National Climatic Data Center. Storm Events Database. Retrieved 07.29.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Lightning&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=LOS%2BANGELES%3A37&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA

162 National Climatic Data Center. Storm Events Database. Retrieved 07.29.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Lightning&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=LOS%2BANGELES%3A37&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA
miles away, but are erroneously recorded as events that have occurred in the County.\textsuperscript{163} When such a discrepancy arises, the more conservative aggregate hazard wind event value (i.e., 466 events) is used to determine the historical frequency of occurrence for the severe weather hazard. The origin of this discrepancy is unknown at this time.

**Historical, Aggregated Severe Hazard Losses for Los Angeles County since 1996**

According to the NCEI Storm Events Database, the severe weather events that Los Angeles County has experienced since 1996 have been costly. There have been 4 deaths and 18 injuries, and property damage estimates have totaled approximately $3,500,000; no crop damage has been reported. \textit{It is important to note that for all Los Angeles County severe weather hazard events recorded on the Storm Events Database, lightning has accounted for half of the deaths, and for 13 out of 14 (92.9\%) injuries reported. However, hail has accounted for all reported estimated property damages.}

**Wind Hazards Not Included in the NCEI Storm Events Database**

*Santa Ana Winds*

Santa Ana wind events occur at least twice per month from October through April.\textsuperscript{164} From 1948 to 2012, total of 2056 events on the 65-year record were recorded in the Southern California region, yielding an average of \textit{32 occurrences per year}. Typical Santa Ana wind events last 1–2 days and represent 27\% of the occurrences, with events lasting up to 6 days accounting for 90\% of all occurrences. The remaining 10\% are made up almost entirely of events lasting between 7 and 12 days.\textsuperscript{165} \textsuperscript{166}

Figure below shows the mean monthly frequency per season of Santa Ana Wind events detected from 1948 to 2012. Extreme Santa Ana wind events are shown in dark red, and are defined as those events that are above the 90th percentile of all events on record.

\begin{itemize}
\item \textsuperscript{165} Retrieved on 07.14.2021 from \url{https://agupubs.onlinelibrary.wiley.com/doi/epdf/10.1002/2016GL067887}
\end{itemize}
Diablo Winds

Diablo wind events occur approximately **2.5 events per year**. These events are most frequent during the fall and early winter seasons, with the highest frequency of events occurring in October. As a result, the highest risk of Diablo-wind-related damage is in the fall and early winter.\textsuperscript{169}
Figure below shows the monthly frequency of Diablo winds (along with average live fuel moisture content). The Diablo Wind data are derived from a 17-year climatology of San Francisco Bay Area regional surface weather stations.\textsuperscript{170}

Figure 4-20: Monthly Frequency of Diablo Winds and Average Live Fuel Moisture Content (Dashed Line)\textsuperscript{171}

\textbf{Sundowner Winds}

Strong sundowner wind events occur approximately \textbf{2-3 times per year}. These events can create sharp temperature rises, local gale force winds, and significant weather-related problems. Rare, “explosive” types of sundowner wind events occur about 6 times per century that present dangerous weather situations, generating extremely strong and hot winds that can reach gale force or higher speeds.\textsuperscript{172}

\textbf{Historical Frequency of All Severe Weather Hazards}

The following tables show the average historical frequency of severe weather hazard events for Kern County and Los Angeles County, respectively, since 1996.

\textsuperscript{170} Retrieved on 07.15.2021 from https://www.fireweather.org/diablo-winds
\textsuperscript{171} Retrieved on 07.13.2021 from https://www.fireweather.org/diablo-winds
Table 4-28: Severe Weather Hazard Event

Frequencies for Kern County since 1996.

<table>
<thead>
<tr>
<th>Severe Weather Hazard Category</th>
<th>Average Number of Hazard Events Per Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wind (Includes High, Strong and Thunderstorm Winds ONLY)</td>
<td>54.28</td>
</tr>
<tr>
<td>Tornado</td>
<td>0.39</td>
</tr>
<tr>
<td>Hail</td>
<td>1.38</td>
</tr>
<tr>
<td>Lightning</td>
<td>1.58</td>
</tr>
<tr>
<td>Diablo Wind*</td>
<td>2.5</td>
</tr>
<tr>
<td>Santa Ana Wind</td>
<td>32</td>
</tr>
<tr>
<td>Sundowner Wind*</td>
<td>2 to 3</td>
</tr>
</tbody>
</table>

* Note: The Diablo, and Sundowner wind hazards are not present in Kern County. They are included here for information purposes only.
Table 4-29: Severe Weather Hazard Event

Frequencies for Los Angeles County since 1996.

<table>
<thead>
<tr>
<th>Severe Weather Hazard Category</th>
<th>Average Number of Hazard Events Per Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wind (Includes High, Strong and Thunderstorm Winds ONLY)</td>
<td>16.86</td>
</tr>
<tr>
<td>Tornado</td>
<td>0.47</td>
</tr>
<tr>
<td>Hail</td>
<td>0.71</td>
</tr>
<tr>
<td>Lightning</td>
<td>0.36</td>
</tr>
<tr>
<td>Diablo Wind*</td>
<td>2.5</td>
</tr>
<tr>
<td>Santa Ana Wind</td>
<td>32</td>
</tr>
<tr>
<td>Sundowner Wind*</td>
<td>2 to 3</td>
</tr>
</tbody>
</table>

* Note: The Diablo and Sundowner wind hazards are not present in Los Angeles County. They are included here for information purposes only.

Potential Impacts of the Hazard

The significance (or priority) of a hazard’s potential impacts is based primarily on the frequency and resulting damage caused by the hazard, including deaths/injuries and property, crop, and economic damage. All assets and people within CSU Bakersfield campus areas are at risk from the effects of severe weather hazards.

**Wind Hazards (Including Tornadoes)**

Wind hazard events have the potential to impact people, property, and operations on campuses across the CSU system. People caught in the open during an extreme wind event are exposed to high winds and debris, and could be injured or killed.

The habitability of buildings can be compromised (by damaging roofs, windows, or other weak points in the building envelope), leading to long-term operational issues for the campus. As with most university campuses, space is always at a premium at the CSU Bakersfield campus, and the loss of any currently utilized space due to building or structural damage would likely disrupt operations and the University’s mission.
Extreme wind events can result in power failure, which would impact the operation of the campus. Fallen tree limbs and other potential transportation hazards may also cause disruption to the surrounding community and limit ingress/egress to the campus.

**CSU Bakersfield Main Campus, Bakersfield (Kern County)**

According to the 2020 Kern County Multi-Jurisdictional Hazard Mitigation Plan, “high winds/straight-line winds” are considered to be a high-priority severe weather hazard by Kern County. These wind hazards are included in an “Extreme Weather” category, and are rated as having “limited” or low to moderate potential impact on Kern County and (by extension) on the CSU Bakersfield main campus. Tornadoes are not considered to be significant in Kern County; as a result, tornadoes have low significance and minimal potential impact on Kern County and (by extension) on the CSU Bakersfield main campus.

**CSU Bakersfield – Antelope Valley Campus, Lancaster (Los Angeles County)**

According to the 2019 City of Lancaster Hazard Mitigation Plan, “windstorms” are considered to be significant, and are rated as having a moderate to high potential impact on the City of Lancaster and (by extension) on the CSU Bakersfield – Antelope Valley Campus.

**Hail**

Hail typically impacts property by damaging structures, cars, and utilities as it falls. Dents in cars, broken glass, and holes in roofs are common impacts of hail. Injuries to people from hail are less common, though they can happen, as hail is a hard object falling in an unpredictable manner at a fairly high rate of speed.

**CSU Bakersfield Main Campus, Bakersfield (Kern County)**

According to the 2020 Kern County Multi-Jurisdictional Hazard Mitigation Plan, hail hazards are rare in Kern County; as a result, they are considered to be of low significance, and therefore to have a minimal potential impact on Kern County and (by extension) on the CSU Bakersfield main campus.

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The 2019 City of Lancaster Hazard Mitigation Plan does not consider hail hazards to be significant enough to profile. As a result, hail hazards are considered to be of low significance, and therefore to have a minimal potential impact on the City of Lancaster and (by extension) on the CSU Bakersfield – Antelope Valley Campus.177

**Lightning**

Lightning strikes the United States about 20-25 million times a year.178 Although most lightning occurs in the summer months, people can be struck at any time of year. Since 1990, lightning has killed an average of 39 people each year in the United States, and hundreds more have been injured.179 Property losses due to lightning have been very costly across the U.S. For example, from 2005 through 2020, U.S. homeowner’s insurance claim payouts for lightning losses totaled approximately $15,334,600,000, or $958,412,500 worth of payouts per year.180 (Commercial claim payouts for lightning losses for the U.S. were not available.)

**CSU Bakersfield Main Campus, Bakersfield (Kern County)**

According to the 2020 Kern County Multi-Jurisdictional Hazard Mitigation Plan, lightning is not identified as a priority hazard; as a result, it is considered to be of low significance, and therefore to have a minimal potential impact on Kern County and (by extension) the CSU Bakersfield main campus.181

The 2019 City of Lancaster Hazard Mitigation Plan does not consider lightning hazards to be significant enough to profile. As a result, lightning hazards are considered to be of low significance, and therefore to have a minimal potential impact on the City of Lancaster and (by extension) on the CSU Bakersfield – Antelope Valley Campus.182

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Probability of Future Occurrence of the Hazard

Areas throughout California, including all California State University (CSU) campuses, experience severe weather events every year. Future occurrences of such events are projected to increase in both their frequency and intensity.

**CSU Bakersfield Main Campus, Bakersfield (Kern County)**

The 2020 Kern County Multi-Jurisdictional Hazard Mitigation Plan states that there is between a 10% and 100% chance that severe weather wind hazards profiled will occur in the future in Kern County, and it rates the probability of future occurrence of severe weather (or “extreme weather”) as “likely.” However, according to the NCEI Storm Events Database, severe weather wind hazard events have occurred in Kern County far more than once annually – at an average of 54.28 events per year since 1996. Furthermore, while the severe weather hazard is a non-spatial hazard that affects all areas of both CSU Bakersfield main campus equally, the smallest geographic unit of measurement for almost all official severe weather event data is at the county level. Because the severe weather data used in this assessment do not exist at the campus level, it is assumed that the severe weather probabilities for the CSU Bakersfield main campus reflect those of the surrounding community and County identified in the Table below.

Based on the data available from both the 2020 Kern County Multi-Jurisdictional Hazard Mitigation Plan and the NCEI Storm Events Database, the severe weather hazard is expected to occur on (or otherwise impact) Kern County and the CSU Bakersfield campus at least once on an annual basis. Therefore, the probability of future occurrence of the severe weather hazard for the CSU Bakersfield main campus is **HIGHLY LIKELY**.

**CSU Bakersfield – Antelope Valley Campus, Lancaster (Los Angeles County)**

The 2019 City of Lancaster Hazard Mitigation Plan states that the probability of future severe wind events is approximately 3.08 out of a maximum score of 4.00, where a “3” is considered to be “likely.” However, according to the NCEI Storm Events Database, severe weather wind hazard events have occurred in Los Angeles County far more than once per year – at an average of 16.86 events per year since 1996. Furthermore, while the severe weather hazard is a non-spatial hazard that affects all areas of the CSU Bakersfield – Antelope Valley campus equally, the smallest geographic unit of measurement for almost all official severe weather event data is at the county level. Because the severe weather data used in this assessment do not exist at the campus level, it is assumed that


the severe weather probabilities for the CSU Bakersfield – Antelope Valley campus reflect those of the surrounding community and County identified in the Table below.

Based on the data available from both the 2019 City of Lancaster Hazard Mitigation Plan and the NCEI Storm Events Database, the severe weather hazard is expected to occur on (or otherwise impact) the CSU Bakersfield – Antelope Valley campus at least once on an annual basis. Therefore, the probability of future occurrence of the severe weather hazard for CSU Bakersfield – Antelope Valley is **HIGHLY LIKELY**.

**CSU Bakersfield – All Campus Areas**

The probability of future occurrence of the severe weather hazard for all CSU Bakersfield campus areas is **HIGHLY LIKELY**.

The following tables show the probabilities of future occurrence for component severe weather hazards for CSU Bakersfield campuses in Kern County and Los Angeles County.

Table 4-30: Severe Weather Hazard Probabilities of Future Occurrence for Kern County and CSU Bakersfield Main Campus (Bakersfield, CA)

<table>
<thead>
<tr>
<th>Severe Weather Hazard Category</th>
<th>Average Number of Hazard Events Per Year</th>
<th>Probability of Future Occurrence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wind (Includes High, Strong and Thunderstorm Winds ONLY)</td>
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<tr>
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<tr>
<td>Lightning</td>
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<td>Highly Likely</td>
</tr>
<tr>
<td>Diablo Wind**</td>
<td>2.5</td>
<td>Not Rated</td>
</tr>
<tr>
<td>Santa Ana Wind</td>
<td>32</td>
<td>Highly Likely</td>
</tr>
<tr>
<td>Sundowner Wind**</td>
<td>2 to 3</td>
<td>Not Rated</td>
</tr>
</tbody>
</table>

**Severe Weather Hazard** | **Highly Likely**

**Note:** The Diablo and Sundowner wind hazards are not present in Kern County, and therefore are not rated for probability of future occurrence. They are included here for information purposes only.
Table 4-31: Severe Weather Hazard Probabilities of Future Occurrence for
Los Angeles County and CSU Bakersfield - Antelope Valley (Lancaster, CA).

<table>
<thead>
<tr>
<th>Severe Weather Hazard Category</th>
<th>Average Number of Hazard Events Per Year</th>
<th>Probability of Future Occurrence</th>
</tr>
</thead>
<tbody>
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<td>Sundowner Wind**</td>
<td>2 to 3</td>
<td>Not Rated</td>
</tr>
</tbody>
</table>

** Note: The Diablo and Sundowner wind hazards are not present in Los Angeles County, and therefore are not rated for probability of future occurrence. They are included here for information purposes only.

Vulnerability to the Hazard

People, structures, and assets on both CSU Bakersfield campuses are all vulnerable to the impacts associated with severe weather. Infrastructure can be damaged or destroyed by hail, wind, tornadoes, thunderstorms, and lightning, which can result in service interruptions and outages. Structures can be damaged or destroyed by hail, wind, tornadoes, thunderstorms, and lightning. People can be injured or killed by lightning, flying debris, hail, or extreme wind events. Both CSU Bakersfield campuses also have vehicles, as well as off-campus conference and recreational facilities, that are all vulnerable to a severe weather event.

Estimate of Potential Losses

Severe weather is a non-spatial hazard that affects the entire CSU Bakersfield campus. Each of the hazards associated with severe weather can result in losses throughout the planning area.
All structures within all CSU Bakersfield campus areas are at risk from severe weather. Buildings on the main campus could be damaged by wind, hail, and/or lightning. If even a fraction of these assets were to be damaged, the resulting estimated losses would still be in the millions of dollars. The total replacement costs due to severe weather hazard are $191,391,025 for the CSU Bakersfield main campus, and are unknown for the CSU Bakersfield - Antelope Valley campus. An analysis of projected dollar losses to campus buildings from severe weather as a percentage of building replacement costs is also not currently available, though CSU leadership may pursue such data in the future.

The population at the CSU Bakersfield campus varies throughout the day. As of Fall, 2019, CSU Bakersfield had 11,199 students and 1,277 faculty and staff. All are at risk from severe weather events, with 12,476 being directly vulnerable in this scenario.

Vulnerability Assessment Conclusions

Severe weather presents a variety of hazards to both CSU Bakersfield campuses. People, assets, infrastructure, and vehicles can all be damaged by this hazard, and losses can quickly begin to rise. In the aggregate, severe weather is a frequently occurring hazard (mostly in the form of wind hazard events) that presents a variety of risks to CSU Bakersfield.

It is evident that CSU Bakersfield has vulnerabilities to and risks from severe weather hazard incidents, and that pre-event planning, communication, and mitigation efforts should be implemented. Public education and outreach regarding areas of shelter that could be used by campus populations during severe weather events is considered by campus leadership to be one viable mitigation option. The campus planning committee will continue to look for feasible and cost-effective options for the mitigation of severe weather risks going forward.

Identified Data Limitations

Numerous federal agencies maintain a variety of records regarding losses associated with hazards. Unfortunately, no single source is considered to offer a definitive accounting of all losses. The Federal Emergency Management Agency (FEMA) maintains records on federal expenditures associated with declared major disasters. The US Army Corps of Engineers (USACE) and the Natural Resources Conservation Service (NRCS) collect data on losses during the course of some of their ongoing projects and studies. Additionally, the National Oceanic and Atmospheric Administration’s (NOAA) National Centers for Environmental Information (NCEI) collects and maintains data about natural hazards in summary format, as well as occurrences, dates, injuries, deaths, and estimated costs for individual storm events. Many of these databases and other data collection

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185 Retrieved on 07.19.2021 from https://www2.calstate.edu/csu-system/about-the-csu/facts-about-the-csu/enrollment/Pages/default.aspx
services, including the NCEI, have inherent data limitations when searching for information at a scale as small as a single campus.

The best available data and records have been used throughout this section. Where no data or records exist or could be located, that deficiency is noted.

4.4 Social Resilience Assessment

Overview

While every person is vulnerable to risk, individuals from diverse populations such as those with access and functional needs are disproportionately more vulnerable and may be at a higher risk to harm in a disaster event. In addition to physical vulnerabilities, the intersectionality between physical hazard risks and population social vulnerabilities must be considered to holistically address overall campus risk.

As inclusivity is a high priority for CSU, addressing campus risk and resilience must be done through the lens of inclusion and equity. Addressing social vulnerability is an increasingly critical requirement of state and national doctrines and described in at the end of this section of the HVRA. Every individual of the campus’s richly diverse population group needs to have the capacity, skills, and knowledge in order to understand, access, and participate in risk reduction and disaster response in ways that are meaningful to their own unique situation. In a campus community, having strong social support networks and active involvement in community disaster responses may negatively or positively impact these opportunities and reduce the resilience-building process. This section offers a glimpse into the CSU Channel Islands campus’s unique social construct, population demographics, strengths and concerns and presents a high-level assessment of the resilience, coping capacities and potential social vulnerabilities of students, staff and faculty. The research variables that were asked are often considered sensitive subjects, and few are traditionally included in emergency management/hazard mitigation planning.

This social resilience assessment of college campuses is the first of its kind in the nation. The research methodology unfolded as the interviews with campuses progressed. The assessment data presented are not definitive or authoritative. The answers, analysis, and suggested trends are strictly indicators for potential social risk. They do not represent an accurate data capture as limitations on the data gathering process influenced an ability to provide accuracy. This assessment provides indications of increased risk, not accuracy of response or a true reflection of the situation of the campus. The information presented is to be considered in the context of the more detailed system-wide CSU social vulnerability assessment that is included in the baseline HVRA.
Campus-Identified Populations of Concern

During the campus interview, the following responses were provided when asked, “In considering the diverse population group(s) amongst student body, faculty and staff, which are of the most concern in your emergency management planning?”

Table 4-32: High level summary of campus populations of concern

<table>
<thead>
<tr>
<th>Question</th>
<th>Campus Response</th>
</tr>
</thead>
</table>
| Which population groups amongst the student body, faculty, and staff, are of the most concern for physical and social vulnerabilities in emergency management planning? | - Populations with access and functional needs  
- Non-English-speaking students and employees  
- Populations with mental health issues |
| Which population groups are most difficult to reach in an event?          | N/A                                                  |
| Which population groups have little/limited support networks if impacted by an event? | N/A                                                  |

Note: CSU Bakersfield was early interview, so interview process and question structure were not yet fully defined.

Resilience Variables Related to Campus Emergency Management

The interviewees were asked to reflect on a set of 12 variables for the campus populations of student, faculty and staff: homelessness (*housing insecurity*), food security, health and wellness, disability/access and functional needs (AFN), racial equity, digital equity, communications, international students, immigrants/immigration status issues (*undocumented, DACA, etc.*), LGBTQI (Lesbian Gay Bisexual Transgender Questioning (or queer) Intersex), and transportation dependency. They were also offered an opportunity to add any other factor they wanted to include. The following two questions were asked:
Is this factor a particular issue of concern for emergency management on your campus? Responses were summarized as **Very High, High, Medium, Low**

- Is this factor reflected in the emergency plans and processes for your campus? Responses were summarized as **Yes, No, In Progress, NA**

In order to provide a high-level qualitative response for the answers, the approach of averaging response was taken. If conflicting answers were expressed by the interviewees, the answer (code) was averaged out. A detailed explanation of the response averaging approach is included in the base HVRA.

Table 4-33: Campus-specific emergency management issues of concern and inclusion in emergency management plans and processes.

<table>
<thead>
<tr>
<th>Issue of Concern</th>
<th>Plans &amp; Processes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Homelessness (Housing Insecurity)</td>
<td>Low</td>
</tr>
<tr>
<td>Food Security</td>
<td>Low</td>
</tr>
<tr>
<td>Health &amp; Wellness</td>
<td>Medium</td>
</tr>
<tr>
<td>AFN</td>
<td>Low</td>
</tr>
<tr>
<td>Digital Equity</td>
<td>Low</td>
</tr>
<tr>
<td>Comms.</td>
<td>Low</td>
</tr>
<tr>
<td>International Students / Immigrants / Immigration Status</td>
<td>Medium</td>
</tr>
<tr>
<td>LGBTQI</td>
<td>Medium</td>
</tr>
</tbody>
</table>

Qualitative Narrative: Campus Overview of Potential Resilience Vulnerabilities

The following are interview notes of interest:

- Representatives in the Emergency Operations Center represent immigrant populations. Emergency management leads go and meet with immigrant populations every semester to discuss emergency management issues.
- In addition to the food pantry with a twice a month food distribution, the students have an edible garden.
Campus High Hazards and Potentially Vulnerable Populations

This section provides a brief introduction to the link between socially vulnerable populations and a particular hazard type. While extensive research has been conducted on the impacts of hazards, not all linkages have been documented or published, and detail for finding them are beyond the scope of this assessment. It’s important to note, the intersectional nature of what makes an individual’s personal experience and resilience to an event is played out by unique factors for that individual or population. The nuanced social vulnerabilities often come from the social and physical environment in which a person is embedded.

In order to aid in further assessing campus resilience, below is a general description of the known impacts. From some hazards, the descriptions are robust, while others are only brief introductions.

Table 4-34: CSU Bakersfield *Highly Likely, Likely and Possible* Hazards

<table>
<thead>
<tr>
<th>Hazard</th>
<th>Future Occurrence Probability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Communicable Disease</td>
<td>Highly Likely</td>
</tr>
<tr>
<td>Drought</td>
<td>Highly Likely</td>
</tr>
<tr>
<td>Earthquake</td>
<td>Possible</td>
</tr>
<tr>
<td>Extreme Temperature</td>
<td>Highly Likely (Heat Only)</td>
</tr>
<tr>
<td>Flood</td>
<td>Possible</td>
</tr>
<tr>
<td>Hazardous Materials</td>
<td>Possible</td>
</tr>
<tr>
<td>Power Outage</td>
<td>Likely</td>
</tr>
<tr>
<td>Wildfire</td>
<td>Unlikely (Fire); Possible (Smoke)</td>
</tr>
</tbody>
</table>
**Drought**

The 2012-2016 drought had severe effects on two vulnerable sectors of our population: those in low-income brackets, and those, especially Native Americans, who rely on subsistence fishing for their livelihoods.\(^{187}\) Water bills increased throughout the state. Due to rising water prices, for the working poor, many have paid four to five percent of their income for water. Since many CSU students are commuters, and many living with families, future drought impacts may potentially affect a percentage of non-resident students. NASA’s modeling shows that future droughts are likely to last longer and be more intense, even leading to “megadroughts” in the western states.\(^ {188}\) Fresh water supplies are predicted to be full of extremes, with both droughts and extreme precipitation events being more severe. The interrelationship between drought and other hazard conditions may lead to a set of secondary impacts. Drought conditions lead to water quality issues due to loss of drinking water, increased fire danger that leads to drought-induced fires and elevated AQI levels, as well as extreme heat or prolonged heat events.

**Earthquake**

Impacts on populations from earthquakes are complex, with long-term implications on social stability for all populations. In addition to the physical impact exposure during a no-notice earthquake event and the social and logistical challenges of a recovering community, an earthquake can have lasting impacts long afterwards due to post traumatic stress disorder (PTSD).

Socioeconomic vulnerabilities of populations at risk were analyzed in the hypothetical yet scientifically realistic earthquake sequence that is being used to better understand hazards for the San Francisco Bay region during and after a magnitude-7 earthquake (mainshock) on the Hayward Fault and its aftershocks. In this study, the at-risk populations located in areas of concentrated damage are anticipated to experience longer recovery trajectories, increased long term housing displacement, and transportation impacts due to dependencies on transit dependencies. When neighborhood schools close, families with school age children may move to other areas to keep their children in schools. Persons with access and functions needs are likely to be more dependent on access to functioning medical, social and personal health care services that would be overwhelmed by the event and therefore increasing their vulnerabilities. For the homeless populations, the loss of social community services and damages to shelters could add to protracted relocations. For the young and mobile populations who rent, the major disruption to housing, jobs and transit will also drive relocation. Widespread


housing damage and preexisting housing market constraints will make it “extremely challenging” for the socially and economically vulnerable populations to find alternative housing near their home communities. Those who utilize interim and irregular housing for months and years after a disaster are more vulnerable to physical, social, and mental disorders, including suicide, substance abuse, and physical and verbal abuse. Aftershocks and post disaster conditions delay population return and increase outmigration.\textsuperscript{189}

\textit{Extreme Temps}

People susceptible to respiratory ailments (asthma, lower and upper respiratory disease) disproportionately suffer from the effects of fire, smoke, air pollutions, allergens, heat and PSPS. Those with limited income or without resources are affected disproportionately due to the inability to provide safe shelter, air conditioning, cooling, air purification, medical care, and quality foods, and are also least able to obtain information related to climate risks and adaptation strategies.

\textbf{Heat}

Heatstroke, cardiovascular disease, respiratory disease and cerebrovascular disease are related to extreme heat events. Increased number of heat waves creates heat-related physical stress on populations and is exacerbated in the metropolitan areas where greater amounts of heat-absorbing surfaces (e.g., asphalt and concrete) trap heat and emit higher temperatures throughout the night.

The heat also extends the geographic range and the distribution of disease-carrying insects and pests. Health professionals are concerned that California’s warming climate will allow species to acclimate. Such vectors include such pests as ticks that carry Lyme disease, and mosquitos that transmit Zika, dengue fever, West Nile, plague and tularemia. Some others, such as chikungunya, Chagas disease, and Rift Valley fever virus, are threats as well.

Some communities of color and some low-income, homeless, and immigrant populations are more exposed to heat waves, as these groups often reside in urban areas affected by heat island effects. In addition, these populations are likely to have limited adaptive capacity due to a lack of adequately insulated housing, inability to afford or to use air conditioning, inadequate access to public shelters such as cooling centers, and inadequate access to both routine and emergency health care. These social, economic, and health risk factors give rise to the observed increase in deaths and disease from extreme heat in some immigrant and impoverished communities.

Heat stroke, the most serious heat-related illness, occurs when the body is unable to control its temperature. Body temperature rises rapidly, the sweating mechanism fails, and the body cannot cool down. In extreme causes, heat stroke can cause confusion and unconsciousness, so the victim is unable to seek treatment without assistance.

There are several groups of people who are uniquely vulnerable to the effects of extreme heat, such as infants and children, older adults aged 65 and up, athletes and outdoor workers, low-income households, and individuals with certain chronic medical conditions.

When dealing with an extreme heat event, the most common impacts are those generally felt by the people living in the targeted area. For people in particular, heat can kill when the body is pushed beyond its limits. Most heat disorders occur because the victim has been overexposed to heat. As discussed, the major human risks associated with extreme heat include dehydration, sunburn, fatigue, heat exhaustion, heat stroke, and in severe cases, death.

Some portions of the population are more at risk to the effects of extreme heat. The very young, the elderly, and certain groups with chronic medical conditions (such as asthma or other pulmonary illnesses, heart disease, poor blood circulation, neurological illnesses, and obesity) are generally more vulnerable to the effects of extreme heat, and are more likely to suffer illness or death as a result.

This is especially true if exposure is extended for a period of time and preventative measures are not taken immediately. Distributional implications of impacts, and even less on distributional implications of adaptation actions.” 190

**Flood**

Risk from floods relates to community risk, exposure and infrastructural losses. The degree of vulnerability to these events and their impacts depends on human behavior and the traditional social factors such as situational awareness, prior knowledge of hazards, social capital and decision-making capabilities. The exposure of humans to floods continues to increase, driven by changes in hydrology and land use. The adverse impacts on socially vulnerable populations are amplified because a disproportionately high number live in flood-prone areas. Research has shown that places of social vulnerabilities are places characterized by housing and racial disparities, such as mobile home parks, structural fragility and poverty, and higher percentages of populations such

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as Black and Native Americans, and others with shared histories of discrimination, marginalization and exclusion.  

Health impacts from flooding are well recognized due to the extensive history of flooding in California and around the nation. The impacts range from waterborne illnesses from contaminated waters, respiratory illnesses that impact the lungs, throat, and airways from airborne particles, mold on flooded buildings that can trigger asthma, allergies and other illnesses—all which are particularly impactful to older, younger and individuals with pre-existing health condition. Foodborne illnesses can increase if there are issues with power outages or sewer overflows. Individuals with increased mental health concerns can be impacted by the stress or anxiety from the impacts of the flood. Poor quality housing can increase vulnerability to many flood risks, including flood inundation, power outages, mold growth, rodent vectors, and serious health impacts. For those with limited finances, flood inundation and impacts to infrastructure or farmlands may lead to extensive income losses.

The poorest residents suffer disproportionately to flood situations, especially those who have been less able to fund homeowner’s insurance to protect against flood losses. Loss of life is not unusual in flooding situations, as is loss of property, livestock, pets, workplaces, and tourist industries. There is a strong interrelationship between water events and other hazards. Flooding, storms and water quality are related to each other. Drought conditions can exacerbate floods as the surface soils are hardened and not as ready to allow surface water absorption. Extreme heat events can cause snowmelt, inundating waterways and causing flood and water quality issues. Flooding and storm events can have impacts on public health, environmental health, agricultural health and economic system health. Mental health issues are reported for all people who have experience flood losses, including anxiety, fear, anger, sadness and grief. Additionally, waterborne disease outbreaks are reported weeks after the flood events. Mold contamination leads to indoor air issues. Damp indoor environments lead to increased prevalence of asthma, and also upper and lower respiratory symptoms.

These issues may influence the diverse CSU populations, both on and off campus, in a number of ways long after a flood event, or the related hazards impacts, has concluded.

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Hazardous Materials

The severity of a hazardous materials release depends upon the type of material released, the amount of the release, and the proximity to populations or environmentally sensitive areas such as wetlands or waterways. The release of materials can lead to injuries or evacuation of nearby residents. Wind direction at the time of the release can also have a bearing on the severity (as well as the location and extent) of a hazardous materials release.

The primary threat from the hazardous materials incident hazard is to the structures located along transmission lines and transportation routes or near facilities that use or store hazardous materials. Minor incidents would likely cause no damage and little disruption, assuming they could be contained quickly. Major incidents could have fatal and disastrous consequences. The severity of a hazardous material release relates primarily to its impact on human safety and welfare and on the threat to the environment. Threats to human safety and welfare include:

- Poisoning of water or food sources and/or supply
- Presence of toxic fumes or explosive conditions
- Damage to personal property
- Need for the evacuation of people
- Interference with public or commercial transportation

Environmental risks are not uniformly distributed across groups of people. Age, poverty, and minority status place some groups at a disproportionately high risk for environmental disease.\(^{193}\) Poor access to health information and health care means less health promotion, less risk avoidance, a less healthy diet, and more adverse conditions that increase susceptibility to exposure. Delayed recognition of exposure, diagnosis, and treatment allows effects to accumulate.\(^{194}\)

Power Outage/Public Safety Power Shutdowns (PSPS)

Loss of power creates economic hardship to a region experiencing regular PSPS events, such as those experienced throughout the state over the recent years. Many businesses close, including gas stations, grocery stores, and local retail establishments. These impacts may deeply impact students dependent on support jobs, as well impacting family members of campus staff and faculty. PSPS increases risks to the public due to inability to use medical devices, spoilage of food and medicines, and disruption to infrastructure, such as supply of clean water and electricity used to run home medical equipment, such as lift chairs and ventilators.

\(^{193}\) https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3222496/

Wildfire

Increased wildfire threat occurs especially in the end of fall, when conditions are driest, but before the winter rains have come; an east-to-west wind gusts exacerbate fire risk. Wildfire threats have the concomitant threat of Public Safety Power Shutoffs (PSPS). And, in the case of an actual wildfire, danger exists both from fire and from the smoke. Recent wildfires have demonstrated that some demographics are disproportionately affected. Native Americans are six times more likely to be affected than white people. Blacks and Hispanic people are 50 percent more vulnerable. These values take into account the likelihood of a community being affected and the greater difficulty of that community to recover. These statistics reflect the lack of access to resources to pay for insurance, to rebuild and recover, to implement fire safety measures, and to access other resources. Price gouging after a fire (such as documented in Sonoma County after the 2017 Tubbs Fire) further exacerbates the disparity. 195 Furthermore, the disabled and the elderly are at particular risk from extreme wildfire conditions, as they are often not as able to effectively evacuate. Of the 85 people who died in the Camp Fire in Butte in 2018, 62 of them were at least 65 years old. 196

Smoke from wildfires creates a significant public health threat. Especially vulnerable are individuals who have heart or lung issues, such heart disease, lung disease or asthma. Those most vulnerable include the medically fragile, elderly and children. Air Quality Indexes track the level of the following: 197 particulate matter, surface levels of ozone, carbon monoxide, sulfur dioxide, and nitrogen dioxide. All of these can cause respiratory distress and harm lungs. 198

The California Department of Public Health reports the increased public health risks, and risk indicators that include: heat-related ED visits, populations living in wildfire areas, adults with multiple chronic conditions, populations living in poverty, race/ethnicity, outdoor workers, public transit access, air conditioner ownership and tree canopy. 199


Hazard Mitigation and Emergency Management Planning

The goal of this high-level assessment is to provide a starting point to encourage further exploring campus social risks and vulnerabilities, as well as to inform and to enhance holistic emergency management and hazard mitigation decision making, planning processes and future adaptive risk management strategies. By including the social resilience factors, mitigation investments may move beyond standardized planning and regulations, structure and infrastructure projects, and natural systems protections to embrace a more expanded, customized emergency operations plan and an education and outreach program unique to the campus.

A more robust social resilience inquiry is strongly encouraged to develop an accurate picture, based on methodical and scientific research-based data. Such an effort would be envisioned through both nuanced discussions with a variety of campus stakeholders and the invitation of nontraditional stakeholders to join in a collaborative resilience partnership. Such a forward-leaning effort would be directly in keeping with CSU’s commitment to inclusion and equity in risk reduction.
Section 05
California State University, Channel Islands

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5.1 University Profile

University History

California State University Channel Islands (CSU Channel Islands, or CSUCI) is a four-year, public university located in Camarillo (Ventura County), California, and is the newest campus of the California State University (CSU) System. Planning for the establishment of CSU Channel Islands first began in 1965, when State Senator Robert J. Lagomarsino co-authored Senate Bill 288 with Assemblyman Burt Hansen, calling for establishment of a four-year college in Ventura County; that same year, Governor Pat Brown signed a bill authorizing $20,000 for an advance acquisition site study for a state college for Ventura County. However, it was not until 1997 that the California State Legislature and the California State University (CSU) Board of Trustees provided funds to begin the conversion of the Camarillo State Hospital property (located in Camarillo, CA) into a college campus. In August, 1999, the CSU Northridge Ventura Campus moved to the Camarillo, CA site as a satellite facility for CSU Northridge; the site then became known as CSU Northridge at Channel Islands. Three years later, on August 16, 2002, CSU Channel Islands officially opened as the 23rd (and newest) campus in the California State University system. CSU Channel Islands became a federally-recognized Hispanic Serving Institution (HSI) in 2010, and maintains that designation today.

University Governance

The campus president is the chief executive officer who oversees the administration of the entire university. The president manages campus operations and fundraising, sets campus priorities, and oversees the hiring and support of staff and faculty. The president also maintains a close working relationship with the CSU’s systemwide office, reporting to the chancellor and participating in the systemwide Executive Council.

The provost is the chief academic officer of the university, overseeing all academic affairs and programs of the university. The provost reports directly to the president.

The President’s Executive Leadership Team addresses the strategic and operational issues of the university. This team provides recommendations on university-wide policies and practices, and advises the campus President on the development and implementation of university strategies and plans.

University Mission

“Placing students at the center of the educational experience, California State University Channel Islands provides undergraduate and graduate education that facilitates learning within and across disciplines through integrative approaches, emphasizes experiential and service learning, and graduates students with multicultural and international perspectives.”
University Location

The CSU Channel Islands main campus is located in Camarillo, California, midway between Santa Barbara and Los Angeles. Aside from the main campus, CSU Channel Islands operates several other facilities in Southern California: (1) a satellite campus in Goleta, CA; (2) a boating center in Oxnard, CA; and (3) the Santa Rosa Island Research Station (SRIRS), a research facility for students and researchers located in Channel Islands National Park, about 26 miles off the coast of Santa Barbara, California.

University Population

CSU Channel Islands has a total enrollment of 7,455 students. The full-time enrollment at is 6,037 students and the part-time enrollment is 1,418. This means that 81% of students enrolled at CSU Channel Islands are enrolled full-time.

The enrolled student population at CSU Channel Islands, both undergraduate and graduate, is 48.6% Hispanic or Latino, 29.2% White, 5.62% Asian, 4.55% Two or More Races, 2.36% Black or African American, 0.349% American Indian or Alaska Native, and 0.121% Native Hawaiian or Other Pacific Islanders.

The most popular Bachelor’s Degree concentrations at CSU Channel Islands were General Psychology, General Business Administration & Management, and Speech Communication & Rhetoric. CSU Channel Islands is a commuter campus.

5.2 Interim Final Rule for Hazard Vulnerability and Risk Assessment

Requirement §201.6(c)(2): The plan shall include a risk assessment that provides the factual basis for activities proposed in the strategy to reduce losses from identified hazards. Local risk assessments must provide sufficient information to enable the jurisdiction to identify and prioritize appropriate mitigation actions to reduce losses from identified hazards.

Requirement §201.6(c)(2)(i): [The risk assessment shall include a] description of the type...location and extent of all natural hazards that can affect the jurisdiction. The plan shall include information on previous occurrences of hazard events and on the probability of future hazard events.

Requirement §201.6(c)(2)(ii): [The risk assessment shall include a] description of the jurisdiction’s vulnerability to the hazards described in paragraph (c)(2)(i) of this section. This description shall include an overall summary of each hazard and its impact on the community.

Requirement §201.6(c)(2)(ii)(A): [The risk assessment] must also address National Flood Insurance Program (NFIP) insured structures that have been repetitively damaged floods.

Requirement §201.6(c)(2)(ii)(A): The plan should describe vulnerability in terms of the types and numbers of existing and future buildings, infrastructure, and critical facilities located in the identified hazard area.
Requirement §201.6(c)(2)(ii)(B): [The plan should describe vulnerability in terms of an] estimate of the potential dollar losses to vulnerable structures identified in paragraph (c)(2)(ii)(A) of this section and a description of the methodology used to prepare the estimate.

Requirement §201.6(c)(2)(ii)(C): [The plan should describe vulnerability in terms of] providing a general description of land uses and development trends within the community so that mitigation options can be considered in future land use decisions.

Requirement §201.6(c)(2)(iii): For multi-jurisdictional plans, the risk assessment must assess each jurisdiction’s risks where they vary from the risks facing the entire planning area.

5.3 Hazard Identification and Risk Assessment

Overview of California State University, Channel Islands History of Hazards

Numerous federal agencies maintain a variety of records regarding losses associated with hazards. Unfortunately, no single source is considered to offer a definitive accounting of all losses. The Federal Emergency Management Agency (FEMA) maintains records on federal expenditures associated with declared major disasters. The US Army Corps of Engineers (USACE) and the Natural Resources Conservation Service (NRCS) collect data on losses during the course of some of their ongoing projects and studies. Additionally, the National Oceanic and Atmospheric Administration’s (NOAA) National Centers for Environmental Information (NCEI) database collects and maintains data about natural hazards in summary format. The data includes occurrences, dates, injuries, deaths, and estimated costs. Many of these databases and other data collection services, including the NCEI, have inherent data limitations when searching for information at a university scale.

The best available data and records were used throughout this assessment.

Hazard Identification

As part of the initial hazard identification process, the Campus Assessment Team considered potential hazards with the most chance to significantly affect the planning area. The hazards include those that have occurred in the past and may occur in the future. A variety of sources were used to develop the list of hazards considered including national, regional, and local sources such as emergency operations plans, FEMA’s How-To Series, websites, published documents, databases, and maps, as well as discussion among the Campus Assessment Team members.

In the initial phase of the planning process, the Campus Assessment Team considered 14 hazards and the risks they create for the University and its material assets, population, and operations. The hazards initially considered, and the determinations as to the treatment of those hazards, are shown in Table 5-1 (following).

Table 5-1: Hazard Identification Determinations
## Future Occurrence Probability

In order to determine the probability of future occurrences of each hazard profiled, the following scale was developed:

- **Highly Likely** - 76%-100% that the hazard would occur annually.
- **Likely** - 50%-75% that the hazard would occur annually.
- **Possible** - 11%-49% that the hazard would occur each annually.
- **Unlikely** - 0%-10% that the hazard would occur each annually.

### Table of Hazard Occurrences

<table>
<thead>
<tr>
<th>Hazard</th>
<th>Determination (Yes/No)</th>
<th>Reason for Determination</th>
<th>Future Occurrence Probability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Communicable Disease</td>
<td>Yes</td>
<td>Hazard of concern for campus</td>
<td>Highly Likely</td>
</tr>
<tr>
<td>Dam and Levee Failure</td>
<td>Yes</td>
<td>Hazard of concern for campus</td>
<td>Unlikely</td>
</tr>
<tr>
<td>Drought</td>
<td>Yes</td>
<td>Hazard of concern for campus</td>
<td>Highly Likely</td>
</tr>
<tr>
<td>Earthquake</td>
<td>Yes</td>
<td>Hazard of concern for campus</td>
<td>Possible</td>
</tr>
<tr>
<td>Erosion</td>
<td>Yes</td>
<td>Hazard of concern for campus</td>
<td>Highly Likely</td>
</tr>
<tr>
<td>Extreme Temperature</td>
<td>No</td>
<td>Not a hazard of concern for campus</td>
<td>N/A</td>
</tr>
<tr>
<td>Flood</td>
<td>Yes</td>
<td>Hazard of concern for campus</td>
<td>Likely</td>
</tr>
<tr>
<td>Hazardous Materials</td>
<td>Yes</td>
<td>Hazard of concern for campus</td>
<td>Unlikely</td>
</tr>
<tr>
<td>Landslide</td>
<td>Yes</td>
<td>Hazard of concern for campus</td>
<td>Possible</td>
</tr>
<tr>
<td>Power Outage</td>
<td>Yes</td>
<td>Hazard of concern for campus</td>
<td>Likely</td>
</tr>
<tr>
<td>Sea Level Rise</td>
<td>No</td>
<td>Not a hazard of concern for campus</td>
<td>N/A</td>
</tr>
<tr>
<td>Tsunami</td>
<td>Yes</td>
<td>Hazard of concern for campus</td>
<td>Likely</td>
</tr>
<tr>
<td>Volcano</td>
<td>Yes</td>
<td>Hazard of concern for campus</td>
<td>Unlikely</td>
</tr>
<tr>
<td>Wildfire</td>
<td>Yes</td>
<td>Hazard of concern for campus</td>
<td>Likely (Fire); Possible (Smoke)</td>
</tr>
</tbody>
</table>
**Communicable Disease**

**Description of the Hazard**

Communicable diseases are illnesses that occur due to infectious agents or their toxic products and are infectious due to their potential of transmission from one person or species to another by a replicating agent. They may be transmitted from a reservoir to a susceptible host either directly as from an infected person or animal or indirectly through the agency of an intermediate plant or animal host, vector, or the inanimate environment. Communicable diseases are clinically evident illness resulting from the presence of pathogenic microbial agents, including pathogenic viruses, pathogenic bacteria, fungi, protozoa, multi-cellular parasites, and aberrant proteins known as prions. The degree of spread of a communicable disease depends on both the ability of an organism to enter, survive and multiply in the host and the comparative ease with which the disease is transmitted to other hosts.

Some ways in which communicable diseases spread are by:

- Travel through the air, such as tuberculosis, measles, or COVID-19;
- Physical contact with an infected person, such as through touch (staphylococcus), sexual intercourse (gonorrhea, HIV), fecal/oral transmission (hepatitis A), or droplets (influenza, TB, COVID-19);
- Contact with a contaminated surface or object (Norwalk virus), food (salmonella, E. coli), blood (HIV, hepatitis B), or water (cholera); and
- Bites from insects or animals capable of transmitting the disease (mosquito: malaria and yellow fever; flea: plague)

Collectively, the twenty-three (23) campuses and Chancellor’s Office of the California State University (CSU) system have identified nine (9) communicable disease hazards that have had significant impacts on their respective student, faculty, and staff populations. Of these communicable diseases, COVID-19 is considered to be the most prominent and widespread agent across all CSU campuses. (See Table 5-2 below.)
Table 5-2: Communicable Diseases at Identified CSU Campuses

<table>
<thead>
<tr>
<th>Collective List of Communicable Diseases Identified by All CSU Campuses</th>
<th>Number of CSU Campuses (Including Chancellor’s Office) Identifying Communicable Disease Having Significant Impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>COVID-19 (SARS-CoV-2)</td>
<td>24</td>
</tr>
<tr>
<td>Meningitis</td>
<td>7</td>
</tr>
<tr>
<td>Measles</td>
<td>6</td>
</tr>
<tr>
<td>Influenza (Including H1N1/Swine Flu)</td>
<td>6</td>
</tr>
<tr>
<td>Tuberculosis</td>
<td>5</td>
</tr>
<tr>
<td>Norovirus</td>
<td>4</td>
</tr>
<tr>
<td>Mumps</td>
<td>2</td>
</tr>
<tr>
<td>E. Coli</td>
<td>2</td>
</tr>
<tr>
<td>Sexually Transmitted Diseases (STDs)</td>
<td>2</td>
</tr>
</tbody>
</table>

(Source: Interviews with CSU campus staff at CSU campuses and at CSU Chancellor’s Office.)

With the exception of COVID-19, there is variability among CSU campuses regarding which communicable diseases have had the greatest impact on individual campus communities. Table 5-3 shows the communicable disease hazards that have had the greatest impact on each CSU campus.

Table 5-3: Communicable Disease Hazards at CSU Campuses with Greatest Impact

<table>
<thead>
<tr>
<th>CSU Campus</th>
<th>Identified Communicable Disease Hazards with the Greatest Impact on CSU Campus</th>
</tr>
</thead>
<tbody>
<tr>
<td>CSU Bakersfield</td>
<td>COVID-19, Meningitis</td>
</tr>
<tr>
<td><strong>CSU Channel Islands</strong></td>
<td>COVID-19, Measles</td>
</tr>
<tr>
<td>Chico State</td>
<td>COVID-19, Tuberculosis</td>
</tr>
<tr>
<td>CSU Dominguez Hills</td>
<td>COVID-19</td>
</tr>
<tr>
<td>Cal State East Bay</td>
<td>COVID-19, Meningitis</td>
</tr>
<tr>
<td>Fresno State</td>
<td>COVID-19, Meningitis, Tuberculosis</td>
</tr>
<tr>
<td>Cal State Fullerton</td>
<td>COVID-19, Influenza</td>
</tr>
<tr>
<td>Humboldt State</td>
<td>COVID-19, Measles, Norovirus, Influenza, STDs</td>
</tr>
<tr>
<td>Cal State Long Beach</td>
<td>COVID-19</td>
</tr>
<tr>
<td>Institution</td>
<td>Diseases</td>
</tr>
<tr>
<td>----------------------------------</td>
<td>-----------------------------------------------</td>
</tr>
<tr>
<td>Cal State LA</td>
<td>COVID-19, E. coli, Measles</td>
</tr>
<tr>
<td>Cal Maritime</td>
<td>COVID-19</td>
</tr>
<tr>
<td>CSU Monterey Bay</td>
<td>COVID-19</td>
</tr>
<tr>
<td>CSUN (Northridge)</td>
<td>COVID-19, Measles</td>
</tr>
<tr>
<td>Cal Poly Pomona</td>
<td>COVID-19, Influenza (Swine Flu - H1N1)</td>
</tr>
<tr>
<td>Sacramento State</td>
<td>COVID-19</td>
</tr>
<tr>
<td>Cal State San Bernardino</td>
<td>COVID-19, Tuberculosis</td>
</tr>
<tr>
<td>San Diego State</td>
<td>COVID-19, Meningitis, Mumps</td>
</tr>
<tr>
<td>San Francisco State</td>
<td>COVID-19</td>
</tr>
<tr>
<td>San José State</td>
<td>COVID-19, H1N1</td>
</tr>
<tr>
<td>Cal Poly San Luis Obispo</td>
<td>COVID-19, Meningitis, Norovirus</td>
</tr>
<tr>
<td>CSU San Marcos</td>
<td>COVID-19</td>
</tr>
<tr>
<td>Sonoma State</td>
<td>COVID-19, H1N1, Norovirus</td>
</tr>
<tr>
<td>Stanislaus State</td>
<td>COVID-19, Tuberculosis</td>
</tr>
<tr>
<td>Office of the Chancellor</td>
<td>COVID-19</td>
</tr>
<tr>
<td>CSU System-Wide</td>
<td>COVID-19, Meningitis, Measles, Tuberculosis, Influenza-Swine Flu-H1N1, Mumps, Norovirus, E. coli, STDs</td>
</tr>
</tbody>
</table>

(Source: Interviews with CSU campus staff at CSU campuses and at CSU Chancellor’s Office.)

Descriptions of Identified Communicable Disease Hazards at CSU Channel Islands

CSU Channel Islands (CSUCI) has identified two (2) communicable disease hazards that have had the greatest impact on campus – COVID-19 and Measles. The following are brief descriptions of the communicable disease hazards at CSUCI.

COVID-19 (SARS-CoV-2)

Coronaviruses are a family of viruses that can cause illnesses such as the common cold, severe acute respiratory syndrome (SARS) and Middle East respiratory syndrome (MERS). In 2019, a new coronavirus was identified as the cause of a disease outbreak that originated in China. This virus is now known as the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2). The disease it causes is called Coronavirus Disease 2019 (COVID-19). In March 2020, the World Health Organization (WHO) declared the COVID-19 outbreak a pandemic.

Signs and symptoms of coronavirus disease 2019 (i.e., COVID-19) may appear two to 14 days after exposure. Common signs and symptoms can include fever, cough, and tiredness. Early symptoms of COVID-19 may also include a loss of taste or smell.
The virus that causes COVID-19 spreads easily among people, and more continues to be discovered over time about how it spreads. Data has shown that the COVID-19 virus spreads mainly from person to person among those in close contact (within about 6 feet, or 2 meters). The virus is transmitted by respiratory droplets being released when someone with the virus coughs, sneezes, breathes, sings or talks. These droplets can be inhaled or land in the mouth, nose or eyes of a person nearby. In some situations, the COVID-19 virus can spread by a person being exposed to small droplets or aerosols that stay in the air for several minutes or hours (i.e., airborne transmission). It’s not yet known how common it is for the virus to spread this way. The COVID-19 virus can also spread if a person touches a surface or object with the virus on it and then touches his or her mouth, nose or eyes; however, this is not considered to be a main way it spreads.

The severity of COVID-19 symptoms can range from very mild to severe. Some people may have only a few symptoms, and some people may have no symptoms at all. However, some people may experience worsened symptoms, such as worsened shortness of breath and pneumonia. People who are older have a higher risk of serious illness from COVID-19, and the risk increases with age. People who have existing medical conditions also may have a higher risk of serious illness from COVID-19. In some cases, the disease can cause severe medical complications and may even lead to death.⁵

Measles

Measles (also known as rubeola) is a highly contagious childhood infection caused by a virus. The measles virus replicates in the nose and throat of an infected child or adult. Then, when someone with measles coughs, sneezes or talks, infected droplets spray into the air, where other people can inhale them. The infected droplets may also land on a surface, where they remain active and contagious for several hours. The virus is contracted by putting touching one’s nose, mouth, or eyes after touching the infected surface.

Measles can be serious and even fatal for small children. The disease still kills more than 100,000 people a year worldwide, most under the age of 5. However, as a result of high vaccination rates in general, measles hasn’t been widespread in the United States for more than a decade.⁶

Location of the Hazard

Communicable diseases have the potential to affect the entire CSU-Channel Islands (CSUCI) planning area equally. As a result, the communicable disease hazard can be found at the CSU Channel Islands (CSUCI) main campus located in Camarillo, CA (Ventura County). The communicable disease hazard can also be found at three (3) facilities that CSUCI operates:

- A satellite campus (CSUCI Extended University) in Goleta, CA (Santa Barbara County);\(^7\)
- A boating center for CSUCI students and local community members (CSU Channel Islands Boating Center) in Oxnard, CA (Ventura County);\(^8\) and
- The Santa Rosa Island Research Station (SRIRS), a research facility for students and researchers located in Channel Islands National Park, about 26 miles off the coast of Santa Barbara, California (Santa Barbara County).\(^9\)

Because of the ubiquitous nature of many communicable diseases, students, faculty, staff at (and visitors to) all CSUCI locations are at risk of exposure to the communicable disease hazard.

**CSU Student Housing Locations and Populations**

Although CSU-campus-owned student housing opportunities have been severely limited due to the COVID-19 pandemic, this situation is temporary. Eventually, students will be allowed back on campus at full capacity, and many of these students will be living in campus-owned housing. When this occurs, over 53,000 students (i.e., just over 11% of the CSU total enrollment) will be at increased risk of exposure to communicable disease hazards, owing to the “close-quarters” living arrangements in student housing. Table 5-4 shows the number of students that were living in CSU-campus-owned housing in Fall 2019, prior to the COVID-19 pandemic.\(^{10,11}\)

**Table 5-4: CSU Campus Student Housing Populations**

<table>
<thead>
<tr>
<th>CSU Campus</th>
<th>Approximate Enrollment Population (Fall 2019)</th>
<th>Approximate Proportion of Students Living in School Housing</th>
<th>Approximate School Housing Population (Fall 2019)</th>
</tr>
</thead>
<tbody>
<tr>
<td>CSU Bakersfield</td>
<td>11,199</td>
<td>5%</td>
<td>560</td>
</tr>
<tr>
<td><strong>CSU Channel Islands</strong>(^{12})</td>
<td><strong>7,093</strong></td>
<td><strong>6%</strong></td>
<td><strong>432</strong></td>
</tr>
<tr>
<td>Chico State</td>
<td>17,019</td>
<td>2%</td>
<td>340</td>
</tr>
<tr>
<td>CSU Dominguez Hills</td>
<td>17,027</td>
<td>5%</td>
<td>851</td>
</tr>
<tr>
<td>Cal State East Bay</td>
<td>14,705</td>
<td>15%</td>
<td>2,206</td>
</tr>
<tr>
<td>Fresno State</td>
<td>24,139</td>
<td>5%</td>
<td>1,207</td>
</tr>
</tbody>
</table>

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\(^7\) CSU Channel Islands. *Goleta Campus.* Retrieved 05.07.2021 from: [https://maps.csuci.edu/](https://maps.csuci.edu/)


\(^9\) CSU Channel Islands. *Santa Rosa Island and CI’s Research Station.* Retrieved 05.07.2021 from: [https://www.csuci.edu/sri/](https://www.csuci.edu/sri/)

\(^10\) California State University. *Enrollment.* Retrieved 04.30.2021 from: [https://www2.calstate.edu/csu-system/about-the-csu/facts-about-the-csu/enrollment/Pages/default.aspx](https://www2.calstate.edu/csu-system/about-the-csu/facts-about-the-csu/enrollment/Pages/default.aspx)

\(^11\) California State University. *CSU Campus Match.* Retrieved 04.30.2021 from: [https://www2.calstate.edu/attend/campuses/campus-match/Pages/campus-match.aspx](https://www2.calstate.edu/attend/campuses/campus-match/Pages/campus-match.aspx)

\(^12\) CSU Channel Islands. *CSU Channel Islands Viewbook.* Retrieved 04.30.2021 from: [https://www.csuci.edu/viewbook/index.htm](https://www.csuci.edu/viewbook/index.htm)
<table>
<thead>
<tr>
<th>Institution</th>
<th>Students</th>
<th>% Increase</th>
<th>Applications</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cal State Fullerton</td>
<td>39,868</td>
<td>6%</td>
<td>2,392</td>
</tr>
<tr>
<td>Humboldt State</td>
<td>6,983</td>
<td>9%</td>
<td>628</td>
</tr>
<tr>
<td>Cal State Long Beach</td>
<td>38,074</td>
<td>9%</td>
<td>3,427</td>
</tr>
<tr>
<td>Cal State LA</td>
<td>26,361</td>
<td>4%</td>
<td>1,054</td>
</tr>
<tr>
<td>Cal Maritime</td>
<td>911</td>
<td>85%</td>
<td>774</td>
</tr>
<tr>
<td>CSU Monterey Bay</td>
<td>7,123</td>
<td>46%</td>
<td>3,277</td>
</tr>
<tr>
<td>CSUN (Northridge)¹³</td>
<td>38,391</td>
<td>8%</td>
<td>3,071</td>
</tr>
<tr>
<td>Cal Poly Pomona</td>
<td>27,914</td>
<td>9%</td>
<td>2,512</td>
</tr>
<tr>
<td>Sacramento State</td>
<td>31,156</td>
<td>6%</td>
<td>1,869</td>
</tr>
<tr>
<td>Cal State San Bernardino</td>
<td>20,311</td>
<td>8%</td>
<td>1,625</td>
</tr>
<tr>
<td>San Diego State</td>
<td>35,081</td>
<td>15%</td>
<td>5,262</td>
</tr>
<tr>
<td>San Francisco State</td>
<td>28,880</td>
<td>13%</td>
<td>3,754</td>
</tr>
<tr>
<td>San José State</td>
<td>33,282</td>
<td>13%</td>
<td>4,327</td>
</tr>
<tr>
<td>Cal Poly San Luis Obispo</td>
<td>21,242</td>
<td>37%</td>
<td>7,860</td>
</tr>
<tr>
<td>CSU San Marcos¹⁴</td>
<td>14,519</td>
<td>11%</td>
<td>1,597</td>
</tr>
<tr>
<td>Sonoma State</td>
<td>8,649</td>
<td>37%</td>
<td>3,200</td>
</tr>
<tr>
<td>Stanislaus State</td>
<td>10,614</td>
<td>8%</td>
<td>849</td>
</tr>
<tr>
<td>Office of the Chancellor</td>
<td>0</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>CSU System-Wide</td>
<td>480,541</td>
<td>11%</td>
<td>53,076</td>
</tr>
</tbody>
</table>

**Extent of the Hazard**

Various communicable diseases are categorized by the Center for Disease Control and Prevention (CDC) by levels of containment called Biosafety Levels (or BSLs). The higher the BSL, the greater the level of containment and level of effort necessary to prevent transmission of the disease, and therefore the greater the hazard.

Biosafety Levels prescribe procedures and levels of containment for a particular microorganism or material (including research involving recombinant or synthetic nucleic acid molecules) and procedures associated with that containment. BSLs also consider primary barriers (e.g., biosafety cabinets), secondary barriers, facility design, air handling,

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laboratory security, etc. BSLs are graded from 1 to 4; as the BSL increases so does the relative risk of the agent/procedures as well the stringency of procedures and facility design.

Figure 5-1 describes the different BSLs, and provides examples of communicable diseases that would typically fall in to these classifications, as well as the typical protections that would be necessary to prevent transmission of each of the diseases.

Figure 5-1: Biosafety Levels (BSLs)\(^{15}\)

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**The Extent of CSU Channel Islands Communicable Disease Hazards Except COVID-19:**

Before the COVID-19 pandemic, there were cases of measles at CSU Channel Islands. Measles would be classified at the BSL-2 containment level.\(^{16}\)

**The Extent of CSU Channel Islands COVID-19 Communicable Disease Hazard:**

As a microorganism, the SARS-CoV-2 (COVID-19) virus requires a high level of containment. It is therefore classified at BSL-3.\(^{17}\)

**History of the Hazard**

Over an approximately one-year period, from mid-March, 2020 to March 23, 2021, there were a reported 27 cases of COVID-19 at CSU Channel Islands. CSU-campus-specific COVID-19 case data for CSU Channel Islands can be found in the *History of the Hazard* section below.

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Most communicable disease data are maintained by the state and at the county levels, and are not generally available at the municipal or campus levels, unless (a) the CSU campus falls under the jurisdiction of a city-level health department, or (b) a geographically specific outbreak occurs on campus or in the local community. The exception to this is the current COVID-19 pandemic, where both campus and County-level case data have been collected. As a result, it is important to provide COVID-19 case statistics for both CSU campuses and the counties where CSU campus assets are located.

The following tables show both campus and County-level COVID-19 Case data for CSUCI. These case data are updated on at least a weekly basis. (Please note that the COVID-19 case numbers here may not reflect the most recent updates.)

The following (Table 5-5) includes confirmed COVID-19 cases since May 2020 involving CSUCI students, faculty or staff who may have exposed others while working, visiting, attending in-person instruction, or living on campus (student housing) during the illness.

Table 5-5: CSU Channel Islands Campus-Level COVID-19 Case Data (as of 03.05.2021)\(^{18}\)

<table>
<thead>
<tr>
<th>Population</th>
<th>Confirmed Cases</th>
</tr>
</thead>
<tbody>
<tr>
<td>Students</td>
<td>17</td>
</tr>
<tr>
<td>Employees</td>
<td>8</td>
</tr>
<tr>
<td>External Community Members</td>
<td>2</td>
</tr>
<tr>
<td><strong>Total Cases</strong></td>
<td><strong>27</strong></td>
</tr>
</tbody>
</table>

*Cases listed are for individuals who have been physically present on campus.*

Table 5-6: Confirmed COVID-19 Statistics for Ventura County (as of 03.19.2021)\(^{19}\)

<table>
<thead>
<tr>
<th>Total Confirmed County Cases</th>
<th>Total Tests Performed</th>
<th>Total Deaths</th>
</tr>
</thead>
<tbody>
<tr>
<td>79,028</td>
<td>1,212,169</td>
<td>940</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Total Confirmed County Cases</th>
<th>Person-to-Person Acquired Cases</th>
<th>Community-Acquired Cases</th>
<th>Cases Under Investigation</th>
<th>Undetermined</th>
</tr>
</thead>
<tbody>
<tr>
<td>7,363</td>
<td>3,534</td>
<td>406</td>
<td>67,725</td>
<td></td>
</tr>
</tbody>
</table>


Table 5-7: COVID-19 Statistics for Santa Barbara County (as of 03.18.2021)\textsuperscript{20}

<table>
<thead>
<tr>
<th>New Cases</th>
<th>Active Cases</th>
<th>New Deaths</th>
<th>Hospitalized</th>
</tr>
</thead>
<tbody>
<tr>
<td>52</td>
<td>187</td>
<td>4</td>
<td>40</td>
</tr>
<tr>
<td>Total Cases</td>
<td></td>
<td>32,755</td>
<td></td>
</tr>
<tr>
<td>Total Deaths</td>
<td></td>
<td>434</td>
<td></td>
</tr>
</tbody>
</table>

Potential Impacts of the Hazard

Communicable disease outbreaks and pandemics potentially have (and will continue to have) direct impact on life, health, and safety across the CSU system, including the CSU – Channel Islands campus. The extent of this impact is contingent on the type of infection or contagion, the severity of the outbreak, and the speed at which it is transmitted. Property and infrastructure integrity may be affected if large portions of the campus population contracts communicable diseases at the same time and are therefore unable to perform maintenance, operations, and educational tasks. This would be particularly disruptive if those impacted are first responders or other essential personnel. Long-term outbreaks affecting large numbers of CSU – Channel Islands students could result in cancelled classes, delayed matriculation, or other disruptions to the CSU System’s mission. This has already occurred with the current COVID-19 pandemic, and could occur again with more virulent strains of communicable diseases, including COVID-19.

Communicable disease hazards found across the CSU system (including CSU – Channel Islands) vary both by level of containment (BSL) (described previously) and by level of individual/public health risk, or Risk Group (RG) level. While BSLs describe the procedures and required levels of containment in a laboratory setting, Risk Groups (RGs) reflect the potential effects of disease exposure on humans or animals. Like BSLs, RGs range from Level 1 (RG1) to Level 4 (RG4), with Level 1 (RG1) posing minimal risk to healthy individuals and public health and Level 4 (RG4) posing a very serious or extreme risks to individuals and public. BSLs generally correlate with Risk Group (RG) Levels (e.g., a RG2 agent is worked with at BSL-2), but there are exceptions (e.g., production volumes, high-risk procedures, etc.).\textsuperscript{21}

The World Health Organization’s (WHO) Laboratory Biosafety Manual, 3rd ed., NIH Guidelines, categorizes Risk Groups (RGs) in the following way:

\textsuperscript{20} Santa Barbara County Public Health Department. Community Data Dashboard. Retrieved 03.18.2021 from: https://publichealthsbc.org/data/

Table 5-8: WHO Risk Group Categorization\textsuperscript{22}

<table>
<thead>
<tr>
<th>Risk Group (RG)</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>RG1</td>
<td>Rarely associated with disease in healthy adult humans or animals and pose no-to-little public health risk (e.g., Saccharomyces cerevisiae, E. coli K-12 strain derivatives often used for recombinant/molecular biology, many environmental organisms)</td>
</tr>
<tr>
<td>RG2</td>
<td>Associated with mild to moderate disease for which preventative measures or post exposure treatments are often available; public health impact is limited (e.g., Streptococcus pyogenes, Salmonella, hepatitis B virus)</td>
</tr>
<tr>
<td>RG3</td>
<td>Associated with serious to lethal human disease for which preventative vaccines or post-exposure therapies may be scarce. Public health impact is limited-to-moderate (e.g., Mycobacterium tuberculosis, hantaviruses, West Nile virus, SARS)</td>
</tr>
<tr>
<td>RG4</td>
<td>Associated with serious to lethal human disease for which preventative vaccines or post exposure therapies are not usually available. Public health impact is high (e.g., Ebola virus, Marburg virus, smallpox virus, etc.)</td>
</tr>
</tbody>
</table>

Table 5-9 describes the four (4) Risk Group Levels (RGs), and provides examples of communicable diseases that would typically fall in to these classifications, and the typical protections that would be necessary to prevent transmission of the disease. It is important to note that all but two (2) communicable disease hazards identified by CSU campuses fall under either the lower-risk RG1 or RG2 categories. COVID-19 and tuberculosis are the two (2) communicable diseases fall under the higher-risk RG3 category. However, with the advent of the recently-developed COVID-19 vaccine, and with the expectation of an increasingly robust vaccine supply, it is possible that the RG level for COVID-19 could be lowered in the future, thereby reducing both the extent and the potential impact of COVID-19.

Table 5-9: Risk Group Levels (RGs) with Example Diseases and Recommended Precautions\textsuperscript{23}

<table>
<thead>
<tr>
<th>Level</th>
<th>Examples</th>
<th>Typical Protection to Prevent Transmission</th>
</tr>
</thead>
</table>

\textsuperscript{22} World Health Organization (WHO). Laboratory Biosafety Manual, 3\textsuperscript{rd} Ed. Print. Retrieved 05.03.2021 from: https://www.who.int/csr/resources/publications/biosafety/Biosafety7.pdf

\textsuperscript{23} CDC/National Institutes of Health. Biosafety in Microbiological and Biomedical Laboratories, 6\textsuperscript{th} Ed. Print. Retrieved 05.03.2021 from: https://www.cdc.gov/labs/BMBL.html
<table>
<thead>
<tr>
<th>Risk Group</th>
<th>Bacteria and Viruses</th>
<th>Precautions</th>
</tr>
</thead>
<tbody>
<tr>
<td>RG 1</td>
<td>E. Coli</td>
<td>Precautions are minimal, most likely involving gloves and some sort of facial protection. Usually, contaminated materials are left in open (but separately indicated) waste receptacles. Decontamination procedures for this level are similar in most respects to modern precautions against everyday viruses (i.e.: washing one's hands with anti-bacterial soap, washing all exposed surfaces of the lab with disinfectants, etc.).</td>
</tr>
<tr>
<td>RG 2</td>
<td>Chicken Pox, Hepatitis A, B, C, Lyme disease, Salmonella, Mumps, Measles, Malaria, Scrapie, Dengue Fever, HIV</td>
<td>These bacteria and viruses cause mild disease in humans or are difficult to contract via aerosol. Routine diagnostic work with clinical specimens can be done safely at BSL-2, using BSL-2 practices and procedures.</td>
</tr>
<tr>
<td>RG 3</td>
<td>Anthrax, West Nile Virus, SARS Virus (Including COVID-19), Tuberculosis, Typhus, Yellow Fever, Hantaviruses, Avian Flu</td>
<td>These bacteria and viruses cause severe to fatal disease in human, but vaccines or other treatments do exist to combat them. Laboratory personnel have specific training in handling pathogenic and potentially lethal agents and are supervised by competent scientists who are experienced in working with these agents. This is considered a neutral or warm zone.</td>
</tr>
</tbody>
</table>
These viruses and bacteria cause severe to fatal disease in humans, for which vaccines or other treatments are not available. When dealing with biological hazards at this level the use of a Hazmat suit and a self-contained oxygen supply is mandatory. The entrance and exit of a BSL-4 lab will contain multiple showers, a vacuum room, an ultraviolet light room, autonomous detection system, and other safety precautions designed to destroy all traces of the biohazard. Multiple airlocks are employed and are electronically secured to prevent both doors opening at the same time. All air and water service going to and coming from a BSL-4 lab will undergo similar decontamination procedures to eliminate the possibility of an accidental release.

Probability of Future Occurrence of the Hazard

There are significant data limitations regarding non-COVID-19 communicable disease cases, as the information thereof is outdated, anecdotal, and/or inadequate. As a result, it is not feasible to provide quantitative probabilities of future occurrence for non-COVID-19 communicable disease hazards. However, based on the limited data, it is feasible to present qualitative probabilities of future occurrence based on ranges of communicable disease frequency. Table 5-12 shows a probability scale of future occurrence for the nine (9) communicable disease hazards profiled in this assessment. This scale is divided into four (4) levels of probability:

Table 5-10: Likelihood of Future Hazard Occurrence

<table>
<thead>
<tr>
<th>Likelihood</th>
<th>Parameters for Determining Likelihood</th>
</tr>
</thead>
<tbody>
<tr>
<td>Highly Likely</td>
<td>76 – 100% probability that hazard will occur annually (high to very high frequency)</td>
</tr>
<tr>
<td>Likely</td>
<td>50 – 75% probability that hazard will occur annually (moderate to high frequency)</td>
</tr>
<tr>
<td>Possible</td>
<td>11 – 49% probability that hazard will occur annually (low to moderate frequency)</td>
</tr>
<tr>
<td>Unlikely</td>
<td>0 – 10% probability that hazard will occur annually (very low to low frequency)</td>
</tr>
</tbody>
</table>

Due to significant data limitations surrounding non-COVID communicable diseases, the probability of future occurrence of CSU-system-wide communicable disease is measured by the proportion of campuses that have identified a particular communicable disease as having an impact on the campus community. In this measure, the more frequent a
communicable disease is seen as impactful CSU-wide, the greater the probability of future occurrence.

Note: Note: Each communicable disease’s probability of future occurrence ranking CSU-system-wide reflects the ranking at the individual CSU campus level unless noted otherwise.

Table 5-11: Probability of Future Occurrence of Communicable Disease Hazard for CSU System

<table>
<thead>
<tr>
<th>Collective List of Communicable Diseases Identified by All CSU Campuses</th>
<th>Number of CSU Campuses (Including Chancellor’s Office) Identifying Communicable Disease Having Significant Impact</th>
<th>Proportion of CSU Campuses Identifying Communicable Disease as Having Significant Impact System-Wide</th>
<th>CSU System-Wide Probability Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>COVID-19 (SARS-CoV-2)</td>
<td>24</td>
<td>1.00</td>
<td>Highly Likely</td>
</tr>
<tr>
<td>Meningitis</td>
<td>7</td>
<td>0.29</td>
<td>Possible</td>
</tr>
<tr>
<td>Measles</td>
<td>6</td>
<td>0.25</td>
<td>Possible</td>
</tr>
<tr>
<td>Influenza (Including H1N1/Swine Flu)</td>
<td>6</td>
<td>0.25</td>
<td>Possible</td>
</tr>
<tr>
<td>Tuberculosis</td>
<td>5</td>
<td>0.21</td>
<td>Possible</td>
</tr>
<tr>
<td>Norovirus</td>
<td>4</td>
<td>0.17</td>
<td>Possible</td>
</tr>
<tr>
<td>Mumps</td>
<td>2</td>
<td>0.08</td>
<td>Unlikely</td>
</tr>
<tr>
<td>E. Coli</td>
<td>2</td>
<td>0.08</td>
<td>Unlikely</td>
</tr>
<tr>
<td>Sexually Transmitted Diseases (STDs)</td>
<td>2</td>
<td>0.08</td>
<td>Unlikely</td>
</tr>
</tbody>
</table>

(Source: Interviews with staff at CSU campuses and at the CSU Chancellor’s Office.)

Vulnerability to the Hazard

Vulnerability to a communicable diseases hazard resides in the population of a given area – both human and animal – not in the infrastructure or physical assets. While CSU assets and infrastructure could be impacted indirectly by the communicable disease hazard, these impacts would be secondary to the impact that the communicable disease hazard would have on students, faculty, staff, and visitors at the CSU – Channel Islands campus.

CSU campus settings are geographically diverse, with locations ranging from small towns to medium-sized cities to densely populated urban areas. Hundreds of thousands of people work, study, and/or pass through CSU campuses on any given day. (As of Fall
2019, the CSU System had 480,541 students and 53,763 faculty and staff. Each of these persons is vulnerable to communicable disease, particularly if it is a pathogen that individual has not been immunized against, or for which no immunization exists. Prolonged outbreaks could result in a loss of services, failure of infrastructure (from lack of operators or maintenance), and closure of facilities. This exact scenario has played out to some degree in the current COVID-19 pandemic on the Channel Islands campus.

Estimate of Potential Losses

The COVID-19 Pandemic Health Impact on CSU Campuses and Surrounding Communities

The most prescient metric for estimating losses from COVID-19 is loss of life. The nationwide campus-related COVID-19 death rate of 0.02% remains well below the average COVID-19 death rate in the U.S. However, due to data limitations, there is no information on CSU-campus-specific deaths by COVID-19 or by any other communicable diseases. In fact, COVID-19 is the only communicable disease for which case reports have been readily available for CSU campuses.

At some point in the future, CSU campuses will return to full capacity. Without adequate surveillance regarding campus access and student and employee interaction, CSU campuses (including CSU – Channel Islands) are at risk of developing an extreme incidence of COVID-19, and may become “super-spreaders” for adjacent communities. The emergence of more virulent COVID-19 variants would only add to the potential for high negative impacts on life safety, operations, and service delivery across the CSU system. (Other communicable diseases would also re-emerge, but with low to moderate negative impacts on life safety, operations, and service delivery.)

Economic Impact of COVID-19 Pandemic on CSU Financial Health

During the first few months of the COVID-19 pandemic in 2020, the CSU system suffered tremendous negative fiscal impacts. From March through July of 2020 alone, over $146 million worth of revenue losses were sustained across the CSU system due to refunds to students for parking, housing and dining service fees during Spring Semester, 2020. (See Figure 5-2 below for the economic impact to the CSU – Channel Islands campus). Several CSU campuses saw refund losses surpass $10 million.

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24 The California State University. Enrollment. Retrieved 05.03.2021 from: https://www2.calstate.edu/csu-system/about-the-csu/facts-about-the-csu/enrollment/Pages/default.aspx


Mitigative Relief from Federal Assistance

The $1.5 billion in total federal assistance sent to the CSU system will help relieve the losses of revenues from services like dorms, parking and dining services during a year of mainly empty campuses. (See Table 5-15) However, because of staggering COVID-related revenue losses, the CSU system is planning for three (3) years of fiscal duress.

Table 5-12: Total Federal Assistance to CSU for COVID-19 Related Losses, 2020 – 2021

<table>
<thead>
<tr>
<th>Institution</th>
<th>December 2020 Stimulus</th>
<th>CARES Act</th>
<th>APLU Projection of HEERF Total ARP Act Funding Allocation</th>
<th>Total Estimated Federal COVID Relief Funding</th>
</tr>
</thead>
<tbody>
<tr>
<td>California Polytechnic State University</td>
<td>$20,752,799</td>
<td>$14,725,000</td>
<td>$37,000,928</td>
<td>$72,478,727</td>
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<tr>
<td>California State Polytechnic University, Pomona</td>
<td>$48,614,353</td>
<td>$31,102,000</td>
<td>$86,044,649</td>
<td>$165,761,002</td>
</tr>
<tr>
<td>California State University Channel Islands</td>
<td>$14,288,099</td>
<td>$8,512,000</td>
<td>$24,915,170</td>
<td>$47,715,269</td>
</tr>
<tr>
<td>California State University Maritime Academy</td>
<td>$1,381,700</td>
<td>$1,204,000</td>
<td>$2,472,622</td>
<td>$5,058,322</td>
</tr>
<tr>
<td>California State University - Sacramento</td>
<td>$59,891,260</td>
<td>$35,643,000</td>
<td>$104,900,133</td>
<td>$200,434,393</td>
</tr>
<tr>
<td>California State University, Bakersfield</td>
<td>$22,855,632</td>
<td>$12,483,000</td>
<td>$40,285,565</td>
<td>$75,624,197</td>
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<tr>
<td>California State University, Chico</td>
<td>$31,603,856</td>
<td>$20,019,000</td>
<td>$55,754,538</td>
<td>$107,377,394</td>
</tr>
<tr>
<td>California State University, Dominguez Hills</td>
<td>$31,843,563</td>
<td>$18,312,000</td>
<td>$55,915,410</td>
<td>$106,070,973</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>University</th>
<th>Total Revenue 2019-2020</th>
<th>Total Revenue 2020-2021</th>
<th>Total Revenue 2021-2022</th>
<th>Total Revenue 2022-2023</th>
</tr>
</thead>
<tbody>
<tr>
<td>California State University, East Bay</td>
<td>$24,243,652</td>
<td>$14,394,000</td>
<td>$42,929,208</td>
<td>$81,566,860</td>
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<tr>
<td>California State University, Fresno</td>
<td>$52,725,317</td>
<td>$32,557,000</td>
<td>$92,926,594</td>
<td>$178,208,911</td>
</tr>
<tr>
<td>California State University, Fullerton</td>
<td>$67,736,949</td>
<td>$41,088,000</td>
<td>$120,859,884</td>
<td>$229,684,833</td>
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<tr>
<td>California State University, Long Beach</td>
<td>$67,421,424</td>
<td>$41,202,000</td>
<td>$119,508,329</td>
<td>$228,131,753</td>
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<td>California State University, Los Angeles</td>
<td>$61,905,561</td>
<td>$40,067,000</td>
<td>$108,543,672</td>
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<tr>
<td>California State University, Monterey Bay</td>
<td>$13,455,716</td>
<td>$8,705,000</td>
<td>$23,922,768</td>
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<tr>
<td>California State University, Northridge</td>
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<td>$47,458,000</td>
<td>$131,021,450</td>
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<tr>
<td>California State University, San Bernardino</td>
<td>$42,438,131</td>
<td>$27,924,000</td>
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<td>California State University, San Marcos</td>
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<td>$15,542,000</td>
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<td>California State University, Stanislaus</td>
<td>$22,007,207</td>
<td>$12,928,000</td>
<td>$38,636,391</td>
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<td>Humboldt State University</td>
<td>$16,130,016</td>
<td>$11,146,000</td>
<td>$28,831,619</td>
<td>$56,107,635</td>
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<tr>
<td>San Diego State University</td>
<td>$45,914,127</td>
<td>$30,394,000</td>
<td>$80,592,385</td>
<td>$156,900,512</td>
</tr>
<tr>
<td>San Francisco State University</td>
<td>$47,404,409</td>
<td>$30,000,000</td>
<td>$83,075,470</td>
<td>$160,479,879</td>
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<tr>
<td>San Jose State University</td>
<td>$46,631,939</td>
<td>$30,977,000</td>
<td>$82,976,130</td>
<td>$160,585,069</td>
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<tr>
<td>Sonoma State University</td>
<td>$13,980,795</td>
<td>$9,153,000</td>
<td>$24,732,994</td>
<td>$47,866,789</td>
</tr>
</tbody>
</table>
Vulnerability Assessment Conclusions

Before the COVID-19 pandemic, populations at all CSU campuses and CSU-affiliated facilities were substantial. Collectively, as of Fall 2019, CSU campuses had 480,541 students and 53,763 faculty and staff. All were at risk from the communicable disease events, with 534,304 people being directly vulnerable. The COVID-19 pandemic has caused campus population numbers to plummet to a small fraction of full capacity.

At some point in the future, campus population numbers will return to their pre-pandemic levels, and students, faculty, and staff will again be vulnerable to the communicable disease hazard. If just 10% of the total CSU population were to become ill with a highly infective communicable disease like influenza or another strain of SARS, this would mean that approximately 53,430 people would be sick at the same time. This scenario would likely overwhelm available on-campus medical services could even overwhelm portions of the larger community’s medical resources – especially if there were large numbers of infected people with immune system compromises or other underlying health problems. See Table 5-13 below for the “10% outbreak scenario” projections for the CSU – Channel Islands campus and for the entire CSU system.

Table 5-13: Scenario of Communicable Disease Hazard Affecting 10% of the CSU Population

<table>
<thead>
<tr>
<th>CSU Campus</th>
<th>Approximate Enrollment Population (Fall 2019)³¹</th>
<th>Approximate Total FT/PT Faculty/Staff Population (Fall 2019)³²</th>
<th>Total Combined Approximate Student and Faculty/Staff Population</th>
<th>10% Outbreak Scenario (Students and Faculty/Staff Combined)</th>
</tr>
</thead>
<tbody>
<tr>
<td>CSU Bakersfield</td>
<td>11,199</td>
<td>1,277</td>
<td>12,476</td>
<td>1,248</td>
</tr>
<tr>
<td>CSU Channel Islands</td>
<td>7,093</td>
<td>994</td>
<td>8,087</td>
<td>809</td>
</tr>
<tr>
<td>Chico State</td>
<td>17,019</td>
<td>1,969</td>
<td>18,988</td>
<td>1,899</td>
</tr>
<tr>
<td>CSU Dominguez Hills</td>
<td>17,027</td>
<td>1,761</td>
<td>18,788</td>
<td>1,879</td>
</tr>
<tr>
<td>Cal State East Bay</td>
<td>14,705</td>
<td>1,764</td>
<td>16,469</td>
<td>1,647</td>
</tr>
<tr>
<td>Fresno State</td>
<td>24,139</td>
<td>2,534</td>
<td>26,673</td>
<td>2,667</td>
</tr>
</tbody>
</table>


<table>
<thead>
<tr>
<th>Institution</th>
<th>Fall 2021 Enrollment</th>
<th>Fall 2020 Enrollment</th>
<th>Winter 2021 Winter Enrollment</th>
<th>Spring 2021 Enrollment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cal State Fullerton</td>
<td>39,868</td>
<td>3,736</td>
<td>43,604</td>
<td>4,360</td>
</tr>
<tr>
<td>Humboldt State</td>
<td>6,983</td>
<td>1,171</td>
<td>8,154</td>
<td>815</td>
</tr>
<tr>
<td>Cal State Long Beach</td>
<td>38,074</td>
<td>4,004</td>
<td>42,078</td>
<td>4,208</td>
</tr>
<tr>
<td>Cal State LA</td>
<td>26,361</td>
<td>2,821</td>
<td>29,182</td>
<td>2,918</td>
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<tr>
<td>Cal Maritime</td>
<td>911</td>
<td>329</td>
<td>1,240</td>
<td>124</td>
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<tr>
<td>CSU Monterey Bay</td>
<td>7,123</td>
<td>1,059</td>
<td>8,182</td>
<td>818</td>
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<tr>
<td>CSUN (Northridge)</td>
<td>38,391</td>
<td>3,832</td>
<td>42,223</td>
<td>4,222</td>
</tr>
<tr>
<td>Cal Poly Pomona</td>
<td>27,914</td>
<td>2,650</td>
<td>30,564</td>
<td>3,056</td>
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<tr>
<td>Sacramento State</td>
<td>31,156</td>
<td>3,228</td>
<td>34,384</td>
<td>3,438</td>
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<tr>
<td>Cal State San Bernardino</td>
<td>20,311</td>
<td>2,118</td>
<td>22,429</td>
<td>2,243</td>
</tr>
<tr>
<td>San Diego State</td>
<td>35,081</td>
<td>3,702</td>
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<td>3,878</td>
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<tr>
<td>San Francisco State</td>
<td>28,880</td>
<td>3,401</td>
<td>32,281</td>
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</tr>
<tr>
<td>San José State</td>
<td>33,282</td>
<td>3,568</td>
<td>36,850</td>
<td>3,685</td>
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<tr>
<td>Cal Poly San Luis Obispo</td>
<td>21,242</td>
<td>2,871</td>
<td>24,113</td>
<td>2,411</td>
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<tr>
<td>CSU San Marcos</td>
<td>14,519</td>
<td>1,687</td>
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<td>1,621</td>
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<tr>
<td>Sonoma State</td>
<td>8,649</td>
<td>1,338</td>
<td>9,987</td>
<td>999</td>
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<tr>
<td>Stanislaus State</td>
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<td>1,276</td>
<td>11,890</td>
<td>1,189</td>
</tr>
<tr>
<td>Office of the Chancellor</td>
<td>0</td>
<td>673</td>
<td>673</td>
<td>67</td>
</tr>
<tr>
<td><strong>CSU System-Wide</strong></td>
<td><strong>480,541</strong></td>
<td><strong>53,763</strong></td>
<td><strong>534,304</strong></td>
<td><strong>53,430</strong></td>
</tr>
</tbody>
</table>

*Note: Enrollment figures do not include non-specific CSU campus International Programs (455 students) or CALStateTEACH Program (933 students).*

While the case numbers of COVID-19 have been significantly lower (about 1% of the total CSU population) than those in the 10% scenario, the degree of virulence and resultant morbidity and mortality caused by COVID-19 have led to widespread campus shutdowns, educational disruption, and economic harm to the CSU system, including CSU – Channel Islands. In short, the real-time COVID-19 communicable disease outbreak scenario has proven far more devastating than the 10% simulated scenario.

**Identified Data Limitations**

There is a wealth of technical information available for communicable disease. However, there is also limited non-COVID-19 communicable disease data available regarding risk or vulnerability of specific populations throughout the CSU. Much of the data that does exist...
is protected by privacy policies, and therefore cannot be obtained for more specific populations. As a result, performing a detailed quantitative assessment for this hazard is difficult.

Data that could be collected prior to the next update in order to improve this methodology includes:

- Data regarding infection rates at the campus level and for specific populations;
- Data regarding communicable disease case numbers and outcomes, by CSU campus;
- Data regarding projected population changes;
- Data regarding absenteeism; and
- Data regarding increased operating costs as a result of absenteeism (i.e., temporary shifting of duties resulting in business interruption).

**Dam and Levee Failure**

**Description of the Hazard**

A dam failure represents the structural collapse of a dam that stores water in a reservoir behind the dam. These failures are typically the result of structural age, damage to the structure caused by earthquake or flooding, inadequate discharge or spillway capacity, inadequate maintenance, improper construction materials, or extreme inflow of water into the reservoir. Prolonged precipitation may result in overtopping of the dam resulting in structural compromise. The tremendous energy generated by a sudden breach of the dam will have significant downstream effects. Flood damage resulting from dam failures potentially will result in economic losses, environmental damage, destruction of agriculture, and human casualties. This type of incident is extremely dangerous as it can occur rapidly, with no warning resulting in an inability to effectively evacuate threatened communities.

A levee failure is similar to dam failures as the result will be a breach causing flooding on the dry side of the levee. Levees are embankments whose primary purpose is to furnish flood protection from seasonal high water or divert the flow of water. Most levees in California are intended to withstand peak water levels generated by heavy precipitation or rapid snowmelt in a watershed. Other levees are designed to withstand fluctuating water levels on a continuous basis such as those in the California Delta exposed to tidal influences. Levees routinely extend for lengthy distances immediately protecting communities. Levees can be found throughout the state but are most prominent in the Sacramento and San Joaquin Valleys.

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Levee failures can vary from over toppings to small uncontrolled discharge to catastrophic failure. Areas downstream of the failure will be subject to inundation dependent on the volume of water released. These levee failures are also typically the result of structural age, damage to the structure caused by earthquake or flooding, slumping, seepage underneath the levee, high velocity flows eroding the levee, inadequate capacity, inadequate maintenance, improper construction materials, or extreme inflow of water into the system. Flood damage resulting from levee failures potentially will result in economic losses, environmental damage, destruction of agriculture, and human casualties.

A dam or levee failure flooding will vary depending on a number of factors including the extent of the collapse or breach, the volume of water behind the structure, and the nature of the exposed downstream features. This unpredictable flooding presents a threat to life and property in addition to critical infrastructure. Lifelines and supply routes will likely be damaged or made impassible by flood erosion or standing water. Water quality and health concerns would likely be cascading effects of dam or levee failures.

Location of the Hazard

Ventura County is home to a variety of flood control facilities and levee systems mostly in the coastal plains and valleys region including along the Santa Clara River and Calleguas Creek. The Santa Clara River drains the mountains of Ventura County and Lake Piru and Castaic Lake in Los Angeles County towards Ventura. The Calleguas Creek drains the Santa Monica Mountains and the Conejo Valley passing just northwest of the CSU Channel Islands campus.

The Calleguas Creek is normally a dry creek providing flood control and drainage. The creek feeds into the Pacific Ocean before extending 30 miles from Simi Valley. The Bard Lake reservoir through the Wood Ranch Dam also feeds into the Calleguas Creek just southeast of Simi Valley. The creek is an unregulated channel from the dam to the ocean. The CSU Channel Islands campus is situated slightly higher in elevation on a hillside from the Calleguas Creek channel. The distance from the river to the campus boundary is just over a half of a mile.

Levees have been constructed to protect the banks of the Calleguas Creek as the channel extends past the campus. Levees are also used in containment of flood channels in areas of level topography on the valley floor. The northwest part of the CSU Channel Islands campus is located within a designated levee protected zone identified in the National Levee Database34 affecting Modoc Hall, El Dorado Hall, Central Plant, and University Drive.

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Figure 5-3: Dams and Levees Located Near CSU Channel Islands
Extent of the Hazard

Dams are classified according to the hazard that they pose to life and property in the event of failure, rather than the likelihood of that failure.

- High hazard potential dams may result in loss of human life, and will likely result in economic, environmental, or lifeline losses.
- Significant hazard potential dams are not expected to result in loss of life, but are expected to cause economic, environmental, and lifeline losses.
- Low hazard potential dams are not expected to result in loss of life, and there is a low expectation of economic, environmental, or lifeline losses. What losses do occur are generally limited to the dam owner.

Dams classified as high hazard are required to have Emergency Action Plans (EAP). EAPS are formal documents that identify potential emergency conditions at the dam and specify preplanned actions to be followed in case of failure. An EAP is required for all high hazard dams and is recommended for all significant hazard dams.

Table 5-14: Ventura County Dams Upstream from CSU Channel Islands

<table>
<thead>
<tr>
<th>River</th>
<th>Dam</th>
<th>Storage</th>
<th>Hazard Severity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Calleguas</td>
<td>Wood Ranch</td>
<td>11,000af</td>
<td>High Hazard</td>
</tr>
</tbody>
</table>

The CSU Channel Islands campus lies outside of the inundation zone of the Wood Ranch Dam. In the event of a catastrophic failure of the Wood Ranch Dam, the CSU Channel Islands campus is expected to remain out of the inundation area. The inundation area is expected to spread water on the opposite side of the Calleguas Creek channel. However, there are multiple transportation corridors that lie within the dam inundation zone that would compromise access to and from the campus affecting the ability to evacuate, gain access to emergency services, and receive supplies. The roadways expected to become inundated in a dam breach scenario include South Lewis Road, the primary access route to the campus from US Highway 101 and other Ventura County locations and US Highway 101 is anticipated to be affected in Camarillo. Based on these conditions, the planning committee ranks the extent of the dam failure hazard as Low.
Extent – Levee Failure

Levees are used along numerous irrigation channels and other waterways including the Calleguas Creek. The eastern bank of the Calleguas Creek channel is lined with a levee protecting the area surrounding the campus. A portion of the CSU Channel Islands campus lies within a levee flood protected area. In the event the Calleguas Creek was flowing at elevated levels and a failure of a levee were to occur, the western edges of the CSU Channel Islands campus would likely experience flood related damages. This specific hazard would substantially alter the ability of the campus to maintain operations as damages would be extensive. Depending on the location of a breach, the campus community would be heavily affected with the loss of life and homes, access to campus would be limited, and student financial capacity to support ongoing education being

35 California Department of Water Resources, *Dam Breach Inundation Map Publisher*. Retrieved 04.13.2021 from: [https://fmds.water.ca.gov/webgis/?appid=dam_prototype_v2](https://fmds.water.ca.gov/webgis/?appid=dam_prototype_v2)
diminished. Based on these conditions, the planning committee ranks the extent of the levee failure hazard as **Moderate**.

**History of the Hazard**

There are no records of dam failure for any dam within Ventura County.

However, in March of 1928, the St. Francis Dam in Los Angeles County providing water storage for the Owens River Aqueduct collapsed shortly after being constructed. The downstream channel fed into the Santa Clara River in Ventura County. The midnight collapse created a wall of water moving down the valley that was reported to be as high as 78 feet tall 42 miles from the collapse. This inundation created 25 feet deep waters throughout the river valley including in the town of Santa Paula. Virtually everything in the path of the rushing water was destroyed including bridges, structures, orchards, and railways. 70-foot-deep mud deposits and massive debris were left behind. It is estimated that 500 people were killed, and damages were $20 million in 1928.

**Potential Impacts of the Hazard**

Dam Failure Impacts - Water that is released due to a dam that has failed generates tremendous energy and force causing a flood that will be catastrophic to life and property. Water levels from the failed dam could be significantly higher than those experienced in worst case scenario flood events. Areas closer to the failed dam will be more likely to experience complete devastation while other areas within the inundation zone will see varying levels of flood waters. The extent of the impacts of a failed dam would vary based on a number of factors such as the volume of water released, the base flow of the river, the time of the failure, the amount of warning provided, and the distance from the dam. Impacts resulting from a dam failure include:

- Loss of life
- Property destruction or damage
- Loss of property contents
- Infrastructure damage
- Flooded or destroyed lifelines/supply routes
- Damaged or destroyed utilities
- Loss of community economic base
- Employment losses
- Agricultural (crops and livestock) damages or destruction
- Environmental damage
- Floods generating threats to public health
- Flood generated debris

**Levee Failure Impacts**

A levee failure may result in substantial amounts of water to enter into developed areas protected by the levee. The force and volume of water that is generated by a levee failure
may cause extensive structural damage in close proximity to the breach and effects of flooding spreading well beyond the point of the failure. The extent of the impacts would vary based on a number of factors such as the volume of water released, the time of the failure, the amount of warning provided, the location of the breach, elevation, and distance from the breach. Potential impacts resulting from a levee failure include:

- Loss of life
- Property destruction or damage
- Loss of property contents
- Infrastructure damage
- Public health hazards resulting from mold, mildew, and disease due to flood water
- Flooded or destroyed lifelines/supply routes
- Damaged or destroyed utilities
- Loss of community economic base
- Employment losses
- Agricultural (crops and livestock) damages or destruction
- Environmental damage
- Prolonged periods of necessary dewatering
- Disruptions to education delivery to community

**Probability of Future Occurrence of the Hazard**

Ventura County remains at risk from dam and levee failure. The location of the CSU Channel Islands campus downstream from the Bard Lake/Wood Ranch Dam and Lake Piru in addition to being within a flood protected area demonstrates that the potential exists for future dam or levee related issues. There are no official recurrence intervals that have been calculated for dam or levee failures. The probability of future occurrence for both dam and levee failures is **Unlikely**.

**Vulnerability to the Hazard**

The CSU Channel Islands campus is subject to the effects of flooding resulting from compromised dams and levees. The Wood Ranch Dam upstream from the campus presents the potential for catastrophic flooding and damage through much of the Camarillo area. The Calleguas Creek and extending irrigation channels are lined by levees intended to protect the surrounding areas from rises in water level. In the case of dam failure, the amount of time to respond to the needs of the campus community prior to inundation will be limited.

The most significant challenge regarding dam failures is they generally result in catastrophic outcomes. The levees that line Calleguas Creek and those that encase the irrigation channels are owned and operated by a variety of agencies. Any breach along a levee is impossible to predict where a failure may occur. It is likely that response action will not be fully implemented until the incident situational intelligence provides adequate information as to compromised locations. These variables place all those working and living within the dam inundation and flood protection zones in vulnerable locations.
The dam inundation zone covers an area 1.5 miles wide in the center of Camarillo and extends downstream towards the CSU Channel Islands campus. Everyone downstream of the dam in the inundation zone will be vulnerable to the effects of floods and forces of moving water. The CSU Channel Islands campus lies just outside the Wood Ranch Dam inundation zone. However, the access routes into campus remain inside the inundation zone.

The levee systems presenting a threat to Camarillo exist along the Calleguas Creek through the heart of the city and extending southward towards the campus. The CSU Channel Islands campus lies in proximity to levees lining the Calleguas Creek. However, the distributed placement of levees, most near development may expose significant vulnerabilities to other areas of the region even if the campus is unaffected. There is potential the campus community will be affected as a breach may cause flooding and damages to the homes of students, faculty, and staff or to access/supply routes, utilities, or other critical services. The potential for flood damaged structures being left uninhabitable including campus residence halls will result in the vulnerability of numerous displaced individuals and households. The lack of flood insurance will cause extreme financial burdens on those affected.

Vulnerability to a dam or levee failure on the CSU Channel Islands campus will vary depending on when the failure was to occur. The risk to the campus population will be lessened during periods when classes are not in session or during periods of breaks. Conversely, during the days and hours that classes are in session and staff are at their workplaces, the human vulnerability increases. However, in region-wide events this vulnerability may be shared with the homes and workplaces of members of the campus community and their families.

Certain campus populations will experience greater challenges to a post-flood / failure environment. Vulnerable populations will likely need to navigate through flood generated debris, face extreme health safety issues from flood waters, experience extreme stresses of a disaster, an inability to communicate to or gain access to support networks, and find difficulty in accessing equipment or supplies to aid in a specific need.

**Estimate of Potential Losses**

Estimates of potential losses will be influenced by a variety of factors. The volume and force of the water will determine the scale of damages affecting campus infrastructure, equipment, and other impacted features. The proximity to the failure and elevation above flood waters will affect the level of damage and individuals exposed. The time of the academic year, the day of week, and hour in which the failure was to occur will influence the number of people on campus and potential casualties. Losses will be generated by the physical damages, the loss of revenue, loss of academic research, loss of building contents, and community wide economic reductions.

Based on estimate replacement costs of facilities and structures on campus, the total replacement costs due to earthquake are $191,391,025. However, it is unlikely for a dam or levee failure event to cause catastrophic destruction at CSU Channel Islands.
Vulnerability Assessment Conclusions

While the occurrence of dam and levee failures have not been historically relevant near the CSU Channel Islands campus, the potential for hazards related to the region’s levees and dams still exist. However, the presence of earthquake faults in proximity to the existing dam and levee structures presents a valid danger to downstream locations in the event of an earthquake. In the unlikely event of a high priority dam’s total failure, the consequences of a dam failure would generate catastrophic results to downstream communities. The potential for dam or levee failure further generates the added potential for a number of cascading effects such as disruptions to the local economy, utility failures, disruptions to providing for the needs of the community, and development of public health hazards. These effects would be exacerbated by effects of seasonal flooding, ongoing heavy precipitation, or excessive run-off from the watershed contributing to the river system. The potential for widespread flooding and damage of structures due to the force of water has exponentially powerful impacts on particular populations among the campus community including those with access or functional needs, international students, the homeless, and students residing in the residence halls.

Identified Data Limitations

Missing campus structural replacement costs and complete inventory of building construction features or mitigation efforts to lessen the impact due to flood inundation.
Drought

Description of the Hazard

Drought is defined as a condition where moisture levels fall significantly below normal for an extended period of time over a large area that adversely affects plants, animal life, and humans. Drought is a gradual phenomenon. Although droughts are sometimes characterized as emergencies, they differ from typical emergency events. Most natural disasters, such as floods or forest fires, occur relatively rapidly and afford little time for preparing for disaster response. Droughts occur slowly, over a multi-year period, and it is often not obvious or easy to quantify when a drought begins and ends.

Throughout California, one dry year does not normally constitute a drought. California’s extensive system of water supply infrastructure (reservoirs, groundwater basins, and conveyance assets) mitigates the effect of short-term dry periods for most water users. Defining when a drought begins is a function of drought impacts to water users. Drought in one location may not constitute a drought for all water users, as some users in relative proximity may have a different water supply. For example, individual water suppliers may use a combination of sources such as rainfall/runoff, water in storage, or expected supply from a water wholesaler to define their water supply conditions.

Drought can be characterized as one or more of the four following types:

- **Meteorological drought** is defined on the basis of the degree of dryness (in comparison to some “normal” or average amount) and the duration of the dry period. A meteorological drought must be considered as region-specific since the atmospheric conditions that result in deficiencies of precipitation are highly variable from region to region.

- **Hydrological drought** is associated with the effects of periods of precipitation (including snowfall) shortfalls on surface or subsurface water supply (e.g., streamflow, reservoir and lake levels, ground water). The frequency and severity of hydrological drought is often defined on a watershed or river basin scale. Although all droughts originate with a deficiency of precipitation, hydrologists are more concerned with how this deficiency plays out through the hydrologic system. Hydrological droughts are usually out of phase with or lag the occurrence of meteorological and agricultural droughts. It takes longer for precipitation deficiencies to show up in components of the hydrological system such as soil moisture, streamflow, and ground water and reservoir levels. As a result, these impacts are out of phase with impacts in other economic sectors.

- **Agricultural drought** focus is on soil moisture deficiencies, differences between actual and potential evaporation, reduced ground water or reservoir levels, and so forth. Plant water demand depends on prevailing weather conditions, biological characteristics of the specific plant, its stage of growth, and the physical and biological properties of the soil.
- **Socioeconomic drought** refers to when physical water shortage begins to affect health, well-being, and quality of life of people, or when the drought starts to affect the supply and demand of an economic product that relies on water.

The drought issue in California is further compounded by water rights. The central challenge is how to prioritize water usage among a broad variety of contexts. It is for this reason that water is a commodity possessed and utilized under a variety of legal doctrines. As such, many competing sets of interests create a dynamic prioritization process between, for example, farming and federally protected fish habitats and water supply for municipal/public use (including usage for CSU - Channel Islands) versus water usage for wildfire abatement or natural resource protection.

**Location of the Hazard**

Drought conditions have been identified in Ventura County and the city of Camarillo where CSU – Channel Islands is located. Drought is not a location-specific hazard and affects the entire planning area equally. Drought location is not isolated to each campus footprint but occurs as a geographic sub-set of drought conditions occurring at larger scales. From 2000 – 2020, drought conditions have existed continuously somewhere in the state, with 80-100% of the state impacted for 12 of the last 20 years.36

**Extent of the Hazard**

Given the historical occurrence of severe drought impacts throughout the planning area and across the state and the potential future impact exacerbated by climate change, the CSU Planning Committee recognizes that drought will continue to pose a high degree of risk, potentially impacting crops, livestock, water resources, the natural environment at large, buildings and infrastructure (from land subsidence), and local economies. In addition, although drought affects the entire planning equally, the potential impacts may be variable and specific to each campus/jurisdiction, depending on contextual factors such as the degree of assets and activities, historically impacted by drought within each jurisdiction.

In addition, land subsidence has occurred and will continue in areas where the groundwater basin has been subject to overdraft and long-term recharge is inadequate to maintain the water table elevation, leaving underground voids. Subsidence levels in California have been measured up to 30-feet with subsidence bowls covering hundreds of square miles. As such, drought-related subsidence may result in serious structural damage to buildings, roads, irrigation ditches, underground utilities, and pipelines. These potential effects of drought are rare, but are applicable concerns for the campus over the long term.

The U.S. Drought Monitor developed tables of impacts reported during past droughts in California in order to depict the extent of drought risk for each level of drought on the

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U.S. These possible extent conditions for California complement the general impacts column of the U.S. Drought Monitor Classification Scheme.

Table 5-15: Impacts of Drought Levels as Determined by US Drought Monitor

<table>
<thead>
<tr>
<th>Category</th>
<th>Impact</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>D0</strong></td>
<td>Soil is dry; irrigation delivery begins early</td>
</tr>
<tr>
<td></td>
<td>Dryland crop germination is stunted</td>
</tr>
<tr>
<td></td>
<td>Active fire season begins</td>
</tr>
<tr>
<td></td>
<td>Winter resort visitation is low; snowpack is minimal</td>
</tr>
<tr>
<td><strong>D1</strong></td>
<td>Dryland pasture growth is stunted; producers give supplemental feed to cattle</td>
</tr>
<tr>
<td></td>
<td>Landscaping and gardens need irrigation earlier; wildlife patterns begin to change</td>
</tr>
<tr>
<td></td>
<td>Stock ponds and creeks are lower than usual</td>
</tr>
<tr>
<td><strong>D2</strong></td>
<td>Grazing land is inadequate</td>
</tr>
<tr>
<td></td>
<td>Producers increase water efficiency methods and drought-resistant crops</td>
</tr>
<tr>
<td></td>
<td>Fire season is longer, with high burn intensity, dry fuels, and large fire spatial extent; more fire crews are on staff</td>
</tr>
<tr>
<td></td>
<td>Wine country tourism increases; lake- and river-based tourism declines; boat ramps close</td>
</tr>
<tr>
<td></td>
<td>Trees are stressed; plants increase reproductive mechanisms; wildlife diseases increase</td>
</tr>
<tr>
<td></td>
<td>Water temperature increases; programs to divert water to protect fish begin</td>
</tr>
<tr>
<td></td>
<td>River flows decrease; reservoir levels are low and banks are exposed</td>
</tr>
<tr>
<td><strong>D3</strong></td>
<td>Livestock need expensive supplemental feed, cattle and horses are sold; little pasture remains, producers find it difficult to maintain organic meat requirements</td>
</tr>
<tr>
<td></td>
<td>Fruit trees bud early; producers begin irrigating in the winter</td>
</tr>
<tr>
<td></td>
<td>Federal water is not adequate to meet irrigation contracts; extracting supplemental groundwater is expensive</td>
</tr>
<tr>
<td></td>
<td>Dairy operations close</td>
</tr>
<tr>
<td></td>
<td>Marijuana growers illegally tap water out of rivers</td>
</tr>
<tr>
<td></td>
<td>Fire season lasts year-round; fires occur in typically wet parts of state; burn bans are implemented</td>
</tr>
</tbody>
</table>

Ski and rafting business is low, mountain communities suffer
Orchard removal and well drilling company business increase; panning for gold increases
Low river levels impede fish migration and cause lower survival rates
Wildlife encroach on developed areas; little native food and water is available for bears, which hibernate less
Water sanitation is a concern, reservoir levels drop significantly, surface water is nearly dry, flows are very low; water theft occurs
Wells and aquifer levels decrease; homeowners drill new wells
Water conservation rebate programs increase; water use restrictions are implemented; water transfers increase
Water is inadequate for agriculture, wildlife, and urban needs; reservoirs are extremely low; hydropower is restricted
Fields are left fallow; orchards are removed; vegetable yields are low; honey harvest is small
Fire season is very costly; number of fires and area burned are extensive
Many recreational activities are affected
Fish rescue and relocation begins; pine beetle infestation occurs; forest mortality is high; wetlands dry up; survival of native plants and animals is low; fewer wildflowers bloom; wildlife death is widespread; algae blooms appear
Policy change; agriculture unemployment is high, food aid is needed
Poor air quality affects health; greenhouse gas emissions increase as hydropower production decreases; West Nile Virus outbreaks rise
Water shortages are widespread; surface water is depleted; federal irrigation water deliveries are extremely low; junior water rights are curtailed; water prices are extremely high; wells are dry, more and deeper wells are drilled; water quality is poor;

**History of the Hazard**

Historically, drought has been so prevalent in California that its presence is almost continuous. According to the US Drought Monitor, Time Series data, Ventura County has experienced numerous drought period from 2000–2021 but it has not impacted the CSU-Channel Islands footprint due to consistent water reservoir sources.

According to the National Drought Mitigation Center, over 3,500 reports and publications covering 370 drought-related events took place across the state (many of which were statewide events) between 2000-2020. In addition, the National Center for Environmental Information (NCEI) reports more than 500 events statewide during this same time period.
These events produced a comprehensive range of impacts to water supply, regulations and allocations to businesses and municipalities, budgets and resources for firefighting, water law and policy, and physical impacts to built and natural environments. As such, data records of previous occurrences can be viewed as separate time and event demarcations for a hazard almost continuously in effect across the state with cascading impact potential.

Figure 5-5: Periods of Drought in Ventura County, California, 2000 – 2021

According to the Department of Water Resources, droughts exceeding three years are relatively common in Southern California, but relatively rare in Northern California - the region is the geographic source of much of the state’s developed water supply. The 1929-34 drought established the criteria commonly used in designing storage capacity and yield of large Northern California reservoirs.

According to the US Drought Monitor’s time series data, from 2000-2021 (with the exception of a 2–3-month period in 2000 and 2011), some degree of drought conditions have been continuously in effect somewhere in California. In fact, 80% - 100% of the state has been subjected to drought conditions for 12 of the last 20 years, with the most severe drought being the 100% state-wide event from 2012-2017.

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Given the ubiquitous nature of the drought risk in California, the following drought event was selected as an exemplar due to its broad and significant impacts on the state and (according to the US Drought Monitor’s Time Series data) on the city, county and region surrounding CSU - Channel Islands campus planning area:

2012 – 2017 – Drought produced severe impacts to water wells throughout the state of California, with a high number of wells running dry. Land subsidence due to increased groundwater pumping also occurred in numerous areas of the state such as the San Joaquin and Central Valleys. Crop damage was widespread as well. Water allotments were drastically reduced in many towns and water agencies, with extremely high costs for procuring water. In addition, job loss occurred with many families requiring food supply assistance, and water supply assistance provided to home-owners with dry wells. According to a report released by the UC Davis Center for Watershed Sciences, the 2012 - 2017 period of the California drought cost the state’s agriculture industry about $1 billion in lost revenue, with a total statewide economic cost of the drought calculated to be $2.2 billion. The report says, “it is responsible for the greatest water loss ever seen in California agriculture - about one third less than normal”. The report calls the groundwater situation in California "a slow-moving train wreck." Spring snowpack at Donner Summit reached record low levels in 2014, exceeded in 2015 by a remarkable April 1 snow-water-equivalent value of only 5% of average. Decreased precipitation since contributed to near-record low levels in the Shasta Reservoir. The ongoing drought has contributed to declines in crop values across the state. For example, crops including cotton, corn silage and barley (the field crop category) fell by 42 percent.

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Potential Impacts of the Hazard

Though the campus committee reports a low risk of drought owing to reservoir resources, potential drought impacts are wide-reaching and may be economic, environmental, and/or societal. This assessment of its impact recognizes that although there are no historic occurrences of drought in the planning area, the campus is a sub-set of larger and inter-connected local and regional droughts, and that the (related) historic impacts provide a sound basis for understanding potential (future) impacts.

Though no campus drought impacts have occurred, the most significant potential impact associated with drought across the CSU - Channel Islands campus planning area is the reduction in water availability for the municipal area tied to the campus. Other impacts include crop loss and damage to trees and other natural resources (See Tree Mortality below). The footprint of CSU - Channel Islands to some extent includes these vulnerable resources based on the campus landscape (trees) and the presence (and footprint size) of agricultural research crops and field stations.

As a secondary impact of drought, wildfire is directly attributable to dry atmospheric conditions. Wildfires almost always coincide with drought in California, though not limited to such.43 However, the wildfire hazard is analyzed separately in this plan. (See wildfire hazard).

In reviewing the occurrences of drought for CSU - Channel Islands (in municipality and county), the US Drought Monitor and the National Drought Mitigation Center report that tens of millions of trees died during the (2014-2017) state-wide drought disaster. Though data sources do not provide data for tree mortality specific to CSU - Channel Islands, the broad geographic extent of the impact makes it likely that tree mortality occurred to some degree on the campuses. Due to the lasting and ongoing effects of drought on the landscape, trees will continue to be impacted within the municipalities, counties and regions wherein lies the CSU campus system as long as drought conditions continue to occur in the future.

Given the absence of data, in order for the CSU Committee-located municipality, county and region. Regarding potential impacts, standing dead trees could fall, posing a risk to people, buildings, power lines, roads and other infrastructure. In addition, drought-impacted trees become susceptible to diseases and insect infestations (bark beetle) further adding to the risk of tree mortality and related potential impacts. No data is currently available for tree mortality on campus, however, the CSU Planning Team will pursue data on this issue in the future.

As a potential tertiary impact, prolonged and repeated drought conditions over time can produce land subsidence and the risk of damage to building foundations and infrastructure on campus resulting from ground instability and collapse. Land subsidence is defined as the vertical sinking of the land over manmade or natural underground voids.

Subsidence is often the direct result of groundwater over-extraction in response to drought conditions, as well as oil and gas extraction. Weight can accelerate the process of subsidence resulting from surface development and infrastructure such as roads and buildings, vibrations from construction blasting and heavy truck or train traffic. For example, the State Water Project’s 444-mile-long California Aqueduct has required repairs such as the raising of canal linings, bridges, and water control structures on the Aqueduct – in the Central Valley a five-mile reach of the Eastside Bypass was impacted by subsidence, and the Department of Water Resources estimated that it may cost in the range of $250 million to acquire flowage easements and levee improvements to restore the design capacity of the subsided area.\(^{44}\)

At present, drought-related damage to campus buildings and infrastructure at CSU - Channel Islands has not been reported, but the potential for such impacts is possible. With regard to overall potential impact, water supply/availability for CSU - Channel Islands is ultimately tied to broader inter-dependent, and more intensive modes of water use at local and regional scales such as agriculture and ranching, wildfire protection, larger metropolitan/municipal usage, manufacturing and commerce, tourism, recreation, and wildlife preservation. During drought periods, the State of California’s regulated water allocations are modified and often reduced, which can result in reduced water availability for all usage contexts, including CSU - Channel Islands. A reduction of electric power generation and water quality deterioration are also potential impact factors.

Table 5-16: Summary of Drought Impacts on Water Resources\(^{45}\)

<table>
<thead>
<tr>
<th>Resource</th>
<th>Type of Impact</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sea Level</td>
<td>Direct</td>
<td>Sea level is rising and will likely impact coastal areas</td>
</tr>
<tr>
<td>Soil Moisture</td>
<td>Direct</td>
<td>Prolonged dry seasons can lead to decreases in soil moisture; drier vegetation</td>
</tr>
<tr>
<td>Vegetation</td>
<td>Indirect</td>
<td>Longer and more intense fire season with increased extent of area burned</td>
</tr>
<tr>
<td>Stream Conditions</td>
<td>Direct</td>
<td>Increases in water temperature; potential effects on fish</td>
</tr>
<tr>
<td>Snowpack</td>
<td>Indirect</td>
<td>Increases in temperature will lead to decreases in snowpack</td>
</tr>
<tr>
<td>Runoff</td>
<td>Direct</td>
<td>Warmer temperatures are likely to lead to a shift in peak runoff from spring to</td>
</tr>
</tbody>
</table>


winter and a likely decrease in summer base flow

<table>
<thead>
<tr>
<th>Hydropower</th>
<th>Indirect</th>
<th>Decreased summer flows resulting from earlier snowmelt and a shift in peak runoff could affect hydropower generation during summer months</th>
</tr>
</thead>
<tbody>
<tr>
<td>Precipitation</td>
<td>Direct</td>
<td>Warmer winter temperatures will result in a greater percentage of precipitation falling as rain rather than as snow</td>
</tr>
<tr>
<td>Groundwater</td>
<td>Indirect</td>
<td>Reduction in snowpack and extended periods of drought are likely to increase dependency on groundwater</td>
</tr>
</tbody>
</table>

**Probability of Future Occurrence of the Hazard**

**Highly Likely** — The US Drought Monitor’s time series data (2000-2020) indicates that some degree of drought has nearly a 100% probability of occurrence somewhere in the state in any given year. Given that CSU - Channel Islands lies within a drought impacted region, it is prudent to extend this likelihood of occurrence to the planning area even though it currently is considered a low-risk hazard on campus.

**Vulnerability to the Hazard**

In California, rising temperatures are projected to increase the average lowest elevation at which snow falls, reducing water storage in the snowpack, particularly at those lower mountain elevations which are now on the margins of reliable snowpack accumulation. Higher spring temperatures will also result in earlier melting of the snowpack. The shift in snow melt to earlier in the season is critical for California’s water supply because flood control rules require that water be allowed to flow downstream and that water cannot be stored in reservoirs for use in the dry season. As such, state-level drought risk factors that have led to drought’s state-wide severity and extent, and potential impacts also create drought vulnerabilities at the level of the CSU - Channel Islands campus.

Moreover, climate change will likely adversely impact the vulnerability of watersheds and ecosystems in their ability to deliver important ecosystem services. These changes may limit the natural capacity of healthy forests to capture water and regulate stream flows. Sierra Nevada mountain winters and springs are warming, and on average, precipitation as snowfall relative to rain is decreasing. A warming climate with reduced snowpack will result in earlier snowmelt and will subsequently reduce downstream water availability during summer and early fall.

As such, the state and the CSU - Channel Islands planning area stakeholders potentially have less capacity to address future drought risks due to projected temperature increases and shortages in water; ground-water withdrawals have been occurring at a deficit rate of 1 – 2-million-acre feet per year, where the impacts of drought include decreased
availability of water for agriculture and environmental uses.\footnote{CAL FIRE Fire and Resource Assessment Program (FRAP). \textit{Water Assessment}. Print. Retrieved 05.04.2021 from: \url{https://frap.fire.ca.gov/data/assessment2010/pdfs/3.1water.pdf}} In forested and other vegetated areas, prolonged drought decreases the moisture content of forest fuels and increases the risk of high severity wildfires.

California is the single most productive agricultural state and its agricultural industry relies heavily on reservoir water supplied by snowmelt and rainfall runoff. Yearly variations in snowpack depths have implications for water availability as snowmelt from the winter snowpack feeds a network of reservoirs. Spring snowpack at Donner Summit reached record low levels in 2014, exceeded in 2015 by a remarkable April 1 snow-water-equivalent value of only 5\% of average. Decreased precipitation since 2011 has contributed to near-record low levels in the Shasta Reservoir.\footnote{National Oceanic and Atmospheric Administration National Centers for Environmental Information. \textit{State Climate Summaries: California}. Retrieved 05.04.2021 from: \url{https://statesummaries.ncics.org/chapter/ca/}}

**Vulnerability of Populations**

The historical and potential impacts of drought on California’s population include agricultural sector job loss, secondary economic losses to local businesses and public recreational resources, increased cost to local and state government for large-scale water acquisition and delivery, and water rationing and water wells running dry for individuals and families. As drought is often accompanied by prolonged periods of extreme heat, negative health impacts such as dehydration can also occur, where children and elderly are most susceptible. Air quality often declines in times of drought which can affect those with respiratory ailments. These same vulnerabilities apply to the students, faculty and staff of the CSU - Channel Islands campus.

**Property Vulnerability**

The historical and potential impacts of drought on property include crop loss, injury and death of livestock and pets, and damage to infrastructure, homes and other buildings resulting from the secondary drought impact of land subsidence. The related drought impacts of tree mortality and land subsidence pose risks to vulnerable critical infrastructure and property. These same vulnerabilities apply to the properties of the CSU - Channel Islands campus.

**Natural Environment Vulnerability**

The core issue shaping drought vulnerabilities throughout California is water supply and demand. Several factors play into the issue including groundwater basins, surface water run-off, public and agricultural demand, and surface water storage water sheds. A USGS led analysis was first conducted in 2010 through the Forest and Rangeland Assessment and ongoing through the USGS Forest and Rangeland Ecosystem Science Center to identify threats and assets where water supply would benefit from environmental management designed to protect or enhance water resources, the key effort which, in part, both defines and mitigates the severity of drought risk and vulnerabilities.
With regard to overall threat and asset findings shaping the potential severity of drought, the watersheds in the Sierra region contribute most greatly to the state’s water supply, but are under threat from climate change, wildfire and development. In addition, groundwater basins in the San Joaquin Valley and Sacramento Valley bioregions are an abundant resource that is heavily threatened by over pumping.

**Critical Facilities Vulnerabilities**

Drought vulnerabilities for CSU - Channel Islands’ critical facilities include water shortfalls for facility operations and critical functions, and potential structural destabilization and damage resulting from land subsidence.

**Estimate of Potential Losses**

An estimate of potential losses from drought has not been calculated for the campus or the CSU system as a whole. However, drought related losses to the city and county of Los Angeles, and the surrounding region such as crop loss and cost increases for water resources have re-occurred over time. Please consult city and county level government, and/or state agricultural agencies for data on the financial impacts from drought.

**Vulnerability Assessment Conclusions**

The CSU Planning Committee understands that the high degree of vulnerability posed by drought will be exacerbated by greater climate variation in the future and therefore greater variation and uncertainty regarding the availability of water supplies which are already under tremendous stress. In response to such vulnerability, state legislation passed in 2014 requires local governments to regulate pumping and recharge to better manage groundwater supplies, and groundwater-dependent regions are required to halt overdraft and bring basins into sustainable levels of pumping and recharge by the early 2040s. That said, the Committee will continue to work with local, regional and state partners and stakeholders to explore solutions for mitigating the drought hazard on its campuses by accessing the best available data and resources on climate change and its relationship to drought.

**Identified Data Limitations**

Data is limited concerning campus-related agricultural assets as well as data on campus tree mortality.
Earthquake

Description of the Hazard

An earthquake is a sudden motion or shaking caused by the release of pressure accumulated along the edge of tectonic plates covering the earth. These huge plates are constantly moving and move ever so slowly under, over, or by passing one another. This movement is gradual however the plates may lock together accumulating enormous amounts of energy. When this energy builds, stress develops, and the adjoining plates will eventually break free and result is ground shaking – an earthquake.

Large earthquakes may result in fissuring, ground settlement, and/or vertical or horizontal displacement. Earthquakes occur without warning and can result in extensive damages and human casualties. Damages associated to earthquake generated ground shaking is normally confined to a narrow area along fault trend from the earthquake epicenter. However, seismic waves may generate ground shaking resulting in damages in areas outside of the fault trend.

In addition to ground motion, there are several secondary hazards that can result from an earthquake including:

Fault Rupture – The rupture of faults is the differential movement of the two sides of the earth’s plates at the point of the fault. Horizontal or vertical displacement may be significant and occur over great distances. The movement and energy that occurs along a fault is released in waves resulting in ground shaking. The intensity of ground shaking varies based on the magnitude of the earthquake, the proximity to the earthquake epicenter, the composition of the ground sediment or rock the waves travel through, and the depth of the earthquake.

Liquefaction – In addition to the primary fault rupture that occurs right along a fault during an earthquake, the ground many miles away can also fail during intense shaking. As seismic waves travel through saturated granular soil; the soil begins to liquefy and act as a fluid. Soil strength and stability is lost causing the effects of ground shaking to intensify and for ground deformation to occur. These water saturated soils when shaken quickly lose the ability to support buildings, bridges, utilities, and other structures. Areas susceptible to liquefaction include places where sandy sediments have been deposited by rivers along their course or by wave action along beaches. The greater the magnitude of an earthquake and longer duration of strong ground shaking will result in an enhanced potential for liquefaction to occur. Settlement can cause damage when the amount settlement varies significantly across the length of a structure. Lateral spreading occurs when liquefaction occurs on gently sloping ground and the liquefied material at depth allows the area to slide, often toward a vertical discontinuity or “free face” such as a creek or stream channel. Liquefaction can occur in susceptible soils below bodies of water, and settlement and lateral spreading can damage structures built on or adjacent to these areas. Transportation bridges across water bodies, wharves, piers and other structures at ports and harbors, and underwater utility lines can be severely damaged by this hidden hazard.
Subsidence - Changes in the local environment that cause subsidence or sinkholes are called triggering mechanisms. Water is the primary factor that affects the local environment and causes subsidence. Water level decline, changes in groundwater flow, increased loading, and deterioration (such as abandoned mines) are all triggering mechanisms. Water level decline may occur naturally, or it may be the result of human action. Factors that lead to water decline are pumping (from wells), localized drainage (for construction activities), dewatering, or drought. Changes in groundwater flow can result from an increase in the velocity of groundwater movement, and increase in the frequency of water table fluctuations, and changes in discharge (either increase or decrease). Increased loading can cause pressure in the soil, leading to the failure of underground cavities and space, such as caves. Vibrations from earthquakes, heavy machinery, and blasting may result in structural collapse, followed by surface resettlement.

Location of the Hazard

The State of California is particularly vulnerable to earthquake activity due to California’s location residing between two large tectonic plates. CSU Channel Islands is located in the Oxnard Plain at the western edge of the Santa Monica Mountains. In general, fault systems surround and traverse through Ventura County including the area of CSU Channel Islands. Throughout the valley the ground is saturated with sediment eroded from the mountains and foothills via multiple stream and river channels.

The Pacific Plate and the North American Plate come together at the San Andreas Fault 50-60 miles northeast of the CSU Channel Islands campus. In addition to the San Andreas Fault, Ventura County is home to or near additional fault systems with the potential to generate strong ground shaking. The Simi-Santa Rosa Fault traverses east to west through Simi Valley into Camarillo 5 miles north of the CSU Channel Islands campus. The Malibu Coast Fault extends approximately east to west 45 miles in length from Santa Monica westward into the Pacific Ocean 7 miles south of the CSU Channel Islands campus. The 30-mile long Oak Ridge Fault extends the length of the Santa Clara River Valley from east of Piru into Ventura 10 miles north of the CSU Channel Islands campus. The Ventura-Pitas Fault parallels the Oak Ridge Fault just to the north through the western portion of the Santa Clara River Valley 12 miles from the campus. The San Cayetano Fault extends in an east to west direction along the base of the mountains of the Western Transverse Range 19 miles north of the campus. There are numerous additional faults in the area.
Figure 5-7A: Faults Located Near CSU Channel Islands

Figure 5-8B: Liquefaction Zone Near CSU Channel Islands
Extent of the Hazard

The extent or severity of earthquake damage is expressed in terms of magnitude, intensity and duration. The amount of energy released during an earthquake is normally conveyed as a magnitude measured from a seismogram. Magnitude is expressed in numbers and decimals representing the physical size of the earthquake. The strength and effect of the shaking on the surface of the earth is classified as the intensity. Intensity is further defined from the effects the earthquake has on people, structures, and the natural environment. The intensity of an earthquake in terms of measuring magnitude and evaluating its effects is generally expressed using the Modified Mercalli (MM) Intensity Scale. Duration is the length of time the earthquake’s energy is released.

The Richter magnitude scale was developed in 1935 by Charles F. Richter of the California Institute of Technology as a mathematical device to compare the size of earthquakes. The Richter Scale is the best-known scale for measuring the magnitude of earthquakes. The magnitude value is proportional to the logarithm of the amplitude of the strongest wave during an earthquake. A recording of 7, for example, indicates a disturbance with ground motion 10 times as large as a recording of 6. The energy released by an earthquake increases by a factor of 31 for every unit increase in the Richter scale.
The Modified Mercalli Intensity Scale provides descriptive values of earthquake intensity that may provide greater meaning to the broader population as the description of intensity refers to the effects actually experienced. This scale uses an arbitrary ranking based on observed earthquake effects. The scale is composed of increasing levels of intensity ranging from shaking that is not recognizable to intense shaking resulting in catastrophic damages and casualties. The Modified Mercalli Intensity Scale is demonstrated below:

<table>
<thead>
<tr>
<th>Magnitude</th>
<th>Mercalli Intensity</th>
<th>Potential Damage</th>
<th>Global Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 2.0</td>
<td>I</td>
<td>None</td>
<td>Continually</td>
</tr>
<tr>
<td>2.0 - 2.9</td>
<td>I to II</td>
<td>None</td>
<td>&gt; IM per year</td>
</tr>
<tr>
<td>3.0 - 3.9</td>
<td>II to IV</td>
<td>Light</td>
<td>&gt; 100,000 per year</td>
</tr>
<tr>
<td>4.0 - 4.9</td>
<td>IV to VII</td>
<td>Light</td>
<td>10K to 15 K per year</td>
</tr>
<tr>
<td>5.0 - 5.9</td>
<td>VI to VII</td>
<td>Moderate</td>
<td>1K to 1,500 per year</td>
</tr>
<tr>
<td>6.0 - 6.9</td>
<td>VII to X</td>
<td>Heavy</td>
<td>100 to 150 per year</td>
</tr>
<tr>
<td>7.0 - 7.9</td>
<td>VII &lt;</td>
<td>Very Heavy</td>
<td>10 - 20 per year</td>
</tr>
<tr>
<td>8.0 - 8.9</td>
<td>VII &lt;</td>
<td></td>
<td>1 per year</td>
</tr>
<tr>
<td>&gt; 9.0</td>
<td>VII &lt;</td>
<td></td>
<td>1 per 10-50 years</td>
</tr>
<tr>
<td>Intensity</td>
<td>Shaking</td>
<td>Description / Damage</td>
<td></td>
</tr>
<tr>
<td>-----------</td>
<td>---------</td>
<td>----------------------</td>
<td></td>
</tr>
<tr>
<td>I</td>
<td>Not felt</td>
<td>Not felt except by a very few under especially favorable conditions.</td>
<td></td>
</tr>
<tr>
<td>II</td>
<td>Weak</td>
<td>Felt only by a few persons at rest, especially on upper floors of buildings.</td>
<td></td>
</tr>
<tr>
<td>III</td>
<td>Weak</td>
<td>Felt quite noticeably by persons indoors, especially on upper floors of buildings. Many people do not recognize it as an earthquake. Standing motor cars may rock slightly. Vibrations similar to the passing of a truck. Duration estimated.</td>
<td></td>
</tr>
<tr>
<td>IV</td>
<td>Light</td>
<td>Felt indoors by many, outdoors by few during the day. At night, some awakened. Dishes, windows, doors disturbed; walls make cracking sound. Sensation like heavy truck striking building. Standing motor cars rocked noticeably.</td>
<td></td>
</tr>
<tr>
<td>V</td>
<td>Moderate</td>
<td>Felt by nearly everyone; many awakened. Some dishes, windows broken. Unstable objects overturned. Pendulum clocks may stop.</td>
<td></td>
</tr>
<tr>
<td>VI</td>
<td>Strong</td>
<td>Felt by all, many frightened. Some heavy furniture moved; a few instances of fallen plaster. Damage slight.</td>
<td></td>
</tr>
<tr>
<td>VII</td>
<td>Very strong</td>
<td>Damage negligible in buildings of good design and construction; slight to moderate in well-built ordinary structures; considerable damage in poorly built or badly designed structures; some chimneys broken.</td>
<td></td>
</tr>
<tr>
<td>VIII</td>
<td>Severe</td>
<td>Damage slight in specially designed structures; considerable damage in ordinary substantial buildings with partial collapse. Damage great in poorly built structures. Fall of chimneys, factory stacks, columns, monuments, walls. Heavy furniture overturned.</td>
<td></td>
</tr>
</tbody>
</table>

---

<table>
<thead>
<tr>
<th>IX</th>
<th>Violent</th>
<th>Damage considerable in specially designed structures; well-designed frame structures thrown out of plumb. Damage great in substantial buildings, with partial collapse. Buildings shifted off foundations.</th>
</tr>
</thead>
<tbody>
<tr>
<td>X</td>
<td>Extreme</td>
<td>Some well-built wooden structures destroyed; most masonry and frame structures destroyed with foundations. Rails bent.</td>
</tr>
</tbody>
</table>

The graph below illustrates the increasing intensity of energy that is released and as the measured magnitude increases. While each whole number increases in magnitude represents a tenfold increase in the measured amplitude, it represents an increasing rate of 32 times more energy released in the same increase in magnitude. As the magnitude of an earthquake is measured higher, the intensity of the earthquake worsens progressively from one category to the next.

Figure 5-9: Earthquake Magnitude and Equivalent Energy Release

![Figure 5-9: Earthquake Magnitude and Equivalent Energy Release](https://www.usgs.gov/media/images/graph-showing-earthquake-magnitudes-and-equivalent-energy-release)

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Based on the earthquake shaking potential in the Ventura County area, the campus residing within a liquefaction zone, the proximity to numerous fault systems including the San Andreas, Oakridge, Red Mountain, San Cayetano, Santa Susana, and the Simi-Santa Rosa Fault Systems, the extent of the earthquake risk is considered Moderate.

**History of the Hazard**

The State of California has a long history of chronic and destructive earthquakes throughout the state. On average, earthquakes strong enough to result in structural damages occur three to four times a year in California, while earthquakes Magnitude 6.0 to 6.9 occur once every two to three years. Ventura County has a limited history of earthquake activity within the County’s boundaries but experienced shaking from earthquakes originating in other counties. The entire area of Ventura County is at risk to seismic activity and has a minimal history of significant earthquakes resulting in damages.

Table 5-19: Historic Earthquakes Near CSU Channel Islands

<table>
<thead>
<tr>
<th>Date</th>
<th>Location</th>
<th>Magnitude</th>
<th>Damages*</th>
</tr>
</thead>
<tbody>
<tr>
<td>6/29/1925</td>
<td>Santa Barbara</td>
<td>6.8</td>
<td>Infrastructure damage; $8 million; 13 fatalities</td>
</tr>
<tr>
<td>11/4/1927</td>
<td>Point Arguello</td>
<td>7.1</td>
<td>Moderate property damage; Tsunami</td>
</tr>
<tr>
<td>3/10/1933</td>
<td>Long Beach</td>
<td>6.4</td>
<td>Widespread damage; &gt;$50 million; 120 fatalities</td>
</tr>
<tr>
<td>6/30/1941</td>
<td>Santa Barbara</td>
<td>5.5</td>
<td>Minor damage; $150,000</td>
</tr>
<tr>
<td>7/21/1952</td>
<td>Tehachapi</td>
<td>7.5</td>
<td>Extensive damages; $50 million; 12 fatalities</td>
</tr>
<tr>
<td>2/9/1971</td>
<td>San Fernando</td>
<td>6.5</td>
<td>Moderate damages (Ventura County), 65 fatalities</td>
</tr>
<tr>
<td>2/21/1973</td>
<td>Point Mugu</td>
<td>5.3</td>
<td>Moderate damage; $1 million</td>
</tr>
<tr>
<td>8/13/1978</td>
<td>Santa Barbara</td>
<td>5.1</td>
<td>Moderate-Heavy damage; $15 million</td>
</tr>
<tr>
<td>1/17/1994</td>
<td>Northridge</td>
<td>6.7</td>
<td>Extensive damages; $20 billion; 57 fatalities</td>
</tr>
<tr>
<td>3/17/2014</td>
<td>Encino</td>
<td>4.4</td>
<td>Minor damage</td>
</tr>
<tr>
<td>3/28/2014</td>
<td>La Habra</td>
<td>5.1</td>
<td>Minor damage</td>
</tr>
</tbody>
</table>

*Damages include combined damages including outside of Ventura County

The February 9, 1971 San Fernando Earthquake estimated a Magnitude 6.5 earthquake struck resulting in significant shaking Ventura County. The earthquake occurred just east of San Fernando, 25 miles to the east of Simi Valley. The earthquake resulted in numerous surface ruptures and significant infrastructure destruction. Significant structural damage occurred throughout the San Fernando Valley area including homes,

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freeways, businesses, hospitals, and other structural damages. The shaking was strong enough to felt throughout southern California, however damages in Ventura County were moderated.

On February 21, 1973, an earthquake struck the Point Mugu area. The shaking was responsible for over $1 million in damages, injuries, and moderate damages. Damages included landslides onto highways, utilities, structural damages to homes, and underground pipes. This earthquake was centered only a few miles from the CSU Channel Islands campus location.

The San Fernando Valley experienced another major earthquake on January 17, 1994. This earthquake was felt throughout southern California. The shaking was the strongest recorded in an urban setting in North America causing the collapse of buildings, apartments, offices, homes, and roadway infrastructure. The quake caused over 25,000 dwellings to be uninhabitable, over $20 billion in damages (1994 values), and 57 fatalities.

Potential Impacts of the Hazard

The shaking of the ground from earthquakes can result in building collapse, bridge failure, utility disruptions and other structural collapse. Large earthquakes can additionally cause natural gas lines to break resulting in structure fires. The proximity to the Oxnard Plain and the alluvial soils surrounding the campus presents a potential for liquefaction creating greater ground instability during seismic events. A major earthquake in the Oxnard and Camarillo area would likely result in region-wide social disruptions in addition to structural damages. The region-wide structural damages may disrupt lifelines and supply chain routes limiting the campus from effective evacuation routes and receiving necessary supplies or equipment.

Most injuries resulting from earthquakes are from collapsing walls, flying glass, or other objects moved by ground shaking. The lack of warning allows individuals minimal time to react and find areas of safety. A moderate earthquake occurring near Camarillo could cause injuries or fatalities to members of the campus community or support networks the campus relies on. These earthquake effects might be aggravated by collateral incidents such as fire, flooding, hazardous material spills, dam/levee compromises, and other cascading events. A catastrophic earthquake near Camarillo could result in extensive casualties. expansive structural damages, panic, widespread utility outages, communication failures, and secondary emergencies such as fire. A catastrophic earthquake would certainly affect the broader Ventura County region limiting immediate assistance that the campus may normally expect.

Some local CSU Channel Islands campus impacts caused by earthquake could include:

- Landslides blocking access routes such as Potrero Rd, Pacific Coast Highway, and US Highway 101
- Structural damage to bridges accessing campus from South Lewis Road
- Potential isolation of campus from community
- Structural damage to Calleguas Creek levees
- Structural damage to campus academic and support buildings
- Structural damage to residence halls resulting in displaced student populations
- Structural damage to power plant and potential loss of power and release of hazardous materials
- Considerable stress and fear among community
- Closure or reduction of service to campus operations

**Probability of Future Occurrence of the Hazard**

The Working Group on California Earthquake Probabilities (WGCEP), a collaboration between the United States Geological Survey (USGS), the Southern California Earthquake Center (SCEC), and the California Geological Survey (CGS) develops Uniform California Earthquake Forecasts (UCERFs) using the best currently available science and technology. The UCERF version 3 provides a three-dimensional view of the likelihood a region in California will experience a Magnitude 6.7 or greater earthquake in the next 30 years. The likelihood for the Ventura County fault systems surrounding Camarillo is included in the following table.

**Table 5-20: Major Potentially Active Faults in Proximity to CSU Channel Islands**

<table>
<thead>
<tr>
<th>Fault Zone</th>
<th>Recurrence</th>
<th>Maximum Magnitude</th>
<th>UCERF3 Likelihood</th>
</tr>
</thead>
<tbody>
<tr>
<td>Malibu Coast</td>
<td>Historic: 2,908 years</td>
<td>6.7</td>
<td>1%</td>
</tr>
<tr>
<td>Oakridge</td>
<td>Varies: 299 years</td>
<td>6.9</td>
<td>8%</td>
</tr>
<tr>
<td>Red Mountain</td>
<td>Varies: 507 years</td>
<td>6.8</td>
<td>7%</td>
</tr>
<tr>
<td>San Andreas</td>
<td>Varies: 20-300 years</td>
<td>8.0</td>
<td>41-43%</td>
</tr>
<tr>
<td>San Cayetano</td>
<td>Varies: 150 years</td>
<td>6.8</td>
<td>6%</td>
</tr>
<tr>
<td>Santa Susana</td>
<td>Varies: 138 years</td>
<td>6.6</td>
<td>6%</td>
</tr>
<tr>
<td>Simi-Santa Rosa</td>
<td>Varies: 933 years</td>
<td>6.7</td>
<td>6%</td>
</tr>
<tr>
<td>Ventura-Pitas Point</td>
<td>Historic: Unknown</td>
<td>6.9</td>
<td>3%</td>
</tr>
</tbody>
</table>

Based on the earthquake shaking potential in the Ventura County area, the campus residing within a liquefaction zone, the proximity to numerous fault systems including the San Andreas, Oakridge, Red Mountain, San Cayetano, Santa Susana, and the Simi-Santa Rosa Fault Systems, the probability of seismic ground shaking generating damage is considered **Possible**.

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Vulnerability to the Hazard

A considerable challenge regarding earthquakes is they generally occur without warning. The fault systems surrounding the region all cross major transportation routes potentially reducing the availability of access and the supply chain. The geographic location of the Channel Islands campus sits at the edge of an alluvial plain that is composed of deposited sediment from the surrounding mountains. In many cases, these sediment-based soils are loose and expose the potential for liquefaction. The majority of the Oxnard Plain has identified a moderate risk of liquefaction including most of the campus.

The known fault systems generating the threat to Ventura County exist on all sides of the area including near the CSU Channel Islands campus. As such, the proximity and potential for large earthquake development from these surrounding systems expose significant vulnerabilities. The potential for earthquake damaged structures being left uninhabitable including campus residence halls will result in numerous displaced individuals and households. The lack of earthquake insurance will cause extreme financial burdens on those affected. Campus buildings and equipment

Elements of the vulnerability to a major earthquake on the CSU Channel Islands campus will vary depending on when the earthquake were to strike. The primary basis of vulnerability is based on the population affected and the built environment exposed. In general, newer construction will be more earthquake resistant than older buildings as building codes and construction technology have improved. A locally centered earthquake, even from moderate events, would have the potential for more damaging results when associated with the moderate liquefaction zones of the area. This would particularly be seen with greater damages to unreinforced masonry buildings.

The risk to the campus population will be lessened during periods when classes are not in session or during periods of breaks. Conversely, during the days and hours that classes are in session and staff are at their workplaces, the human vulnerability increases. Generally, people are safer when at home in wood frame structures as earthquakes tend to generate less structural damage to wood construction than in commercial or industrial facilities. The greater number of people on campus at the time of an earthquake will result in more people being exposed to effects from damaged campus facilities or equipment and require greater evacuation assistance. However, in region-wide events this vulnerability may simply shift to the homes and workplaces of members of the campus community and their families.

The aftermath of a major earthquake will likely result in widespread search and rescue operations for trapped and injured individuals. The demand on emergency services will be great, potentially requiring the campus community to be prepared for these scenarios and initiate response actions as needed. There will be needs for emergency medical care, shelter, water, and food for individuals who have been displaced by the earthquake. In earthquakes causing significant damages, there may be a necessity to provide assistance with identification and support to local agencies in mass fatality management.
There may be a need to evacuate members of the campus community from the campus and to other locations that are deemed to be safer locations. Certain campus populations will experience greater challenges to a post-earthquake environment. Vulnerable populations including those that rely on specific services, require electrical power, homeless students, experience disabilities, non-English speakers, those whose age make evacuating difficult, and others will be most affected. These individuals will likely need to navigate through earthquake generated debris, extreme stresses of a disaster, an inability to communicate to or gain access to support networks, and find difficulty in accessing equipment or supplies to aid in a specific need.

**Estimate of Potential Losses**

Estimates of potential losses will be influenced by a variety of factors. The intensity of the earthquake will determine what scale of damages affecting campus infrastructure, equipment, and other impacted features. Losses will be generated by the physical damages, the loss of revenue, loss of academic research, loss of building contents, and community wide economic reductions.

Based on estimate replacement costs of facilities and structures on campus, the maximum total replacement costs due to earthquake are $179,257,992.

Table 5-21: HAZUS Peak Ground Acceleration (PGA) Zone Estimated Losses

<table>
<thead>
<tr>
<th>PGA Zone Designation</th>
<th>Intensity</th>
<th>No. of Buildings</th>
<th>Maximum Replacement Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Extreme</td>
<td>X+</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Violent</td>
<td>IX</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Severe</td>
<td>VIII</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Very Strong</td>
<td>VII</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Strong</td>
<td>VI</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Moderate</td>
<td>V</td>
<td>37</td>
<td>$179,257,992</td>
</tr>
<tr>
<td>Light</td>
<td>IV</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Weak</td>
<td>II-III</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Not Felt</td>
<td>I</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>NA</td>
<td>NA</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>No Building Value Data Provided*</td>
<td>NA</td>
<td>18</td>
<td>Unknown</td>
</tr>
</tbody>
</table>

*Buildings with no value defined are also included in the respective Zones they are found in.*

**Vulnerability Assessment Conclusions**

It is difficult to predict the severity of casualties, property, and cascading impacts generated by future seismic events affecting the Ventura County region and the CSU Channel Islands campus. Each of the earthquake generated effects will vary widely based on the intensity of the earthquake, location of the epicenter, proximity to people and development, time of day and year, the soil composition under the impacted structures, building construction, among others. In any case, the potential for a major earthquake
exists affecting the campus and causing extensive challenges to the CSU Channel Islands campus and community.

In the event that a major earthquake was to strike along the fault systems surrounding Camarillo, the effects could be significant to the campus community and campus operations. The widespread impacts generated by a major earthquake would extend the effects of casualties, damages, and other impacts to the broader Ventura County region creating large-scale regionwide needs for critical assistance and a heavy demand on limited emergency resources. The threat and impacts presented to the campus will be shared with the campus community from their homes and places of work. The campus will likely be required to address critical needs independently during early phases of the disaster.

The campus population are additionally vulnerable to the effects of major ground shaking that are far reaching. The psychological and social impacts a major earthquake will give rise to will potentially harm individuals and cause tremendous fear. The willingness to return indoors may be hampered especially as after-shock continue. These effects are magnified for populations having specific vulnerabilities or access limitations.

Identified Data Limitations

Missing campus structural replacement costs and an inventory of building construction types to include status of earthquake retrofitting. HAZUS generated analysis is focused on the broader community level versus finetuning the analysis to the micro-level for facilities such as a university campus.


**Erosion**

Description of the Hazard

The US Geological Survey (USGS) defines erosion as "the process whereby materials of the earth’s crust are loosened, dissolved, or worn away and simultaneously moved from one place to another."\(^{53}\) Erosion may occur in areas of streams and rivers, along bluffs, around immovable objects (such as buildings or bridge abutments), or as a cascading result of other natural hazards, such as earthquakes or wildfires. When erosion occurs along bodies of water, the removal of material causes the shore to move further landward.

Forces such as sea level rise and changes in sediment supply impact erosion gradually and can be difficult to recognize. In contrast, the impacts of short-term events, such as storms and flooding, can be severe and are immediately recognizable. Along the Pacific coast, rain, wind, and waves can induce significant short-term erosion.

Location of the Hazard

Erosion is a severe hazard in coastal communities, where sea level rise and storms contribute to de-sedimentation and the retreat of coastal cliffs, bluffs, and beaches. While coastal erosion can happen in any storm, it is more likely during El Niño events, which occur every 5-7 years. For the purpose of this campus-level analysis, the erosion hazard poses a consistent risk across those areas of the CSU – Channel Islands campus with erosion-prone characteristics. For example, erosion has been found in the hillside areas around canals on campus. No other areas under threat of erosion or erosion in process have been identified, though campus leadership may decide to conduct a campus-wide assessment in the future if it decides such an effort is needed.

Other incidents of erosion, such as occurs around buildings, is relatively non-spatial and can occur in any locations with conducive soil structure and a source of movement, such as water or wind. An area’s potential for erosion is determined by several factors, including rainfall, topography, soil characteristics, and vegetative cover.

Extent of the Hazard

Erosion is occurring on the Pacific coastline west of CSU Channel Islands. While there is no published scale of severity or extent for this geologic hazard on the CSU Channel Islands campus, erosion is likely to occur if conditions are favorable. However, given some historical occurrence of erosion on campus, the planning committee ranks the extent of this hazard as Moderate.

History of the Hazard

CSU Channel Islands has experienced past erosion in the hillside areas around canals. Mitigation projects, including replacing ripraps, are being routinely performed.

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Potential Impacts of the Hazard

Coastal erosion can result in severe impacts to local infrastructure, including the undermining of foundations, exposure of underground infrastructure, and breaches of natural or constructed protections. The latter can expose communities to the destructive forces of floodwaters, surge, and debris impacts. On campus, areas of erosion can create pedestrian and transportation hazards, and structures may become unsafe if erosion is not controlled. Public health and safety, structures, and infrastructure can all be negatively impacted, damaged, or destroyed by the erosion hazard.

Probability of Future Occurrence of the Hazard

Erosion is an on-going and dynamic process that occurs regularly. As climate change raises sea levels and induces more frequent and intense weather events, coastal and other erosion may generally become more widespread or severe. These events can cause erosion or exacerbate areas already experiencing erosion. In consideration of the history of occurrence on campus and the potential extent of erosion on and near campus, the probability of at least a limited degree of erosion taking place somewhere on the campus in the future is **High** over the long term.

Vulnerability to the Hazard

Topography, soil structure, land use, and precipitation are all factors of erosion. CSU Channel Islands infrastructure and buildings located on steep slopes, in areas with little vegetation, or in areas with conducive soil types are more vulnerable to erosion. CSU leadership would consider performing an analysis on specific at-risk buildings, slopes and soil types in the future.

In the wider Camarillo community, erosion vulnerabilities include agricultural sector job loss, degradation of riverine ecosystems and coastlines, and loss of water quality.

Estimate of Potential Losses

The historic and potential impacts of erosion on property statewide include reduced agricultural productivity, lower surface water quality, and damaged drainage networks.

Current modeling is not precise enough to allow for an assessment of potential losses to buildings and infrastructure on campus.

Vulnerability Assessment Conclusions

While the ability to predict future erosion on the CSU Channel Islands campus is limited, the core issues shaping erosion vulnerability on campus are flora and landscaping. If left unchecked, erosion can cause significant damage to campus infrastructure and the surrounding environment.

Identified Data Limitations

The complex interactions between soil erosion factors make predictive modeling, determination of hazard areas, and quantification of loss difficult. Localized data on this hazard is also limited, resulting in more generalized findings.
**Flood**

Description of the Hazard

The incredible geographic diversity in California presents tremendous challenges for flood planning and response. The state is home to extensive mountain ranges such as the Sierra Nevada, Cascades, Klamath, Coastal Ranges, and the Southern California Transverse Range all creating tremendous watersheds. Large river systems drain the mountains traveling through populated communities including the Sacramento and San Joaquin Rivers draining into the California Delta. The state has a complex system of reservoirs, dams, and levees providing water storage and flood protection. Finally, California’s 840-mile coastline exposes the coastal regions to tidal influences.

Floods are characterized by the rising and overflowing of excess water from a water source such as a stream, river, lake, canal, or coastal body onto an area of normally dry floodplain. A floodplain is a lowland area downstream and/or adjacent to water bodies that are subject to flood events. Flooding is a naturally occurring event that become hazardous when populations and property are affected.

Flooding can result from excessive precipitation from weather systems generating prolonged rainfall, excessive snowmelt from watersheds upstream from the floodplain, infrastructure failure, exceeding the capacity of dams or levees, tidal influences, or a combination from any of the previous factors.

Flooding may result in significant damage to structures, infrastructure, utilities, landscapes, and the environment. Erosion of stream banks, roadways, other feature may result from the movement of flood waters. The saturated ground resulting from standing flood waters may cause ground instability, collapse, erosion, or other damages. Further, floods will often generate substantial debris that will accumulate and be deposited throughout the flooded areas.

Flooding can be either slow-rise or rapid onset floods. With slow rise floods, there is often warning preceding water rise by hours or days before dangerous conditions present themselves. Slow rise floods that are expected to enter into populated areas generally allow for some time to initiate evacuation and sand bagging efforts. Flooding that occurs rapidly conversely are water events that present with extremely limited warning times and a limited ability to take response actions until flooding has already begun to occur.

Flooding may take on different forms:

- **Flash Flooding** – Flash flooding is typically characterized by a rapid rise, short duration, and large volume of water in a localized area. Heavy rainfall in areas that have limited drainage capacities often contribute to flash flooding conditions. These flooding events frequently occur with limited notice requiring immediate evacuation or rapid response efforts such as sand bagging. Flash flooding may arrive with fast moving water creating added hazardous conditions.
- **Riverine Flooding** – Riverine flooding is usually caused by prolonged rainfall or rainfall combined with heavy snowmelt. When soils are already saturated, the ability for the ground to absorb water is minimized. In a riverine flood, the waterway exceeds channel capacity and extends into areas outside of the channel, often in developed communities. In California, riverine flooding is most likely to occur from November through April. The duration of riverine floods may vary from a period of hours to weeks.

- **Localized Flooding** – Localized flooding is commonly the result of stormwater drainage systems being overwhelmed by unusually heavy rainfall. These flooding events frequently occur in areas that are urbanized or developed with greater amounts of impervious surfaces not allowing ground absorption. This generates added runoff into the drainage systems and onto roadways creating backups.

- **Infrastructure Failure** – Failures of dams or levees presents a serious flooding concern for areas downstream from the compromised structure. This situation may result in a catastrophic flood with limited warning time and widespread areas affected.

- **Coastal Flooding** – Coastal flooding can occur in multiple areas along the California coastline. Flooding may result from intense storms coming from the Pacific Ocean that generate elevated water levels or storm surge. The size, duration, winds generated, and intensity of the storm will influence the effect the waves will have on the shoreline. Periods of high tide can aggravate the conditions allowing greater wave impingement into coastal areas.

**Atmospheric River**

California, including the location of this campus, is subject to the effects of a phenomenon referred to as atmospheric rivers. These weather events consist of long, narrow regions in the atmosphere transporting tremendous amounts of water vapor from the tropics. These weather regions behave like rivers in the sky. They can carry heavy volumes of water vapor compared to the amount of water flow at the mouth of the Mississippi River. As these atmospheric rivers arrive into California they tend to generate significant rain and snow.

Atmospheric rivers can arrive in many different shapes and sizes. The larger events are able to generate extreme rainfall amounts resulting in flooding. They can stall over watersheds vulnerable to flooding, often saturated with heavy snow amounts. The atmospheric rivers known as a “Pineapple Express” coming from the tropics and arriving with warmer air may produce heavy rains that will melt ground snow adding to the water volume that will be added in the flood runoff.

These events can produce heavy amounts of precipitation creating extensive damages. However, these events may present as weaker systems that produce precipitation that is enough to be beneficial for the local water supply. At the higher elevations in the California mountains, these events have the potential to generate a tremendous snowpack providing a source of water during the dry summer months.
Figure 5-10: The Science Behind Atmospheric Rivers

**The science behind atmospheric rivers**

An atmospheric river (AR) is a flowing column of condensed water vapor in the atmosphere responsible for producing significant levels of rain and snow, especially in the Western United States. When ARs move inland and sweep over the mountains, the water vapor rises and cools to create heavy precipitation. Though many ARs are weak systems that simply provide beneficial rain or snow, some of the larger, more powerful ARs can create extreme rainfall and floods capable of disrupting travel, inducing mudslides and causing catastrophic damage to life and property. Visit [www.research.noaa.gov](http://www.research.noaa.gov) to learn more.

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**Location of the Hazard**

The Ventura River, Santa Clara River, and Calleguas Creek have been identified as the primary flood sources for Ventura County. The CSU Channel Islands campus is located adjacent to the Calleguas Creek channel. The Calleguas Creek channel and its protecting levees separates the campus buildings and facilities from the primary access route into other communities in Ventura County. The main part of the campus is slightly higher in elevation than the creek channel. The library and residential neighborhood are further elevated ascending up the hillside. The majority of the CSU Channel Islands campus sits within a Special Flood Hazard Area (SFHA) Zone X (0.2% of Annual Chance of Flood Hazard) designation on the Flood Insurance Rate Map. The athletic fields, northern parking areas, and the western area including Modoc Hall, El Dorado Hall, and the Central Plant reside in a Zone AE Special Flood Hazard Area (Area Inundated by 1% Annual Chance of Flooding). The Zone A designated areas are subject to inundation by a 1-percent annual chance that a flood event will occur.

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Figure 5-11: Flood Hazard Areas at CSU Channel Islands
Ventura County is home to a number of river and stream systems, flood control facilities and levee systems throughout the Santa Clara River Valley and Oxnard Plain regions including the Calleguas Creek. The Calleguas Creek drains the northern portions of the Santa Monica Mountains. The Calleguas Creek is normally dry however can drain substantial volumes of water in heavy precipitation events. The creek channel is located just over a half mile from the main parts of the campus.

Extent of the Hazard
The CSU Channel Islands campus is located mostly in a designated Zone X: 0.2% Annual Chance Flood Hazard. Portions of the northern and western edges of the campus are located within a Zone AE: 1% Annual Chance Flood Hazard. The access routes into and out of the campus servicing Ventura County locations are found in areas designated as Zone AE: 1% Annual Chance Flood Hazard. Although comprehensive campus-level flood data is not available, given that 9 Federally declared flood disasters have occurred in/near the city of Camarillo, along with frequent/annual flood events in winter months, the planning committee ranks the extent of the flood hazard on campus as Moderate. Another consideration for the ranking is that the northern and western portions of the CSU Channel Islands campus lies within a levee flood protected area. In the event Calleguas Creek was flowing at elevated levels beyond the capacity of the designed flood protection, the CSU Channel Islands campus would potentially experience significant flood related damages in these protected areas. Based on these factors. The planning committee ranks the extent of the hazard as Moderate.

In support of the NFIP, FEMA identifies those areas that are more vulnerable to flooding by producing Flood Hazard Boundary Maps (FHBM), Flood Insurance Rate Maps (FIRM), and Flood Boundary and Floodway Maps (FBFM). Several areas of flood hazards are commonly identified on these maps, including the 1% annual chance flood zone. Flood zones are further delineated by risk and are assigned a letter signifier. The flood zone designations are defined and described in the following table.

Table 5-22: Flood Zone Designations and Descriptions

<table>
<thead>
<tr>
<th>Zone Designation</th>
<th>Percent Annual Chance of Flood</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Zone V</td>
<td>1%</td>
<td>Areas along coasts subject to inundation by the 1% annual chance of flooding with additional hazards associated with storm-induced waves. Because hydraulic analyses have not been performed, no BFEs or flood depths are shown.</td>
</tr>
<tr>
<td>Zones VE and V1-30</td>
<td>1%</td>
<td>Areas along coasts subject to inundation by the 1% annual chance of flooding with additional hazards associated with storm-induced waves. BFEs derived from detailed hydraulic analyses are shown within these zones. (Zone VE is used on new and revised map in place of Zones V1-30.)</td>
</tr>
<tr>
<td>Zone A</td>
<td>1%</td>
<td>Areas with a 1% annual chance of flooding and a 26% chance of flooding over the life of a 30-year mortgage. Because detailed analyses are not performed for such areas, no depths or base flood elevations are shown within these areas.</td>
</tr>
<tr>
<td>Zone</td>
<td>Probability</td>
<td></td>
</tr>
<tr>
<td>----------</td>
<td>-------------</td>
<td></td>
</tr>
<tr>
<td>AE</td>
<td>1%</td>
<td></td>
</tr>
<tr>
<td>AH</td>
<td>1%</td>
<td></td>
</tr>
<tr>
<td>AO</td>
<td>1%</td>
<td></td>
</tr>
<tr>
<td>X (shaded)</td>
<td>0.2%</td>
<td></td>
</tr>
<tr>
<td>X (unshaded)</td>
<td>Undetermined</td>
<td></td>
</tr>
</tbody>
</table>

Areas with a 1% annual chance of flooding and a 26% chance of flooding over the life of a 30-year mortgage. In most instances, BFEs derived from detailed analyses are shown at selected intervals within these zones.

Areas with a 1% annual chance of flooding where shallow flooding (usually areas of ponding) can occur with average depths between 1 – 3 feet.

Areas with a 1% annual chance of flooding, where shallow flooding average depths are between 1 – 3 feet.

Represents areas between the limits of the 1% annual chance flooding and 0.2% chance flooding.

Areas outside of the 1% annual chance floodplain and 0.2% annual chance floodplain, areas of 1% annual chance sheet flow flooding where average depths are less than one (1) foot, areas of 1% annual chance stream flooding where the contributing drainage area is less than one (1) square mile, or areas protected from the 1% annual chance flood by levees. No BFEs or depths are shown within this zone.

**History of the Hazard**

Flooding in Camarillo and the broader Ventura County region have typically occurred during the winter months when Pacific storms are more common. The occurrences of significant flooding typically have been the result of successive intense storms with heavy precipitation. The region has experienced flood events that have caused tens of millions of dollars in damages and numerous fatalities. Although no record of flood events are available, heavy rainfall on campus is known to create isolated flooding and ponding. The following provides insight into information of past flooding events that are significant to the CSU Channel Islands campus.
Table 5-23: Historic Flooding Events Near Camarillo\(^{55}\)

<table>
<thead>
<tr>
<th>Date</th>
<th>Event</th>
<th>Declaration</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>February 1969</td>
<td>Flood; Winter Storms</td>
<td>Federal</td>
<td>Santa Clara River</td>
</tr>
<tr>
<td>January 1980</td>
<td>Flood</td>
<td>Federal</td>
<td>Calleguas Creek</td>
</tr>
<tr>
<td>February 1983</td>
<td>Flood; Winter Storms</td>
<td>Federal</td>
<td>Calleguas Creek</td>
</tr>
<tr>
<td>January 1995</td>
<td>Flood; Heavy Rains</td>
<td>Federal</td>
<td>Countywide</td>
</tr>
<tr>
<td>March 1995</td>
<td>Flood; Heavy Rains</td>
<td>Federal</td>
<td>Countywide</td>
</tr>
<tr>
<td>December 1996</td>
<td>Flood; Winter Storms</td>
<td>Federal</td>
<td>Countywide</td>
</tr>
<tr>
<td>January 1997</td>
<td>Flood</td>
<td>Federal</td>
<td>Countywide</td>
</tr>
<tr>
<td>February 1998</td>
<td>Flood; Winter Storms</td>
<td>Federal</td>
<td>Countywide</td>
</tr>
<tr>
<td>January 2005</td>
<td>Flood; Winter Storms</td>
<td>Federal</td>
<td>Countywide</td>
</tr>
</tbody>
</table>

**Potential Impacts of the Hazard**

A flood will potentially result in extensive amounts of water entering onto developed areas. The force and volume of water that is generated by a flood may cause extensive structural damage in areas subject to standing or moving water. The effects of flooding may spread over significant distances covering large areas of land. The extent of the impacts would vary based on a number of factors such as the volume of water flooding, the time of the flood event, the amount of warning provided, the location and extent of the flood boundary, facility elevation, and distance from the flood source.

Potential impacts resulting from flooding include:

- Injuries or loss of life
- Property destruction or damage
- Loss of property contents
- Infrastructure damage including roadways, bridges, other transportation means
- Public health hazards resulting from mold, mildew, and disease due to flood water
- Flooded or destroyed lifelines/supply routes
- Damaged or destroyed utilities
- Loss of community economic base
- Employment losses
- Agricultural (crops and livestock) damages or destruction
- Environmental damage
- Prolonged periods of necessary dewatering
- Flooding erosion may alter natural drainage channels
- Societal and community impacts
- Psychological impacts of impacted populations
- Disruptions to education delivery to community

Additionally, individuals who were unable to evacuate in time or refused to leave will likely need assistance or rescue from the flooded area. Remaining in or being trapped by flood waters places individuals in significant risk of injury or death. The impacts extend beyond the danger placed upon the affected individual and places greater resource demands on agencies and organizations making efforts to rescue trapped individuals.

Probability of Future Occurrence of the Hazard

Ventura County is determined to be at high risk from flooding. The repeated historic occurrences have shown that the region is subject to a 20% chance of flooding in any given year.\(^5^6\) The location of the CSU Channel Islands campus within a Special Flood Hazard Area demonstrates that the potential exists for flooding events.

Based on flood history and campus location in the SFHA, the probability of future occurrence for flooding is **Likely**.

Vulnerability to the Hazard

The CSU Channel Islands campus is subject to the effects of flooding resulting from excessive precipitation, snowmelt, river/levee overflow, or a combination of these. The Calleguas Creek channel presents the greatest potential for flooding and damage on campus and surrounding agricultural areas surrounding the campus. The channels and extending irrigation channels that surround the campus have limited storage or volume capacities. The campus and the campus community are vulnerable to the effects generated by flooding from these systems. Runoff from heavy precipitation in the hillsides along the eastern border of the campus presents a potential threat for flash flooding and isolated small floods on campus.

Vulnerability to flooding on the CSU Channel Islands campus will vary depending on when the flood were to occur and the location of any people and assets located in low lying areas and Zone AE areas. The risk to the campus population will be lessened during periods when classes are not in session or during periods of breaks. Conversely, during the days and hours that classes are in session and staff are at their workplaces, the human vulnerability increases. However, in region-wide events this vulnerability may be extended to the homes and workplaces of members of the campus community and their families.

Some campus buildings and infrastructure, especially those located in low lying areas and Zone AE areas, could be vulnerable to large-scale flooding if it reaches the university. Campus utilities and communication capabilities could be impacted by flood waters rendering them disabled. A rare flood covering a large portion of the city could likely affect communication capabilities well beyond the boundaries of the campus. Remaining flood waters will leave behind molds and other health concerns in affected campus areas.

buildings and facilities likely requiring extensive restoration or demolishing. The residents of the on-campus residence halls, if located in low lying areas and Zone AE areas, may have transportation limitations requiring evacuation procedures to be implemented if populated. Flood waters in such areas may result in damage to campus equipment, communication systems, protected documents, artwork, academic materials, computer systems, research, and other critical activities on lower levels of buildings.

Certain campus populations will experience greater challenges to a post-flood / failure environment. Vulnerable populations will likely need to navigate through flood generated debris, face extreme health safety issues from flood waters, experience extreme stresses of a disaster, an inability to communicate to or gain access to support networks, and find difficulty in accessing equipment or supplies to aid in a specific need. Students remaining on campus such as those residing in the residence halls would be particularly vulnerable especially those without access to adequate transportation.

**Estimate of Potential Losses**

Estimates of potential losses will be influenced by a variety of factors. The volume and force of the water will determine the scale of damages affecting campus infrastructure, equipment, and other impacted features. The location and elevation above flood waters will affect the level of damage and individuals exposed. The time of the academic year, the day of week, and hour in which the flooding was to occur will influence the number of people on campus and potential casualties. The severity of the storms producing precipitation, the speed of the storms moving across the area, the level of snowpack in the higher elevations, and amount of resulting snowmelt will produce varying effects on damages produced and costs incurred. Losses will be generated by the physical damages, the loss of revenue, loss of academic research, loss of building contents, and community wide economic reductions.

Based on estimate replacement costs of facilities and structures on campus, the maximum total replacement costs due to earthquake are $179,257,992. However due to one portion of the campus being located in levee protected area, it is unlikely for flood to cause destructive losses to the entire campus.
Table 5-24: Special Flood Hazard Areas (SFHA) Estimated Losses

<table>
<thead>
<tr>
<th>Zone Designation</th>
<th>No. of Buildings</th>
<th>Maximum Replacement Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Zone V</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Zone VE &amp; V 1-30</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Zone A</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Zone AE</td>
<td>4</td>
<td>$6,100,000</td>
</tr>
<tr>
<td>Zone AH</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Zone AO</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Zone X</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Zone X Minimal Risk</td>
<td>33</td>
<td>$173,157,992</td>
</tr>
<tr>
<td>Not in a SFHA</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>No Building Value Data</td>
<td>18</td>
<td>Unknown</td>
</tr>
</tbody>
</table>

*Buildings with no value defined are also included in the respective Zones they are found in.

Vulnerability Assessment Conclusions

While the campus is located mostly in an area of minimal flood potential (Zone X), it also contains Zone AE areas and other low-lying areas. As such, the primary vulnerabilities to flood on campus are people and assets in Zone AE and other low-lying areas exposed to flooding and ponding from overflow of campus creeks or low probability, large-scale storms that produce heavy amounts of precipitation directly over the campus and surrounding neighborhoods. The proximity to the Calleguas Creek in addition to the levees providing a barrier between the campus and the creek channel further presents a hazard facing the campus.

The potential for flooding on the campus and surrounding area generates the potential for a number of cascading effects such as disruptions to the local economy, utility failures, disruptions to providing for the needs of the campus and the community, and development of public health hazards. These effects would be exacerbated by effects of seasonal flooding, ongoing heavy precipitation, or excessive run-off from the watershed contributing to the river system. The potential for widespread flooding and damage of structures due to the force of water has exponentially powerful impacts on particular segments of the campus community including those with access or functional needs, international students, the homeless, and students residing in the residence halls.

Identified Data Limitations

Missing campus structural replacement costs and complete inventory of building construction features or mitigation efforts to lessen the impact due to flood inundation. HAZUS generated analysis is focused on the broader community level versus finetuning the analysis to the micro-level for facilities such as a university campus.
Hazardous Materials

Description of the Hazard

A hazardous material is defined in California’s State Hazardous Materials Incident Contingency Plan (1991) as “a substance or combination of substances which, because of quantity, concentration, physical, chemical, or infectious characteristics may: cause, or significantly contribute to an increase in deaths or serious illnesses; and/or pose a substantial present or potential hazard to humans or the environment.”57 Hazardous materials are one or more of the following: flammable, corrosive or an irritant, oxidizing, explosive, toxic (poisonous or infectious), thermally unstable or reactive, or radioactive. Hazardous materials are ubiquitous in modern society and may be found at all stages of production, consumption, and disposal.

Federal and state laws permit the intentional release of some hazardous materials into the environment such that the risk to human health and the environment is thought to be acceptable. However, sometimes releases are unintentional, resulting from leaks, accidents, or natural hazards. This section focuses on such accidental releases and fall into the following key categories:

Fixed Hazardous Materials Incident: A fixed hazardous materials incident is the accidental release of chemical substances or mixtures during production or handling at a fixed facility.

Transportation Hazardous Materials Incident: A transportation hazardous materials incident is the accidental release of chemical substances or mixtures during highway, waterway or air transport. Populations, built and natural environments are potentially impacted.

Pipeline Incident: A pipeline transportation incident occurs when a break in a pipeline creates the potential for an explosion or leak of a dangerous substance (oil, gas, etc.) possibly requiring evacuation. An underground pipeline incident can be caused by environmental disruption, accidental damage, or sabotage. Incidents can range from a small, slow leak to a large rupture where an explosion is possible. Inspection and maintenance of the pipeline system along with marked gas line locations and an early warning and response procedure can lessen the risk to those near the pipelines.

Hazardous materials can also be classified according to worker safety and health.58 Information provided by California Division of Safety and Health includes guidelines related to:

- Safety hazards: fire and fire byproducts, electricity, flammable gases, unstable structures, demolition, sharp or flying objects, excavations)

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- **Health hazards**: carbon monoxide ash, soot and dust; asbestos; hazardous liquids; other hazardous substances; heat illness

**Natural-Technological Incidents (Natechs)**: During the past two decades, increasing attention has been given to hazardous materials releases resulting from Natechs or a natural disaster event that triggers a technological hazard event. Natechs are of particular concern for the following reasons:

- They can produce a simultaneous effect on many industrial facilities
- Can overwhelm response capacity
- Containment systems may fail
- May produce cascading disasters
- Response may be hindered by a disaster’s impact on the physical environment

**Location of the Hazard**

Hazardous materials and infrastructure such as fuel tanks, rail lines, chemicals, hazardous waste sites and gas pipelines to varying degrees are located within the CSU system and/or within its surrounding communities. Please refer to Annex 7 for the map identifying the types and locations of hazardous materials and infrastructure on or near the CSU – Channel Islands campus. The planning committee indicates no known hazardous materials are present on campus. At larger scales (beyond the campus planning area), a rail line and one hazardous waste site are about one (1) mile from the campus, and hazardous materials and infrastructure are located throughout the city of Camarillo and Ventura County, and reflect different types, configurations and scales dispersed across these geographic areas.

**Extent of the Hazard**

There is no comprehensive statewide vulnerability assessment available at this time. As such, the true extent of the hazardous materials risk in California and its communities is not known, meaning no overarching conclusions have been reached which have been able to integrate all qualitative and quantitative risk factors to produce a comprehensive measure of the extent of the hazard.

For the CSU – Channel Islands planning committee, no hazmat events have taken place on campus, and no hazardous materials are located close to the campus. Based on these factors along with the types and levels of hazardous materials in the larger community, the extent of the hazard for the CSU – Channel Islands campus is Low, but to consider worst case scenarios as the main driver of policy in order to fully mitigate all possible hazardous materials event outcomes.

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For example, 400 hazardous materials problems are tied to 32 past earthquakes, including more than 495 documented hazardous materials releases due to the Loma Prieta Earthquake alone (this number excludes innumerable leaks in Pacific Gas & Electric’s natural gas distribution system). That said, it is likely that many such hazardous materials releases have received little attention in the past because public authorities, the media, and the public have overlooked them in the rush to address and recover from immediate disaster threats, and that responsible parties may have an incentive to understate the extent of releases or not to report them at all.

History of the Hazard

According to the California Governor’s Office of Emergency Services’ Hazardous Materials Spill Report, the state experiences from 10 to 30 spill events daily. As of April 2021, a total of 2,096 spill events had occurred so far this year. Such events have occurred in all the cities and/or counties where CSU campuses are located.

No hazmat incidents have taken place on the CSU – Channel Islands campus.

Potential Impacts of the Hazard

A large hazardous materials release could affect an entire community or city under certain conditions related to direction of air flow (air-based chemical release) and population density or the contamination of a community’s main water supply. Either type of release could necessitate large scale evacuation. By contrast, in the rural unincorporated areas where population densities are low, even in the event of a large release, the number of homes that may need to be evacuated would be significantly lower than in an urban environment. The occurrence of a hazmat incident can also result in the shut-down of transportation corridors which can last for hours at a time while the impacted area is stabilized.

The release of some toxic gases may cause immediate death, disablement, or sickness if absorbed through the skin, injected, ingested, or inhaled. Contaminated water resources become unsafe and unusable, depending on the amount of contaminant. Some chemicals cause painful and damaging burns if they come in direct contact with skin. Prolonged and concentrated exposure to such chemicals can produce severe long-term impacts to respiratory, endocrine and nervous systems, heart and brain health.

The potential impacts of chemicals and toxic gases discussed here to some degree apply to the students, staff and environment on the CSU – Channel Islands campus.

With regard to the natural environment overall, contamination of air, ground, or water may result in harm to fish, wildlife, livestock, and crops. The release of hazardous materials into the environment may cause debilitation, disease, or birth defects over a

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long period of time. Loss of livestock and crops may lead to economic hardships within the community.

Recent California examples include the 2016 Aliso Canyon methane gas leak\textsuperscript{64}, which caused evacuation of nearby residents, many of whom experienced temporary health problems such as difficulty breathing and eye irritation; and the 2016 Fruitland metal recycle plant fire in Maywood, which released heavy metals such as lead, magnesium, copper, aluminum, antimony, calcium, iron, sulfur, tin, potassium, and zinc which pose severe risks to public health.\textsuperscript{65} Health effects from exposure to these metals included short-term symptoms such as irritation to the eyes, nose, throat, and lungs.

**Potential Impact of the Hazard (Natechs)**

Natural disasters, including earthquake, flood, and fire also pose risks to public health and the environment. For example, following the Northridge Earthquake, California State University (CSU) Northridge laboratories and chemical storage rooms experienced multiple chemical spills. Such incidents, triggered by a natural disaster, pose a significant risk to students, faculty, staff, and first responders. At a minimum, all CSU campuses with a science lab (including CSU – East Bay) is at risk of potential impact from a natural-technological (combined impact) event.

In a severe flood event, floodwaters are often contaminated with hazardous materials posing a threat to public and animal health, groundwater, and other parts of the environment. These hazardous materials may be released from damaged or flooded underground tank sites (e.g., gas stations or chemical storage facilities), propane tanks, manure or human waste handling facilities, fertilizer and pesticide storage, agricultural sites, and household hazardous waste.

In a fire event, (such as the October 2017 Northern California firestorms which destroyed approximately 6,000 residences) entire neighborhoods can be burned to the ground. Hazardous material release creates public health concerns which can delay the initial steps of fire recovery, including reopening burned areas to residents and initiating debris removal activities. The post-fire “toxic sweep” poses a risk of coming into contact with toxic substances due to the presence of synthetic and hazardous materials.

**Probability of Future Occurrence of the Hazard**

The probability of occurrence for a hazmat event on the CSU – Channel Islands campus can be viewed in two different ways: the history of occurrence serves as a sound predictor of future probability assuming current risk and vulnerability factors remain somewhat constant. For the purposes of the current estimate, no current data clearly indicates otherwise. As such, the probability of occurrence is Low because the CSU – Channel Islands campus has no known hazardous materials, and it has not experienced a


That said, hazmat occurrences are largely based on human error, and any changes in risk and vulnerability factors such as a decreased vigilance in materials oversight and handling practices or changes in the amount of chemicals or exposure will likely increase the probability on campus.

Vulnerability to the Hazard

Hazardous materials pose a risk to the CSU – Channel Islands campus. As identified by the campus planning committee and on the hazmat map, the following vulnerabilities are present on campus: no hazardous materials are located on campus, and a rail line and waste facility are about one (1) mile from the campus. Gases and chemicals or hazardous waste, if spilled or released, could severely impact human health and campus operations.

Although it is quite difficult to produce a quantitative measure of vulnerability because (unlike natural hazards) the probability of occurrence is dependent on human error, which itself is variable based upon a fluctuating set of interrelated factors, some of which lack prediction or control, given the complexity of how all natural and built environments and hazmat risks factors interrelate at the local or campus level, it is prudent to assume for planning purposes that the campus’ vulnerability is a sub-set of the larger community’s vulnerability. As such, the CSU – Channel Islands leadership maintains vigilance to mitigate the campus’ vulnerabilities identified above at a minimum.

Estimate of Potential Losses

As discussed previously, it is difficult if not impossible to produce an accurate quantitative measure of vulnerability because of the variable nature of a hazardous materials spill. For example, the release of a toxic airborne chemical in a populated area has severe impact potential, whereas the impact potential of a small chemical spill in a remote or rural area is most likely limited to remediation of soil. And, in both cases, the probability of occurrence is dependent on human error, which itself is variable based upon a fluctuating set of interrelated factors, some of which lack prediction or control. In all cases, different types and amounts of hazardous materials interact with fluctuating combinations of human error to produce different event outcomes with variable impact costs.

Vulnerability Assessment Conclusions

It is well understood that with regards to hazmat vulnerability, each campus and its surrounding community (including CSU – East Bay) operates through a complex and dynamic interaction between industrial and commercial inputs and outputs and the natural and built environment. Such activity produces hazardous materials that move through the environment along both convergent and divergent routes and across all levels of land-use from site to campus to city and county and beyond. It is also clear from a review of the Alameda County hazard mitigation plan and Cal OES’ records of hazardous material spills, that such events occur with great frequency and varying degrees of severity across jurisdictions statewide. As such, in assessing the vulnerability of the CSU – Channel Islands campus, campus-level risks and vulnerabilities are not
discreet or isolated but can become exacerbated or augmented through connections to broader community-level hazmat risks and vulnerabilities.

Finally, in order to draw conclusions on vulnerability, it should be noted that any identified vulnerabilities at the campus level and/or community level are circumscribed and potentially reduced by targeted policy and program interventions. Numerous policies and programs have been established in recent years in response to California’s widespread and complex and integrated hazardous materials risks - California established the Unified Program which consolidates and integrates the administrative requirements, permits, inspections, and enforcement activities of the following environmental and emergency response programs: the Aboveground Petroleum Storage Act (APSA) Program, Area Plans for Hazardous Materials Emergencies, the California Accidental Release Prevention (CalARP) Program, the Hazardous Materials Release Response Plans and Inventories (Business Plans), Hazardous Material Management Plan (HMMP) and Hazardous Material Inventory Statement (HMIS) requirements (California Fire Code), the Hazardous Waste Generator and Onsite Hazardous Waste Treatment (tiered permitting) Programs, and the Underground Storage Tank Program.

Identified Data Limitations

The CSU – Channel Islands planning committee has provided information on campus-level hazmat materials and risks. Data limitations pertain to a comprehensive understanding of human activity and error related to materials control over the long term.
**Landslide**

Description of the Hazard

A landslide is a down-slope movement of soil, rock, or other debris, and can also be referred to as a mass movement or slope failure. These geological hazards can range in size from a few feet to over a mile in length and width and, when heavy and rapidly moving, can cause serious damage and loss of life.

Landslides are classified based on the type of material and type of movement involved. They can range from slow-moving earth flows to fast-moving debris flows, though many large slope failures involve more than one type of movement. The primary natural triggers of slope failures are water, seismic activity, and volcanic activity. Slope saturation by water can occur from intense rainfall, snowmelt, changes in ground-water levels, and surface-water level changes along coastlines. In winter months, El Nino storms or other high rainfall events may saturate soils and trigger slope failure.

**Deep-Seated Landslides**

Deep-seated landslides, ranging in depth from ten to several hundred feet, occur as a result of geologic and hydraulic changes, such as earthquakes or increased levels of groundwater. These landslides can move slowly or quickly and can cause extensive property damage, but rarely result in loss of life.

**Debris Flows Related to Shallow Landslides**

Shallow landslides may mobilize into rapidly moving debris flows and typically occur after sudden saturation of the ground. These types of debris flows are typically more dangerous because they move rapidly, causing both property damage and loss of life.

Debris flows may also occur as a result of post-fire conditions, where wildfires have left barren ground exposed to heavy rainfall. Intense rainfall, generally greater than .5 inch per hour, has the potential to trigger a post-fire debris flow. These landslides may impact lives and properties within its deposition zone, and can result in downstream flooding. These post-fire debris flows often occur during the fall and winter following major summer fires.

**Location of the Hazard**

The susceptibility of an area to landslides depends on several variables, including magnitude of slope gradients, water content, ground cover, presence of erosion, and slope material and structure. However, landslides are most prevalent in terrain with weak material and steep slopes, and the highest risk is found in areas with high rainfall or high

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earthquake potential. Slope failures are also most likely to occur in areas where they have occurred in the past. In California, the most landslide-prone areas are found along the coast and in the northern Franciscan Formation.

General landslide vulnerability can be estimated from the distribution of weak rocks and steep slopes as seen in 5-12. Based on the Figure below, the CSU-Channel Islands is connected to areas moderately susceptible to landslide.

Figure 5-13: Deep-Seated Landslide Susceptibility Surrounding CSU-Channel Islands

Extent of the Hazard

Landslides are most likely to occur in the steep slopes and foothills of the Santa Monica Mountains south and east of the CSU Channel Islands campus. However, the indirect impacts of landslides in the region may cover a larger geographical extent. Based on the campus’ close proximity to the landslide hazard zone, and the history of significant impacts in the city of Camarillo, the planning committee ranks the extent of the landslide hazard for the campus as **Moderate**.

History of the Hazard

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In 2014, a post-fire rockslide and mudslide occurred in Camarillo Springs, approximately 10 miles from CSU Channel Islands. The event occurred after heavy rainfall near the Springs Fire burn scar, destroying 10 homes and damaging 6 homes. Landslides have also occurred in the hillsides surrounding Camarillo in the past. No landslides have occurred on or immediately adjacent to the campus.

Potential Impacts of the Hazard

The CSU Channel Islands campus may be impacted by the disruption of services as a result of landslides in the region or by damage to structures. Students, faculty, and staff who live in nearby communities may also be impacted. Landslides can result in physical damage to buildings and property and have the potential to significantly effect infrastructure in the region. As a landslide moves, it distresses structural foundations by settlement, cracking, and tilting. Fast-moving flows can remove entire structures in one instance, while other types of flows can cause damage gradually.

Transportation and utility infrastructure are particularly vulnerable to landslides, since the failure of any component can disrupt service over a large area. The loss of power and communication and disruption of transportation can have cascading effects throughout an area, including impaired disposal of sewage, contamination of water supplies, and the release of flammable fuels. Transportation routes are also often expensive to clean up, and prolonged obstruction can disrupt the movement of people and goods for long periods of time.

Probability of Future Occurrence of the Hazard

Slope failures are often triggered by other natural hazards such as heavy rainfall and earthquakes, so landslide frequency is somewhat related to the frequency of these other hazards. As climate change impacts the frequency and intensity of triggers such as rain events and fires, landslides may generally occur more often. Historically, landslides have occurred occasionally in the mountains surrounding Camarillo and therefore are likely to occur in the future. Given the location of the campus adjacent to the landslide zone, and the occasional occurrence of landslides on Camarillo, the planning committee ranks the probability of the landslide hazard for the campus as Possible.

Vulnerability to the Hazard

The vulnerability of the built environment to landslides depends on exposure and is more likely to incur damage as a result of proximity, rather than inferior structural design. The structures most vulnerable to landslides are buildings and utility/transportation lifelines, which can be impacted by either impact or ground deformation. Utilities and transportation infrastructure are particularly vulnerable, due to their geographic extent and susceptibility to physical distress. The CSU-Channel Islands campus appears to exhibit building and infrastructure vulnerabilities to some degree based on mapping. See the landslide location map in relation to the campus along with landslide severity zones identified. Campus leadership may decide to assess potential asset vulnerabilities in the future.
Also, any population proximal to a landslide when it occurs is vulnerable to its impacts.

**Estimate of Potential Losses**

There are no current models for estimating potential losses from a landslide directly impacting the campus.

Although the economic impact of landslide damage can exceed that of the direct repair costs, there are currently no applicable methods for estimating indirect costs related to CSU Channel Islands.

**Vulnerability Assessment Conclusions**

Community exposure to landslides varies depending on their physical locations – whether in flat plains or on steep hillsides – and on their dependence on critical infrastructure located in landslide hazard zones.

Landslides could impact the campus in a variety of ways, primarily related to indirect impacts to transportation and utilities. Utility outages can impact health, particularly for vulnerable populations, and can cause interruptions in operations. Interruptions may impact student and employee’s ability to travel to campus and the delivery of classes and events.

**Identified Data Limitations**

The ability to predict future landslides at the CSU Channel Islands campus is limited. However, the USGS estimates that climate change-induced shifts in weather will increase the frequency of post-wildfire landslides, which are expected to occur almost every year in California.
Power Outage

Description of the Hazard

California State University, Channel Islands is located in Ventura County, California. The University campus is in an area of Ventura County known as Channel Islands, made up of an eight-island archipelago located within the Southern California Bight in the Pacific Ocean, off the coast of California. Ventura County has eight facilities dedicated to electrical power with an estimated value of replacement at $31,967,213.

Most aspects of modern life rely on the near continuous availability of utilities, such as electricity, water, and natural gas. An interruption in the supply or distribution of power can affect the campus in various ways like forcing campus closures to limiting campus operations. These interruptions can produce cascading effects from other hazards, such as major windstorms, winter storms and wildfire, which can prompt an intentional disruption or Public Safety Power Shut Off (PSPS).

A power outage event can interrupt day-to-day operations of the campus, like in-person classes, impede, or limit digital, telephonic or radio communications, create traffic jams around the busy avenues and boulevards surrounding the campus, close the student health center and close restaurants around campus and outside the campus. Additionally, thousands of CSU Channel Islands student residents in on-campus housing would also be affected by a power outage on campus.

Additionally, a severe outage to Ventura County or neighboring communities and cities would also directly affect the campus and the community.

An electric power disruptions and outages fall into two categories: intentional and unintentional.

The four types of intentional disruptions:

- Planned: Some disruptions are intentional and can be scheduled based on maintenance or upgrading needs.
- Unscheduled: Some intentional disruptions must be done "on the spot" in response to an emergency.
- Demand-Side Management: Some customers (i.e., on the demand side) have entered into an agreement with their utility provider to curtail their demand for electricity during periods of peak system loads.
- Load Shedding: When the power system is under extreme stress due to heavy demand and/or failure of critical components, it is sometimes necessary to intentionally interrupt the service to selected customers to prevent the entire system from collapsing. These intentional interruptions result in rolling blackouts.

Unintentional or unplanned disruptions are outages that come with essentially no advance notice or warning. This type of disruption is the most problematic. The following are categories of unplanned disruptions:

- Accident by the utility, utility contractor, or others.
- Malfunction or equipment failure.
- Equipment overload (utility company or customer).
- Reduced capability (equipment that cannot operate within its design criteria).
- Tree contact other than from storms.
- Vandalism or intentional damage.
- Weather, including lightning, wind, earthquake, flood, and broken tree limbs taking down power lines.
- Wildfire that damages transmission lines.

Location of the Hazard

Although power outages can take place within a certain area, it has the potential to affect the entire planning area equally.

Extent of the Hazard

In order to anticipate outage conditions and reduce impacts, campus facility managers and others keep track of conditions and data provided by the media, municipal utilities and the California Independent System Operator (CAISO), which is tasked with managing the power distribution grid that supplies most of California, except in areas served by municipal utilities. CAISO is thus the entity that coordinates statewide flow of electrical supply. CAISO uses a series of “stage alerts” to the media based on system conditions. The alerts are as follows:

- Stage 1 - reserve margin falls below 7 percent.
- Stage 2 - reserve margin falls below 5 percent.
- Stage 3 - reserve margin falls below 1.5 percent.

Rotating blackouts become a possibility when Stage 3 is reached. Utility agencies aim to advise affected areas approximately 48 hours in advance of a potential PSPS event and will attempt notification again approximately 24 hours before power is shut off. Campus staff respond accordingly.

Given the prevalence of rolling blackouts and other power outages in California, the campus maintains safety precautions, situational awareness, access to emergency power generators and other protocols for managing campus power outages. That said, only one recorded outage has taken place on campus. As such, the planning committee ranks the extent of the power outage hazard as **Minimal**.

History of the Hazard

CSU Channel Islands has experienced power outages for various reasons. The university works with Southern California Edison, the community’s local electric utility company, to restore energy to the campus for its facilities, assets, resident halls, and classrooms. CSU Channel Islands has not endured many power outages but has encountered a minor disruption due to a loss of power in 2011.
On November 2, 2011, Lieutenant Morris from the Campus Police was informed of a planned power outage by Southern California Edison. A downed pole prompted a power outage at approximately 4pm for twelve hours. The loss of power forced University housing, and campus police to rely on power generators. The campus transitioned to a response strategy by utilizing the various generators it holds and engaging a small team from Unit 6 of electricians and plumbers.

Safety precautions were upheld ensuring campus staff were safely situated within the campus. For some departments, power outages continuing into the morning hours would allow them to not report to work. Additionally, for situational awareness, signage was placed at campus entrances stating that the campus was experiencing a power outage and that the campus was to remain closed until power returned. Campus Police would increase campus security by increasing patrol within empty buildings during the night.

By the following early morning on November 3, the generators were no longer necessary after the power was restored to all campus areas. In approximately ninety minutes the power would be fully restored to the entire campus. A mass message would be disseminated to the campus community that the campus power was fully restored and the University would return to regular campus operations.

Potential Impacts of the Hazard

Instructors, campus residents, staff and administration rely on electricity to maintain ongoing operations. During a widespread power failure, it may take days to restore operations. Electrical power may be the only cooling source for many individuals around the campus and its community, enabling students with disabilities to enter, navigate and leave University buildings and long-term outages can potentially put students, faculty and staff safety at risk. Additionally, many medical devices, communications devices, and security rely on power to maintain their functions and losing power can potentially lead to tragic results.

Climate Change and Energy Shortage

Climate change is expected to bring more frequent and intense natural disasters. These changes have created a variability at a rate that makes historical data a poor predictor of future climate. For example, the warmest years on record in California occurred in 2014, 2015, and 2016. The 2016-2017 year broke the record as the wettest ever recorded in the northern Sierra Nevada Mountains.

Changes in temperatures, precipitation patterns, extreme events, and sea-level rise have the potential to decrease the efficiency of thermal power plants and substations, decrease the capacity of transmission lines, render hydropower less reliable, spur an increase in electricity demand, and put energy infrastructure at risk of flooding.

With climate warming, higher costs from increased demand for cooling in the summer are expected to outweigh the decreases in heating costs in the cooler seasons. Hotter temperatures in California will mean more energy (typically measured in “cooling-degree days”) needed to cool homes and businesses both during heat waves and on a daily
basis, during the daytime peak of the diurnal temperature cycle. During future heat waves, historically cooler coastal cities (e.g., San Francisco and Los Angeles) are projected to experience greater relative increases in temperature, such that areas that never before relied on air conditioning will experience new cooling demands.

Secondary impacts of energy shortages are most often felt by vulnerable populations. For example, those who rely on electric power for life-saving medical equipment, such as respirators, are extremely vulnerable to power outages. Also, during periods of extreme heat emergencies, the elderly and the very young are more vulnerable to the loss of cooling systems requiring power sources.

**Probability of Future Occurrence of the Hazard**

The probability of California experiencing a power outage can be difficult to quantify but is a hazard that occurs annually during the same seasonal periods of temperature variance throughout the calendar year. Camarillo and Ventura County experience such outages. As such, the probability ranking for the Camarillo area is **Likely**; although the campus has recorded fewer events than the surrounding area, it is prudent to assign this same ranking for the campus.

Climate models suggest summer global temperatures are likely to increase while changes between temperature extremes would be more pronounced. As such, it is expected that power outages will occur more frequently in the future.

**Vulnerability to the Hazard**

Based on the data available, and in consideration of the increasing effects of climate change, the campus remains vulnerable to power outages in terms of impacts to people, power infrastructure and campus operations. Nonetheless, as discussed campus leadership works to reduce vulnerabilities through consistent use of safety and operational protocols and emergency power sources to ensure it is able to mitigate and cope with an interruption to electrical power.

**Estimate of Potential Losses**

Although the economic impact of power outage damage can exceed that of the direct repair costs, there are currently no applicable methods for estimating indirect costs related to CSU Channel Islands.

**Vulnerability Assessment Conclusions**

The primary concern for campus leadership is that a loss of power can lead to potential hazards to students, faculty, and staff at Channel Islands. Safety and operations protocols center on the following “direct impact” set of concerns:

Elevators, entry ways, air filtration systems and lighting provide the campus community with the necessary functions to navigate through the campus with ease, maintain a safe campus environment and visibility during nighttime hours. The vulnerable population, like students with physical disabilities may be the most heavily affected by loss of power as they rely on elevators, entry ways with automatic doors and locks and lights may
impede on a student with a disability’s ability to travel and utilize the campus and its structures safely.

The use of communication devices, billing, records, and electrical tools may also become unusable due to a loss of electricity. Many records and billing items may have to revert to “by-hand” procedures and paper copies may be needed for continuity of operations. Additionally, classrooms may not be usable if lighting equipment is not functioning impacting a semester or quarter’s progress for the academic year.

Identified Data Limitations

Cal State Channel Islands did not report any monetary or life losses due to a power outage. Also, the campus did not report any incidents involving a power outage directly affecting the campus community and operations.

*Tsunami*

Description of the Hazard

A tsunami is a wave triggered by any form of land displacement along the edge or bottom of an ocean or lake. Land displacement can be in the form of submarine landslides or submarine dip-slip faults. These types of faults cause ruptures that result in seafloor uplift or down-drop. This mass movement translates to a tsunami or gravity wave within the overlying water at the surface.

Tsunamis travel radially outward from the area of initiation. The size of a tsunami is proportional to the mass that moved to generate the tsunami. As a tsunami approaches the shore and the depth of the water column decreases, the energy in the wave pushes the wave crest above the water surface resulting in a larger wave height. Wave runup is the elevation above mean sea level on dry land that a tsunami reaches. Run-up is what causes inundation of coastal areas that are below the run-up height.

There are two types of source regions for tsunamis—resulting in local and distant source tsunamis as viewed from the affected shoreline. Local tsunamis are typically more threatening because they afford at-risk populations only a few minutes to find safety. California is vulnerable to, and must consider, both types. Identifying tsunami hazards requires 1) evaluating the potential for submarine mass movement both locally and at great ocean distances, and 2) identifying coastal regions within the direct or indirect path of a potential tsunami wave that are below the run-up height.

Tsunamis can travel at speeds of over 600 miles per hour in the open ocean and can grow to over 50 feet in height when they approach a shallow shoreline, potentially causing severe damage to coastal development. At the shoreline, tsunamis may take the form of a fast-rising tide, a cresting wave, or a bore (a large, turbulent wall-like wave). The bore phenomenon resembles a step-like change in the water level that advances rapidly (from 10 to 60 miles per hour). The first wave is usually followed by several larger and more destructive waves.
Location of the Hazard

According to the 2018 CA State Hazard Mitigation Plan, tsunami locations span 94 incorporated communities and 83 unincorporated areas across 20 coastal counties.

As identified on the maps (below), Ventura County is at risk to the tsunami hazard, although the CSU – Channel Islands campus is located away from the tsunami inundation zone. However, due to its safe location, the campus participates in the county’s emergency operations plan by providing a secure “high ground” location for evacuees from the tsunami zone seeking refuge.

Figure 5-14: Tsunami Inundation Area at CSU-Channel Islands
Extent of the Hazard

The factors shaping the extent or severity of the hazard are a combination of geophysical forces (the amount of vertical and horizontal motion of the sea floor, the area over which it occurs, and the efficiency with which energy is transferred from the earth’s crust to the ocean water) and the geographic range of coastal development to be impacted.

More specifically, as a tsunami approaches the shore, wave run-up is the elevation above mean sea level on dry land that a tsunami reaches. A tsunami’s potential severity can be forecasted as a function of the wave’s mass along with the difference between the wave’s run-up height and the ground elevation of the affected coastal location.

There are two types of source regions for tsunamis—resulting in local and distant source tsunamis as viewed from the affected shoreline. Local tsunamis are typically more threatening because they afford at-risk populations only a few minutes to find safety. California is vulnerable to, and must consider, both types. Identifying tsunami hazards requires 1) evaluating the potential for submarine mass movement both locally and at great ocean distances, and 2) identifying coastal regions within the direct or indirect path of a potential tsunami wave that are below the run-up height.

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Given the history of tsunami occurrences in Ventura County, and the range of potential impacts to its coastal communities, although the campus lies outside the inundation zone, the planning committee ranks the extent of tsunami as **Moderate**.

**History of the Hazard**

The California Seismic Safety Commission report, the Tsunami Threat to California Findings and Recommendations on Tsunami Hazards Risks, published in December 2005, indicates that over 80 tsunamis have been observed or recorded along the coast of California in the past 150 years. That said, no tsunamis have impacted CSU campus locations.

According to the National Centers for Environmental Information (NCEI), have been eight tsunamis have caused damage to ports and harbors or coastal inundation in California since 1946. **The most significant events are as follows:**

- In 1964, a tsunami caused by a Magnitude 9.2 earthquake offshore from Alaska resulted in 13 deaths in California and destroyed portions of downtown Crescent City.
- A 2006 tsunami (originating in the Kuril Islands region north of Japan) caused approximately $20 million in damage to Crescent City harbor.
- A 2010 tsunami (originating offshore from Chile) caused millions of dollars in damage to ports and harbors in the state.
- A tsunami in 2011 (caused by a Magnitude 9.0 earthquake offshore of Japan) killed one person at the mouth of the Klamath River and caused up to $100 million of damage to 27 ports, harbors, and marinas throughout the State. The most damage occurred in Crescent City, Santa Cruz and Moss Landing harbors and a federal disaster was declared in Del Norte, Santa Cruz, and Monterey Counties. Both Crescent City and Santa Cruz harbors sustained damage to all docks, and oil spills and water/sediment contamination that resulted from sunk or damaged boats. Because recovery efforts in these two harbors took several years to complete, both harbors incurred business/economic losses that have been difficult to recapture.

Although the campus is not in the tsunami zone, eight (8) tsunamis have occurred in Ventura County between 1812 and the present:

**Historical Tsunami Run-Ups in Ventura County**

- 12/21/1812: Earthquake and Landslide City of Ventura 6.5-foot run-up
- 04/01/1946: Earthquake – Aleutian Islands; Alaska Port Hueneme 3-foot /Ormond Beach 5-foot run-up
- 11/4/1952: Earthquake – Kamchatka Peninsula; Port Hueneme 2-foot run-up
- 3/09/1957: Earthquake – Aleutian Islands; Alaska Port Hueneme 2-foot run-up
- 3/28/1964: Earthquake and Landslide – Alaska; City of Ventura Tide dropped 8.0 feet Oxnard Large swells
- 9/29/2009: Earthquake – Samoa; Ventura Buoys moved near mouth of harbor
- 2/27/2010: Earthquake – Chile; Ventura, Oxnard, Port Hueneme 3-foot run-up
03/11/2011: Earthquake – Japan; Ventura, Oxnard 4-foot run-up Port Hueneme 5-foot run-up

Potential Impacts of the Hazard

Tsunamis can travel at speeds of over 600 miles per hour in the open ocean and can grow to over 50 feet in height when they approach a shallow shoreline, potentially causing total devastation to coastal development.

The configuration of the coastline, the shape of the ocean floor, and the characteristics of advancing waves play important roles in the destructiveness of the waves. Bays, sounds, inlets, rivers, streams, offshore canyons, islands, and flood control channels may cause various effects that alter the level of damage. Offshore canyons can focus tsunami wave energy, and islands can filter the energy. It has been estimated that a tsunami wave entering a flood control channel could reach a mile or more inland, especially if it enters at high tide. The orientation of the coastline determines whether the waves strike head-on or are refracted from other parts of the coastline.

CSU - Channel Islands is not at risk to physical impacts from tsunamis. In carrying out its role as an evacuation center, the key potential impact is a depletion or exceedance of campus resources for managing a refugee population during emergency response.

Potential impacts to buildings and infrastructure within the county’s inundation zone include destruction of the natural environment, destruction of boats, as well as other coastal development, and loss of life. Tsunamis that impact both harbors and communities also can produce free-floating debris hazards and environmental contamination from chemical spills. All these factors shape the potential impact to campus EOP-related capabilities.

Probability of Future Occurrence of the Hazard

The California Seismic Safety Commission report, the Tsunami Threat to California Findings and Recommendations on Tsunami Hazards Risks, published in December 2005, indicates that over 80 tsunamis have been observed or recorded along the coast of California in the past 150 years.70 If we consider historical occurrence as one data set for estimating future events, the average rate of occurrence over the past 150 years is 1 tsunami every 7.9 years. Currently, no analysis is available which differentiates this statewide probability specifically for Ventura County, CA. Although 8 events have been recorded for the county over 209 years (1812-2021), it is prudent to utilize the 1.9-year statewide recurrence internal for planning purposes given extreme difficulties predicting tsunami points of origin.

The rate of future occurrence may change and may be able to make target estimates for specific locations in the future; the California State Tsunami Program is trying to refine the accuracy of the data. In doing so, the State Tsunami Program is completing a set of

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Probabilistic Tsunami Hazard Analysis (PTHA) maps representing risk levels from 100-year to 3000-year average return periods. Analysis using these probabilistically based products will allow for a more common platform for comparison to other seismic and flood probabilistic analyses.

Vulnerability to the Hazard

With regard to CSU campus locations, direct vulnerability of assets and people to tsunami only applies to the CSU Chancellor’s Office in Long Beach, CA, as it is the only campus clearly located in a mapped tsunami zone.

With regard to CSU - Channel Islands’ vulnerabilities, the campus planning committee indicates that due to its role as an evacuee housing and protection facility during tsunami emergency response operations, primary vulnerability is a depletion or exceedance of campus resources in providing response services.

Vulnerability of Populations

For CSU – Channel Islands, population vulnerability is largely reduced through successful evacuation but would pertain to the planning area in its role protecting evacuees.

The populations most vulnerable to the tsunami hazard in Ventura County are the elderly, disabled and very young who reside near beaches, low-lying coastal areas, tidal flats and river deltas that empty into ocean going waters. In the event of a local tsunami generated near the Ventura coast, little warning time would exist, so more of the population would be vulnerable. According to the 2015 Ventura County Multi-Jurisdictional Hazard Mitigation Plan, the areas along the coast of the cities of Ventura, Oxnard, and Port Hueneme and select areas of Unincorporated Ventura County are of most concern.71 The County has established two tsunami evacuation zones, one for a Phase 3 event and one for a Maximum Evacuation Phase. The following percentages of the population live in the evacuation zone for a Maximum Evacuation Phase: Oxnard, 4%, Port Hueneme, 7%, Ventura, 5%, and Unincorporated Ventura County, 4%.

Property Vulnerability

For Ventura County, the impact of tsunami waves and the scouring associated with debris that may be carried in the water could be damaging to all structures along beaches, low-lying coastal areas, tidal flats and river deltas. The most vulnerable structures are those in the front line of tsunami impact and those that are structurally unsound. However, according to the tsunami zone asset mapping for the campus, no assets are located within the inundation zone. The County’s Hazard Mitigation Plan provides a summary of the impacts of a tsunami on the entire County, including the level of impact on landmass, population, residential structures, and critical facilities (Table 5-25).

Table 5-25: Ventura County Tsunami Inundation Exposure Analysis (during Maximum Phase)\textsuperscript{72}

<table>
<thead>
<tr>
<th>Category</th>
<th>Number</th>
<th>% Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Land (square miles)</td>
<td>13.84</td>
<td>0.76%</td>
</tr>
<tr>
<td>Population</td>
<td>17,266</td>
<td>2.10%</td>
</tr>
<tr>
<td>Residential Buildings</td>
<td>8,225</td>
<td>3.54%</td>
</tr>
<tr>
<td>Critical Facilities &amp; Infrastructure</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Commercial fuel distribution facilities</td>
<td>0</td>
<td>0.00%</td>
</tr>
<tr>
<td>Community facilities, including libraries, community centers, and parks</td>
<td>25</td>
<td>7.53%</td>
</tr>
<tr>
<td>Educational facilities, including school buildings and district offices</td>
<td>2</td>
<td>0.56%</td>
</tr>
<tr>
<td>Emergency response facilities, including fire and police stations</td>
<td>1</td>
<td>1.12%</td>
</tr>
<tr>
<td>Government facilities</td>
<td>0</td>
<td>0.00%</td>
</tr>
<tr>
<td>Medical and residential care facilities</td>
<td>0</td>
<td>0.00%</td>
</tr>
<tr>
<td>Public utilities, including pump stations, electric substations, potable water facilities, wastewater facilities, wells, dams, reservoirs, debris basins hydrostations, meter stations, and stream and river gages</td>
<td>27</td>
<td>5.24%</td>
</tr>
<tr>
<td>Transportation infrastructure, including bridges maintained by the County of Ventura, airports, and transit stations</td>
<td>11</td>
<td>6.96%</td>
</tr>
</tbody>
</table>

**TOTAL** | 66 | 4.17% |

**Critical Facilities and Infrastructure Vulnerabilities**

No campus critical facilities or infrastructure are vulnerable to physical impacts from a tsunami wave. However, campus EOC-related facilities or infrastructure could be exceeded by the demands associated with housing and protecting tsunami evacuees. That said, the following infrastructure is vulnerable to damage in Ventura County, CA:

- Water Proximate Infrastructure—Breakwaters and piers collapse, sometimes because of scouring actions that sweep away their foundation material and sometimes because of the sheer impact of the tsunami waves.

- Flood Control Systems—Floodwaters can back up drainage systems, causing localized flooding. Culverts can be blocked by debris from tsunami events, also causing localized urban flooding.

- Utility Systems—Floodwaters can get into drinking water supplies, causing contamination. Sewer systems can be backed up, causing waste to spill into homes, neighborhoods, rivers and streams. Tsunami waves can knock down power lines and radio/cellular communication towers. Power generation facilities can be severely impacted by wave action and by inundation from floodwater.

- Fuels—Destruction of fueling infrastructure and related environmental and potable water contamination can occur.

**Estimate of Potential Losses**

Given that the campus is located outside of the inundation zone, an estimate of potential losses from a tsunami wave impact is not applicable at this time.

For Ventura County, estimated dollar losses to vulnerable buildings and infrastructure lying within the inundation zone is not currently available, but will be pursued in the future. A Maximum Level event (8.5 – 11.0 above tide level) would likely produce catastrophic impacts to all property within the inundation zone.

**Vulnerability Assessment Conclusions**

Community exposure to tsunamis in California varies considerably—some communities may experience great losses that reflect only a small part of their community and others may experience relatively small losses that devastate them. Among the 94 incorporated communities and 83 unincorporated areas of the 20 coastal counties, the communities that are most vulnerable to injury and life safety issues exist within Del Norte and Humboldt counties while the cities of Alameda, Belvedere, Crescent City, Emeryville, Oakland, and Long Beach have the highest combinations of the number and percentage of people and businesses in tsunami-prone areas.73

To improve tsunami vulnerability assessments, FEMA has developed a new tsunami loss estimation module for HAZUS using existing numerical model results for tsunami inundation, flow depth, velocity, and force. This HAZUS module allows new capability for estimation of economic losses, and site-specific analysis of content losses, casualties, infrastructure damage, and evacuation time. The module calibrates losses based on safe zones and community preparedness levels. Such technological improvements in assessment capability can be utilized for tsunami hazard analysis and planning purposes for CSU - Channel Islands.

Along with new probability-based tsunami maps, the HAZUS module will improve the ability to compare tsunami impacts to those of other hazards. Moreover, the probability mapping will be used for numerous applications including identifying potential tsunami hazard “zones of required investigation” under the Seismic Hazards Mapping Act and will

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assist state and local agencies in making land use planning decisions and will help regional and state planners understand the flood potential from tsunamis representing different risk levels. The improved analysis and data will be utilized by CSU - Channel Islands through its partnerships with key stakeholder organizations.

**Identified Data Limitations**

As identified in the Vulnerability Summary (above), with regard to the current planning effort, the primary data limitations for assessing the tsunami hazard for CSU campuses are comprehensive asset valuations lying within the tsunami inundation zone, and the need to apply FEMA’s new probability mapping techniques and tsunami loss estimation module to the footprint of each campus. That said, CSU leadership and planning teams intends to pursue such data in the future.
Volcano (Associated Air Quality)

Description of the Hazard

The US Geological Service defines volcanoes as “openings or vents where lava, tephra (small rocks), and steam erupt on to the Earth’s surface. Through a series of cracks within and beneath the volcano, the vent connects to one or more linked storage areas of molten or partially molten rock (magma). This connection to fresh magma allows the volcano to erupt over and over again in the same location.”

A volcanic eruption occurs when magma, lighter than surrounding rock, is driven upwards by its buoyancy and by pressure from the dissolved gases contained within it. Gases are released from magma as it reaches the surface and pressure decreases. Magma can be erupted in several ways and violent eruptions typically cause tiny pieces of tephra (ash) to be carried away by the wind. This ash is hard, does not dissolve in water, is extremely abrasive and mildly corrosive, and conducts electricity when wet.

The gases released in an eruption include carbon dioxide, sulfur dioxide, hydrogen sulfide, and hydrogen halides. Depending on their concentration, these are potentially hazardous to people, animals, agriculture, and property.

Location of the Hazard

There are eight volcanic areas located throughout California. Seven of these - Medicine Lake Volcano, Mount Shasta, Lassen Volcanic Center, Clear Lake Volcanic Field, Long Valley Volcanic Region, Coso Volcanic Field, and Salton Buttes – are considered active volcanoes. No portion of CSU Channel Islands or Ventura County is located within a volcano hazard zone.

Extent of the Hazard

Volcanic hazards are most severe within a few miles of the volcano vent and the severity generally decreases with distance. Ash impact zones can range from tens to hundreds of miles from the vent source. The US Geological Survey has estimated zones surrounding active volcanoes wherein two (2) inches or more of ashfall following an eruption is possible. While CSU Channel Islands does not fall within an estimated ashfall zone, lighter dustings of ash outside of those areas may directly or indirectly impact the campus. As such, the planning committee ranks the extent of the hazard for the campus as Low.

History of the Hazard

No historical eruption events in California have affected the campus. Over the last 1,000 years, there have been at least 12 eruptions in California. The most recent volcanic

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eruption in California occurred at Lassen Peak about 100 years ago, when a major explosion delivered windborne ash over 275 miles away.

Potential Impacts of the Hazard

The specific impacts vary widely and depend on which type of volcano erupts, the style of explosion, the volume of lava, the eruption duration, and the local water conditions. As CSU Channel Islands is not proximal to an active volcano, only the potential impacts of ashfall and gases have been detailed. While both these hazards can be widespread, their most severe impacts are generally seen closer to the volcanic source.

Although ashfall is typically a nonlethal volcanic hazard, it is the most widespread and disruptive. Falling ash can damage crops, electronics, and machinery. It can also impact human health by irritating the respiratory tract, eyes, and skin. The particles may enter drinking water and structures and may cause structure failure if it is thick and heavy enough. Even a fine layer of ash can disrupt utilities. A portion of California’s major electric transmission lines, aerial telecommunication lifelines, transportation corridors, and water storage and conveyance lie within the state’s volcano hazard zones. Impacts to any of these can impact operations at CSU Channel Islands.

The potential impacts of gases released during volcanic eruptions are as follows:

- Carbon dioxide typically becomes diluted very quickly and is not life threatening. However, it can become trapped in higher concentrations in low-lying areas and has the potential to be fatal.
- Sulfur dioxide can cause acid rain and air pollution downwind of a volcano.
- Hydrogen sulfide can cause irritation of the upper respiratory tract. At high concentrations it can cause unconsciousness and death.
- Hydrogen halides can coat ash particles and, once deposited, poison drinking water, agricultural crops, and grazing land.

Probability of Future Occurrence of the Hazard

The US Geological Survey, based on the record of volcanic activity in California, estimates that the probability of another small- to moderate-sized eruption in the next thirty years is about 16 percent. As such, the annual probability of future occurrence for the campus is ranked by the committee as Unlikely.

Vulnerability to the Hazard

Populations living near volcanoes are the most vulnerable to eruptions and lava flows. However, volcanic ash can travel and affect populations miles away. The location and thickness of ash in any given area is a function of the severity of the eruption and wind speed and direction. For CSU Channel Is, there is low vulnerability to the immediate impacts of volcanic eruptions due to the limited area affected and remote potential of an eruption. In the event of a widespread ashfall event, the elderly, infants, and populations with existing respiratory disease will be at higher risk.

Estimate of Potential Losses
Impacts to critical infrastructure, agriculture, and property from ashfall have the potential to cause widespread disruption, damage, and economic loss throughout the state. In the event of a widespread ashfall event, impacts will be immediate.

Current modeling is not precise enough to allow for an assessment of potential losses from ashfall to structures or infrastructure on or surrounding the campus.

**Vulnerability Assessment Conclusions**

CSU Channel Islands is unlikely to experience the direct impacts of a volcanic event. While the campus may be indirectly impacted by ashfall elsewhere in the state, direct ashfall impacts are generally unlikely but possible in a widespread event. However, the likelihood of any volcanic eruption in the state impacting the campus is very low.

**Identified Data Limitations**

Not all active volcanoes in California have been zoned for hazards by the US Geological Survey. This, together with the infrequent occurrence of volcanic explosions and number of factors determining type and extent of impacts, make the quantification of potential loss difficult.
While wildfires are a natural part of California’s ecosystem, wildfires in California represent a hazard that presents one of the greatest probabilities of destruction along with a demonstrated history of catastrophic fire events in recent years. The destructive fire seasons of 2017 to 2020 illustrated the destructive forces fire presents to communities across the state. Wildfires may result in the structural loss, infrastructure loss, dangerous air quality, environmental damages, economic impacts, injuries, and loss of life. In many communities throughout California, wildfire presents greatest risk to human life and property.

Wildfires have been defined as any free burning vegetation fire that initiates from an unplanned ignition, whether natural or human caused demanding fire suppression actions to contain. These fires are prone to become uncontrolled, spreading through vegetative fuels rapidly exposing people and structures to harm. Wildfires present a significant risk to communities across the state, as evidenced by increasing trends of structural losses from wildland fires. This risk is elevated in areas where development and community growth has intersected, also known as the wildland-urban interface (WUI). In the interface setting, development itself can provide additional fuel for large fires. Recent fires have also demonstrated the ability of fire to consume populated areas in extreme conditions.

California’s Mediterranean climate in combination with its geography and vast population create a combination of factors that promotes an optimal environment for large fire growth and consequences. As there is great diversity of geographic characteristics across the state, the risks and potential consequences of wildfire must be assessed locally. The physical location, weather patterns, local fuel types and volume, extent of the WUI, topography, and additional factors will factor differently from part of the state to another.

The behavior of wildfires in California is significantly influenced by three distinct geographic factors. These factors will help shape the size, direction of spread, rate of combustion, fire intensity, and ability to pre-heat fuels. The physical factors contributing to wildfire behavior include:

- **Topography** – The rate in which wildfires spread increases with greater slopes in topography. The greater the slope will result in more pre-heating of fuel above the advancing fire. The direction that a slope faces will also influence fire behavior as south facing slopes receive greater solar radiation and thus drier vegetation that is more susceptible to combustion. Ridgetops often denote the end of fire spread as fire has greater difficulty spreading downhill.

- **Weather** – Weather factors substantially in influencing the behavior of wildfires. Wind, temperature, humidity, lightning, and lack of precipitation all contribute to a fire’s ability or inability to spread and intensify. California routinely experiences conditions in which these factors are in alignment to contribute to extreme fire

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behavior during the summer and fall seasons. High winds, low humidity, and high temperatures provide an environment promoting extreme fire activity.

- Fuels – Certain types of vegetation are increasingly prone to igniting and promote more intense burning. Areas with greater “fuel loading” (amount of fuel present in terms of weight of fuel per unit of area) increases the amount of fuel to fuel a fire. Greater volumes of dead or dry vegetation compared to live plants is a critical factor. Vegetation during drought conditions will experience decrease in moisture content increasing the conditions for combustion. Fuels close proximity to one another allows for rapid spread through contact or radiant exposures.

A risk assessment for wildfires should be implemented within a geospatial context focusing on the specific location features and incorporates the three components of the wildfire risk triangle – likelihood, intensity, and susceptibility.

Location of the Hazard

Substantial portions of the State of California are exceptionally vulnerable to wildfire activity or reside in a wildland-urban interface (WUI) area due to the vast open spaces, rangelands, forests and other lands with high susceptibility to fire occurring throughout the state. CSU Channel Islands is located along the base of the western edge of the Santa Monica Mountains where they meet the agricultural fields of the Oxnard Plain. Areas considered to be within Fire Hazard Severity Zones defined by the Fire and Resource Assessment Program (FRAP) within the California Department of Forestry and Fire Protection (CalFire) occur to the east, west, and north of the campus. Additionally, these fire hazard zones exist in other areas throughout Ventura County. These areas surrounding the valley are topographically diverse, contain heavier vegetative fuels, and often have residential development interspersed. The land in the Oxnard Plain where the CSU Channel Islands campus is located, is largely agricultural with some development including the campus.

The CSU Channel Islands campus is located in the southern portion of Ventura County south of the City of Camarillo. The area immediately surrounding the campus is predominately agricultural to the west and open hillsides to the east with residential land uses included. Fire Hazard Severity Zones are found throughout the campus and throughout the hillsides surrounding the campus to include Very High Fire Hazard Severity Zones (VHFHSZ).
Ventura County has multiple areas considered as fire hazard zones that present direct threats of burning potential in areas that are in proximity to those hazard areas. Additionally, these large areas of land that are considered to be hazardous for the potential for fire will also produce the threat of diminished or hazardous air quality due to the smoke and particulates produced in the burning process. The air quality for residents of the County and the CSU Channel Islands campus community can be greatly affected by large fires burning in these areas.

Fire Hazards Zones surrounding southern Ventura County demonstrate the broader community threat that wildfires present to the population. Fire hazard severity zones are found surrounding the populated areas of the county. This presents the potential for fire related damages and smoke inundation to occur in many areas that members of the campus community reside at, are employed in, or where they recreate. Transportation routes are equally impacted causing potential added challenges for the campus community to get to areas if safety, get resources, or gain access to the campus.

Extent of the Hazard

While the threat to fire directly affecting the campus is considerable, the direct effect of fire generated smoke is also likely to occur. Fires are likely to occur in close proximity to the campus generating smoke that could envelop the campus in the right atmospheric conditions. Fires that are large enough to generate volumes of smoke to cover great distances have the potential to affect the air quality of the Ventura County area including the campus. This will especially be the case in weather conditions creating strong off-shore winds. This impact has been demonstrated during the summers of 2018, 2019, and 2020 as fires burned across the state and spread smoke over vast distances. Fires burning well outside of the Ventura County region have the potential to distribute smoke onto the CSU Channel Islands campus.

Given the occurrence of 7 Federal Declarations in Ventura County from 2003 - present, along with the fact that Fire Hazard Severity Zones are found throughout the campus and throughout the hillsides surrounding the campus to include Very High Fire Hazard Severity Zones (VHFHSZ), the planning committee ranks the extent of the wildfire hazard for the campus as **High** – the potential exists for wildfire to occur on three sides of the campus.
campus in the surrounding hillsides composed of light to moderate fuels, and the threat of these neighboring hillsides to campus structures is substantial.

The National Fire Danger Rating System (NFDRS) is the current system in use for rating and classifying the potential danger of fire. The NFDRS tracks the effects of previous weather events on both dead and live fuel loads and adjusts accordingly based on future or predicted weather conditions. These complex relationships and equations are computed, and the outputs are expressed in terms that users can quickly and easily understand. The current NFDRS is used by all federal and most state agencies to assess fire danger conditions.

The following table depicts the NFDRS, from the US Forest Service’s Wildland Fire Assessment System.

Table 5-26: National Fire Danger Rating System

<table>
<thead>
<tr>
<th>Rating</th>
<th>Basic Description</th>
<th>Detailed Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>CLASS 1: Low Danger (L)</td>
<td>Fires not easily started</td>
<td>Fuels do not ignite readily from small firebrands. Fires in open or cured grassland may burn freely a few hours after rain, but wood fires spread slowly by creeping or smoldering and burn in irregular fingers. There is little danger of spotting.</td>
</tr>
<tr>
<td>COLOR CODE: Green</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CLASS 2: Moderate Danger (M)</td>
<td>Fires start easily and spread at a moderate rate</td>
<td>Fires can start from most accidental causes. Fires in open cured grassland will burn briskly and spread rapidly on windy days. Woods fires spread slowly to moderately fast. The average fire is of moderate intensity, although heavy concentrations of fuel -- especially draped fuel -- may burn hot. Short-distance spotting may occur but is not persistent. Fires are not likely to become serious and control is relatively easy.</td>
</tr>
<tr>
<td>COLOR CODE: Blue</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CLASS 3: High Danger (H)</td>
<td>Fires start easily and spread at a rapid rate</td>
<td>All fine dead fuels ignite readily, and fires start easily from most causes. Unattended brush and campfires are likely to escape. Fires spread rapidly and short-distance spotting is common. High intensity burning may develop on slopes or in concentrations of fine fuel. Fires may become serious and their control difficult, unless they are hit hard and fast while small.</td>
</tr>
<tr>
<td>COLOR CODE: Yellow</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>CLASS 4: Very High Danger (VH)</th>
<th>Fires start very easily and spread at a very fast rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>COLOR CODE: Orange</td>
<td>Fires start easily from all causes and immediately after ignition, spread rapidly and increase quickly in intensity. Spot fires are a constant danger. Fires burning in light fuels may quickly develop high-intensity characteristics - such as long-distance spotting - and fire whirlwinds when they burn into heavier fuels. Direct attack at the head of such fires is rarely possible after they have been burning more than a few minutes.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>CLASS 5: Extreme (E)</th>
<th>Fire situation is explosive and can result in extensive property damage</th>
</tr>
</thead>
<tbody>
<tr>
<td>COLOR CODE: Red</td>
<td>Fires under extreme conditions start quickly, spread furiously, and burn intensely. All fires are potentially serious. Development into high intensity burning will usually be faster and occur from smaller fires than in the Very High Danger class (4). Direct attack is rarely possible and may be dangerous, except immediately after ignition. Fires that develop headway in heavy slash or in conifer stands may be unmanageable while the extreme burning condition lasts. Under these conditions, the only effective and safe control action is on the flanks, until the weather changes or the fuel supply lessens.</td>
</tr>
</tbody>
</table>

Due to the impacts of wildfires on public health, agencies across the nation have adopted the use of the Air Quality Index (AQI) to communicate and provide a consistent approach to air quality measurements and categorization. The AQI primarily focuses on the health effects caused by pollutants in the air such as smoke. The goal of the AQI is to provide advisories to assist the public in determining when to reduce exposures to inhalation of air pollution as pollution levels rise.
<table>
<thead>
<tr>
<th>Daily AQI Color</th>
<th>Levels of Concern</th>
<th>Values of Index</th>
<th>Description of Air Quality</th>
</tr>
</thead>
<tbody>
<tr>
<td>Green</td>
<td>Good</td>
<td>0 to 50</td>
<td>Air quality is satisfactory, and air pollution poses little or no risk.</td>
</tr>
<tr>
<td>Yellow</td>
<td>Moderate</td>
<td>51 to 100</td>
<td>Air quality is acceptable. However, there may be a risk for some people, particularly those who are unusually sensitive to air pollution.</td>
</tr>
<tr>
<td>Orange</td>
<td>Unhealthy for Sensitive Groups</td>
<td>101 to 150</td>
<td>Members of sensitive groups may experience health effects. The general public is less likely to be affected.</td>
</tr>
<tr>
<td>Red</td>
<td>Unhealthy</td>
<td>151 to 200</td>
<td>Some members of the general public may experience health effects; members of sensitive groups may experience more serious health effects.</td>
</tr>
<tr>
<td>Purple</td>
<td>Very Unhealthy</td>
<td>201 to 300</td>
<td>Health alert: The risk of health effects is increased for everyone.</td>
</tr>
<tr>
<td>Maroon</td>
<td>Hazardous</td>
<td>301 and higher</td>
<td>Health warning of emergency conditions: everyone is more likely to be affected.</td>
</tr>
</tbody>
</table>

### History of the Hazard

The State of California has a long history of chronic and destructive wildfires throughout the state. On average, 8,300 wildfires have caused burnt 928,245 acres across the state over the 20-year period between 2000 and 2020. Ventura County also has a long history of wildfire activity primarily in the foothills and mountains of the Transverse Range and the Santa Monica Mountains. Wildfires occurring in Ventura County have resulted in hundreds of thousands of acres burned and hundreds of millions of dollars in damages. During the past 50 years, 23 wildfires have resulted in greater than 10,000 acres burned in the County.

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80 California Department of Forestry and Fire Protection. *Stats and Events*. Retrieved 05.03.2021 from: [https://www.fire.ca.gov/stats-events/](https://www.fire.ca.gov/stats-events/)
The area immediately surrounding the CSU Channel Islands campus is in proximity to fire hazard zones designated as Very High Fire Hazard Severity Zones (VHFHSZ). Additionally, the County is surrounded by areas that are considered to be of high fire threat that would produce vast quantities of smoke and particulates into the air. The Channel Islands campus has experienced multiple days of poor air quality due to fires burning in Ventura County and neighboring counties. The 2017, 2018, and 2020 fire seasons in particular illustrated the increase in wildfire generated smoke saturating the air of communities throughout the state including Ventura County. CSU Channel Islands personnel reported the ongoing development of policies and procedures to address the response to poor air quality days.

Table 5-28: Historic, Large-Scale Fires Near Channel Islands

<table>
<thead>
<tr>
<th>Date</th>
<th>Fire</th>
<th>Location</th>
<th>Declaration</th>
<th>Damages</th>
</tr>
</thead>
<tbody>
<tr>
<td>10/1967</td>
<td>Parker Ranch</td>
<td>25,000 acres</td>
<td></td>
<td>25,000 acres</td>
</tr>
<tr>
<td>9/1979</td>
<td>Creek Road</td>
<td>32,000 acres</td>
<td></td>
<td>32,000 acres</td>
</tr>
<tr>
<td>10/1985</td>
<td>Ferndale</td>
<td>Santa Paula</td>
<td></td>
<td>47,064 acres</td>
</tr>
<tr>
<td>10/1993</td>
<td>Steckel</td>
<td>Santa Paula</td>
<td></td>
<td>27,088 acres</td>
</tr>
<tr>
<td>10/1993</td>
<td>Green Meadow</td>
<td>Santa Monica Mountains</td>
<td></td>
<td>38,477 acres</td>
</tr>
<tr>
<td>8/1997</td>
<td>Hopper</td>
<td>Fillmore</td>
<td></td>
<td>24,793 acres</td>
</tr>
<tr>
<td>10/2003</td>
<td>Piru</td>
<td>Lake Piru</td>
<td>FM-2502-CA</td>
<td>63,991 acres</td>
</tr>
<tr>
<td>10/2003</td>
<td>Simi Valley</td>
<td>Simi Valley</td>
<td>FM-2504-CA</td>
<td>108,204 acres</td>
</tr>
<tr>
<td>9/2006</td>
<td>Day</td>
<td>Los Padres NF</td>
<td>FM-2677-CA</td>
<td>162,702 acres</td>
</tr>
<tr>
<td>10/2007</td>
<td>Ranch*</td>
<td>Multi-County</td>
<td>FM-2736-CA</td>
<td>58,401 acres</td>
</tr>
<tr>
<td>5/2013</td>
<td>Springs</td>
<td>Camarillo</td>
<td>FM-5024-CA</td>
<td>24,251 acres</td>
</tr>
<tr>
<td>12/2017</td>
<td>Thomas**</td>
<td>Multi-County</td>
<td>FM-5224-CA; EM-3396-CA</td>
<td>281,893 acres</td>
</tr>
<tr>
<td>11/2018</td>
<td>Woolsey*</td>
<td>Multi-County</td>
<td>FM-5280-CA; EM-3409-CA</td>
<td>96,949 acres</td>
</tr>
</tbody>
</table>

*Fire occurred in both Los Angeles County and Ventura County

**Fire occurred in both Santa Barbara County and Ventura County

Fire has contributed significantly to Ventura County’s hazard and disaster history. Some particular fires that have shaped the way fire plays into preparedness, planning, response, recovery, and mitigation efforts are described in the following.

The 2013 Springs Fire occurred in the hills immediately east of the CSU Channel Islands campus. The fire forced the evacuation of the campus along with several neighborhoods. The fire started on May 2, 2013 as heavy Santa Ana Winds and low humidity were present. The 40-50 mile per hour winds allowed for rapid rate of spread and difficult suppression conditions. The fire burned up to the CSU Channel Islands campus and areas of study of rare species of plants.

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The December 4, 2017 Thomas Fire in Santa Barbara and Ventura Counties burning in the hills and mountains of the Transverse Range burned a total of 281,893 acres in moderate to heavy fuels. A high wind event caused high voltage power lines to come into contact with one another creating an electrical arc. The arc dropped hot molten material to the ground into an area experiencing low humidity and low fuel moistures combined with the high winds. The fire demonstrated extreme fire behavior during red flag fire warning conditions. The powerline caused fire forced the evacuations of over 100,000 people, destroyed 1,063 structures, damaged hundreds more, and killed 2 people. The Thomas Fire would become the state’s largest wildfire in history until being surpassed in 2018. The fire was contained on January 12, 2018 and ultimately caused more than $2.2 billion in damages. The CSU Channel Islands campus was not directly threatened by the Thomas Fire.

The Woolsey Fire ignited on November 8, 2018 and burned in Los Angeles and Ventura Counties. Ultimate, the fire would consume 96,949 acres of land, 1,643 structures were destroyed, 364 additional structures were damaged, over 250,000 people were evacuated, and 3 people were killed. The fire would cost approximately $6 billion in damages and fire suppression costs.

The Day Fire was the largest fire of the 2006 wildfire season in California. The fire was ignited on September 4, 2006 as a result of arson. The majority of the fire occurred on the Los Padres National Forest but also burned nearby private lands. Eleven structures were destroyed, and 162,702 acres were burned.

Potential Impacts of the Hazard

The location of the CSU Channel Islands campus surrounded by areas designated as Very High Fire Hazard Severity Zones places a direct threat that flame, ember, and smoke exposure from wildfire to the campus. There is potential for fire to occur on three sides of the campus in the surrounding hillsides composed of light to moderate fuels. The threat of these neighboring hillsides to campus structures is substantial.

Potential impacts to the campus community resulting from wildfires include:

- Injuries or loss of life
- Campus property destruction of damage
- Residential property destruction or damage
- Commercial property destruction or damage
- Loss of property contents
- Infrastructure damage
- Damaged or destroyed lifelines/supply routes
- Damaged or destroyed utilities
- Damaged or destroyed critical facilities supporting campus emergency support needs
- Loss of community economic base
- Employment losses
- Loss to ground supporting vegetation on hillsides resulting in erosion or landslides in future precipitation events
- Agricultural (crops and livestock) damages or destruction
- Environmental damage
- Societal and community impacts
- Damage to organizations and facilities providing support services to vulnerable populations
- Greater evacuation challenges for those most vulnerable
- Psychological impacts of impacted populations
- Disruptions to education delivery to community

Potential impacts resulting from wildfire generated smoke include:
- Dangerous levels of air pollution
- Human Health Effects
  - Similar health impacts to pets
- Air conditioning systems overwhelmed
- Greater demands on air filtration systems
- Greater demands on healthcare systems
- Reduced outdoor work productivity
- Closures of academic sessions

Additionally, there remains a number of secondary impacts from wildfires that could affect the campus community. Utilities feeding areas of Ventura County including the campus may be damaged resulting in power outages. Fire-related damage in the watersheds will likely cause future landslides, degradation to plants supporting hillsides, and impact the hydroelectric power capabilities. Fires may present threats to areas of recreation, scenic value, and wildlife that are a part of the culture of the campus community. Finally, the campus may experience effects of evacuated individuals arriving on campus from other areas as a location of refuge.

**Probability of Future Occurrence of the Hazard**

Based on the wildfire threat potential in the area on and surrounding the CSU Channel Islands campus, including the immediate proximity to Fire Hazard Severity Zones listed as “Very High”, the density of residential and commercial development, and the historic occurrences of fires, the probability of annual wildfire related damage on campus is considered **Possible**.

Based on the wildfire threat potential in the area surrounding the campus and the Camarillo region, including the volume of areas in elevated Fire Hazard Severity Zones throughout the Ventura County valleys, and the historic occurrences of smoke, the probability of wildfire generated smoke impacts to air quality is considered **Possible**.

**Vulnerability to the Hazard**

The CSU Channel Islands campus is subject to direct impact from wildfire due to the campus location within a wildland-urban interface zone. The campus is identified to
reside within a designated local Very High Fire Hazard Severity Zone. The campus is surrounded on three sides by hillsides and open lands containing combustible vegetation. Additionally, vulnerabilities to the effects of wildfire would lie within the campus community who may reside or work in locations that are exposed to the Fire Hazard Severity Zones in other parts of the surrounding region. Wildfires occurring in other areas of the region may result in the displacement of large numbers of people. These effects may spill onto the campus in the form of evacuees or facility support to emergency resources.

Fire directly threatening the campus would likely take the form of vegetation fires along the hillsides and extending onto the campus or localized fires involving single structures or small areas. Smaller vegetation fires are possible surrounding the campus in the urban forest or fields surrounding the city. These incidents would likely have significant impact to the campus.

The primary basis of vulnerability is based on the population affected and the built environment exposed. In general, newer construction will be more fire resistant than older buildings as building and fire codes and construction technology have improved. Density of buildings and proximity of fuels to buildings or equipment at risk of combustion would additionally influence the fire’s ability to spread to structures.

Access to the east using Potrero Road servicing portions of Los Angeles County would likely be cutoff during fire incidents. Access for supplies, equipment, and emergency services in addition to evacuation away from the campus would likely be forced to use western routes towards Oxnard or north to Camarillo.

Additional concerns regarding vulnerabilities to wildfire are related to the smoke that fires in the area would produce. The past few summer seasons have clearly demonstrated the reality of large wildfires producing enough smoke to fill the Sacramento Valley even from substantial distances away. These recent fires have displayed how the effects of this smoke impact the general population and especially vulnerable populations. CSU Channel Islands students, faculty, and staff both on campus and off campus face these same vulnerabilities related to smoke filled air.

Smoke generated from large wildfires pose a threat in terms of diminished air quality that would be exposed to the population within the area of smoke distribution. Individuals with existing health problems such as respiratory or cardiac illnesses are increasingly vulnerable to wildfire generated smoke. Staff who work in roles requiring outdoor activity will be increasingly exposed during days where the air quality index is considered unhealthy or worse. Student athletes participating in outdoor sports and engaging in aerobic activities are increasingly vulnerable to the effects of wildfire.

The vulnerability to members of the campus community in which wildfire generated smoke on the CSU Channel Islands campus will vary depending on when the air quality was to reach unhealthy levels. The risk to the campus population will be lessened during periods when classes are not in session or during periods of breaks. Conversely, during the days and hours that classes are in session and staff are at their workplaces, the
human vulnerability increases. However, in region-wide events this vulnerability may be shared with the homes and workplaces of members of the campus community and their families.

Vulnerable populations will likely face disproportionate health safety issues from smoke filled air, experience increased stresses, may require the need to remain away from the campus enclosed at home, and may find difficulty in accessing equipment or supplies to aid in a specific need.

**Estimate of Potential Losses**

Estimates of potential losses will be influenced by a variety of factors. Costs would also be likely to include mitigation or repairs of HVAC systems, sealing of doors and windows, and other methods of keeping smoke from entering buildings. Secondary costs would include lost academic days during campus closures, lost staff on campus productivity, and health and medical interventions for affected members of the campus community.

Based on estimate replacement costs of facilities and structures on campus, the maximum total replacement costs due to wildfire are $179,257,992. However due to the lack of a complete inventory of building and facility costs, the total replacement estimate is likely much higher.

**Table 5-29: Wildfire Hazard Potential (WHP) Zone Estimated Losses**

<table>
<thead>
<tr>
<th>WHP Zone</th>
<th>No. of Buildings</th>
<th>Maximum Replacement Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Extreme</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Very High</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>High</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Moderate</td>
<td>2</td>
<td>Unknown</td>
</tr>
<tr>
<td>Low</td>
<td>6</td>
<td>$49,747,610</td>
</tr>
<tr>
<td>Very Low</td>
<td>2</td>
<td>$62,889,913</td>
</tr>
<tr>
<td>Non-Burnable</td>
<td>24</td>
<td>$49,456,929</td>
</tr>
<tr>
<td>No Building Value Data Provided*</td>
<td>28</td>
<td>Unknown</td>
</tr>
</tbody>
</table>

*Buildings with no value defined are also included in the respective Zones they are found in.

**Vulnerability Assessment Conclusions**

The occurrence of wildfires has been a frequent event in Ventura County, including wildfire incidents that have threatened or caused damages near the CSU Channel Islands campus. The location of the CSU Channel Islands campus surrounded by open hillsides with light to moderate vegetative fuels along the entire eastern edges presents a threat of fire to the campus community and campus assets. The foothills and mountains surrounding Ventura County host environments that are ideal for the development of wildfire activity. The consequences of fires in these areas would present primary and
secondary consequences to the CSU Channel Islands campus and expose vulnerabilities
on the campus and to the campus community.

The topography of the valley surrounded by mountains allows for smoke filled air to
linger in the valleys of Ventura County area with the potential for unhealthy air quality
depending on wind conditions. Fires in the watersheds of the Santa Monica Mountains
and the Transverse Ranges and tributaries may damage vegetation stabilizing hillsides
and result in increased sediments to be discharged into the river system and reservoirs
reducing their capacity and effectiveness. Communities located within or near the
Wildland Urban Interface may be subject to damaging fires. These same communities
may be home to members of the campus community. The potential for large-scale
wildfires in the region further generates the added potential for a number of cascading
effects such as disruptions to the local economy, utility failures, disruptions to providing
for the needs of the community, and development of public health hazards. The potential
for large-scale wildfires and resulting damage of homes and businesses has
exponentially powerful impacts on particular populations among the campus community
including those with access or functional needs, international students, the homeless, and
students residing in the residence halls.

Identified Data Limitations

Missing campus structural replacement costs and an inventory of building construction
types to include status of earthquake retrofitting. HAZUS generated analysis is focused
on the broader community level versus finetuning the analysis to the micro-level for
facilities such as a university campus.

Severe Weather (Wind, Tornado, Hail, and Lightning)

Description of the Hazard

Severe weather can be described as a variety of weather or climate events that are
beyond or near the ends of the range of observed weather patterns and behavior. These
events can include high or extreme winds, storms, lightning, hail, tornadoes, heat waves,
unusually cold temperatures, extreme rainfall, and flooding. According to the
Intergovernmental Panel on Climate Change (IPCC), to be classified as severe (or
extreme), the occurrence of each value of a climate or weather variable (e.g., wind, hail,
lighntning, tornado, etc.) must be “above (or below) a threshold value near the upper (or
lower) ends of the range of observed values of the variable.”

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82 2018 California State Hazard Mitigation Plan. Section 9.1.10. Retrieved on 07.16.2021 from
https://www.caloes.ca.gov/cal-oes-divisions/hazard-mitigation/hazard-mitigation-planning/state-hazard-
mitigation-plan

83 Seneviratne, S.I., N. Nicholls, D. Easterling, C.M. Goodess, S. Kanae, J. Kossin, Y. Luo, J. Marengo, K.
Mclnnes, M. Rahimi, M. Reichstein, A. Sorteberg, C. Vera, and X. Zhang, 2012: Changes in climate extremes
and their impacts on the natural physical environment. In: Managing the Risks of Extreme Events and
Disasters to Advance Climate Change Adaptation [Field, C.B., V. Barros, T.F. Stocker, D. Qin, D.J. Dokken, K.L.
Severe weather in California can be generated by local, regional, and/or global weather and climate influences. From the individual thunderstorm to the Santa Ana wind event to the strong El Niño, damaging weather elements that are produced by and accompany severe weather and climate phenomena (e.g., damaging winds, hail, lightning, and tornadoes) occur throughout California and the California State University (CSU) system.

**Global Scale Influences on Severe Weather in California: El Niño, La Niña, and ENSO**

The El Niño-Southern Oscillation (ENSO) is a recurring climate pattern involving changes in the temperature of waters in the central and eastern tropical Pacific Ocean. On periods ranging from about three (3) to seven (7) years, the surface waters across a large swath of the tropical Pacific Ocean warm or cool by anywhere from 1°C to 3°C, compared to normal. This oscillating warming and cooling pattern, referred to as the ENSO cycle, directly affects rainfall distribution in the tropics and can have a strong influence on weather across the United States and other parts of the world.

El Niño and La Niña are extreme phases of the ENSO cycle, with a third phase occurring between them called the Neutral phase. The El Niño phase is characterized by unusually warm ocean temperatures and weaker-than-normal east winds in the Equatorial Pacific, while the La Niña phase is characterized by unusually cold ocean temperatures and stronger-than-normal east winds in the Equatorial Pacific. Both extreme ENSO phases lead to significant differences from the average ocean temperatures, winds, surface pressure, and rainfall across parts of the tropical Pacific. The Neutral phase indicates that conditions are near their long-term average.

The extreme ENSO phases affect the frequency and intensity of weather events across the world, including in California. On average, areas across California experience exceptionally stormy winters with increased precipitation under El Niño conditions, but experience less stormy and drier winters under La Niña conditions. This variability in storminess and precipitation brought on by El Niño and La Niña events affects the both the frequency and intensity of severe weather conditions experienced by all CSU campuses, including CSU Channel Islands.

**Regional Climate Influences on Severe Weather across California**

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84 Retrieved on 07.18.2021 from [https://www.weather.gov/mhx/ensowhat](https://www.weather.gov/mhx/ensowhat)


86 Retrieved on 07.17.2021 from [https://www.climate.gov/news-features/understanding-climate/el-ni%C3%B1o-and-la-ni%C3%B1a-frequently-asked-questions](https://www.climate.gov/news-features/understanding-climate/el-ni%C3%B1o-and-la-ni%C3%B1a-frequently-asked-questions)

87 Retrieved on 07.16.2021 from [https://www.pmel.noaa.gov/elnino/what-is-el-nino](https://www.pmel.noaa.gov/elnino/what-is-el-nino)

Most of the weather in California is influenced by the wet-winter/dry-summer Mediterranean climate pattern. In the summer months, Pacific storm tracks are deflected north due to the position of the Pacific High (i.e., a large-scale atmospheric circulation over the Northeast Pacific Ocean), preventing Pacific storms from reaching California. As a result, most summer storms are generated due to the incursion of moist air from the Gulf of Mexico or the Gulf of California, and occur as scattered, locally heavy showers in the desert and mountain regions of the state. In the winter months, the Pacific High decreases in intensity and moves south, permitting powerful Pacific storms to move into and across the state; these storms can produce extreme winds, heavy rains (including “atmospheric river” events), and widespread coastal and inland flooding. (Please see the Flood Hazard profile in this document for information on Floods.) As a result, storm events accompanied by precipitation in California are far more frequent in the winter months than they are in the summer months.89

While the Mediterranean climate pattern influences the seasonal frequency, intensity, geographic spread, and type of some severe weather events CSU campuses experience (including CSU Channel Islands), other severe weather phenomena may occur in California at any time of the year. For example, near the coast and over the Central Valley, there appears to be no defined seasonality to thunderstorms, and these storms are usually light and infrequent. Thunderstorms are more intense and more frequent in the intermediate and higher elevations of the Sierra Nevada, and occur with greater frequency during the summer months.90

Types of Storms in California

The 2018 California State Hazard Mitigation Plan (SHMP) defines a storm as a violent atmospheric disturbance occurring over land and/or water that is distinguished by its strength, characteristics, and the scale of the resulting damage.91 The SHMP also lists the following types of storms that produce hazardous conditions and potential damage throughout the state of California.92 These storms affect (in varying degrees) all CSU campuses, including CSU Channel Islands.

- **Thunderstorm**: A rain-bearing cloud that also produces lightning. Thunderstorms can produce some of nature’s most destructive and deadly weather including tornadoes, hail, strong winds, lightning and flooding.93 Thunderstorms are caused by an atmospheric imbalance from warm unstable air rising rapidly into the atmosphere. Lightning, which occurs during all thunderstorms, can strike

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89 Retrieved on 07.17.2021 from [https://wrcc.dri.edu/Climate/narrative_ca.php](https://wrcc.dri.edu/Climate/narrative_ca.php)
90 Retrieved on 07.17.2021 from [https://wrcc.dri.edu/Climate/narrative_ca.php](https://wrcc.dri.edu/Climate/narrative_ca.php)
Thunderstorms can produce some of nature’s most destructive and deadly weather including tornadoes, hail, strong winds, lightning and flooding. Severe thunderstorms are more intense, violent, and dangerous thunderstorms. The National Oceanic and Atmospheric Administration (NOAA) defines a severe thunderstorm as any storm that produces one or more of the following elements: Damaging winds or speeds of 58 mph (50 knots) or greater, hail 1 inch in diameter or larger, and/or a tornado.

- **Hailstorm**: a type of storm that precipitates round chunks of ice. Hailstorms usually occur during regular thunderstorms.
- **Wind storm**: marked by high wind with little or no precipitation.
- **Winter storm**: A storm that can produce a combination of freezing rain, sleet, heavy snow, and/or strong winds.
- **Coastal storm**: large wind-driven waves and/or storm surge that strike the coastal zone.
- **Ice storm**: Ice storms are one of the most dangerous forms of winter storms. When surface temperatures are below freezing, but a thick layer of above-freezing air remains aloft, rain can fall into the freezing layer and freeze upon impact into a glaze of ice. In general, 8 millimeters (0.31 inch) of accumulation is all that is required, especially in combination with breezy conditions, to start downing power lines as well as tree limbs. Ice storms also make unheated road surfaces too slick to drive on. Ice storms can vary in time range from hours to days and can cripple small towns and large urban centers alike.
- **Snowstorm**: A heavy fall of snow accumulating at a rate of more than 5 centimeters (2 inches) per hour that lasts several hours. Snowstorms, especially
ones with a high liquid equivalent and breezy conditions, can down tree limbs, cut off power, and paralyze travel over a large region.103

Severe Weather Hazard Elements: Wind Hazards, Hail, and Lightning

This hazard profile concentrates on the following types of severe weather hazards: wind hazards (including tornadoes), hail, and lightning. These hazards are produced by a variety of weather phenomena, including thunderstorms, coastal storms, winter storms, and topographically-enhanced downslope winds. While storm and downslope wind hazards are responsible for severe weather events across the CSU system, only the wind, tornado, hail, and lightning elements generated by these hazards are covered in this profile. (Storm-related hazards such as flooding and extreme temperatures are covered in other sections of this document.)

Wind Hazards

Wind is the horizontal movement of air past any given point. Wind begins with differences in air pressures; pressure that is higher at one point than another sets up a force, pushing the high towards the low pressure.104 Wind gusts are defined as “rapid fluctuations in the wind speed with a variation of 10 knots or more between peaks and lulls.”105

Wind hazards in California take several forms: High Wind, Strong Winds, Thunderstorm Winds, Mountain-Valley (Downslope) Winds, and Tornadoes. These hazards are encountered across California, and have the potential to cause harm to or loss of life and/or property throughout California and the CSU system (including CSU Channel Islands).

High Winds, Strong Winds, and Thunderstorm Winds

The National Weather Service reports three (3) types of wind events that occur areas over land: High Winds, Strong Winds, and Thunderstorm Winds. Collectively, these reports are used to determine the frequency with which wind hazard events have affected areas across the U.S., including California.

High Winds

High winds are defined as sustained non-convective winds of 35 knots (40 mph) or greater lasting for 1 hour or longer, or gusts of 50 knots (58 mph) or greater for any duration (or otherwise locally/regionally defined). In some mountainous areas, the above numerical values are 43 knots (50 mph) and 65 knots (75 mph), respectively.106

Strong Winds

Strong winds are defined as non-convective winds gusting less than 50 knots (58 mph), or sustained winds less than 35 knots (40 mph), resulting in a fatality, injury, or damage.\textsuperscript{107}

Thunderstorm Winds

Thunderstorm winds are winds that arise from thunderstorm convection (occurring within 30 minutes of lightning being observed or detected), with speeds of at least 50 knots (58 mph). They can also be winds of any speed (non-severe thunderstorm winds below 50 knots (58 mph)) producing a fatality, injury, or damage.\textsuperscript{108}

Please note: \textit{Straight-line wind} is a term used to define any thunderstorm wind that is not associated with rotation. It is used mainly to differentiate from the rotational winds found in tornado-producing storms.\textsuperscript{109} However, it is not a term used in the NCEI Storm Events Database, and therefore cannot be used to determine severe weather history of or potential impacts to CSU campuses.

Tornadoes

A tornado is an extreme severe weather wind hazard. A tornado is a rapidly rotating column of air extending from a thunderstorm to the surface of the Earth.\textsuperscript{110} This column extends between cloud and the Earth’s surface. The damage from tornadoes comes from the strong winds they contain and the flying debris they create. It is generally believed that rotational wind speeds can be as high as 300 mph in the most violent tornadoes.\textsuperscript{111} On a local scale, tornadoes are the most violent and most destructive of all atmospheric phenomena.\textsuperscript{112}


\textbf{Santa Ana Winds}. A type of wind hazard that is peculiar to Southern California is called a \textit{Santa Ana Wind}. Santa Ana winds are strong, topographically-enhanced, extremely dry downslope winds that originate inland and affect coastal southern California and northern Baja California (Mexico).\textsuperscript{113} They occur when air from a region of high pressure over the dry, desert region of the southwestern U.S. flows westward towards low pressure located off the California coast. This creates dry winds that flow east to west through the mountain passages in Southern California. These winds have a strong seasonal component; they are most common during the cooler months of the year, occurring from

\textsuperscript{109} Retrieved on 07.15.2021 from https://www.nssl.noaa.gov/education/svrwx101/wind/types/  
\textsuperscript{110} Retrieved on 07.15.2021 from https://www.nssl.noaa.gov/education/svrwx101/tornadoes/faq/  
\textsuperscript{111} Retrieved on 07.15.2021 from https://www.weather.gov/bgm/severedefinitions  
September through May. Santa Ana winds typically feel warm (or even hot) because as the cool desert air moves down the side of the mountain, it is compressed, which causes the temperature of the air to rise. If strong enough, Santa Ana winds can cause major property damage, and may present difficulties for airborne and seagoing transportation. They also may increase wildfire risk because of the dryness of the winds and the speed at which they can spread a flame across the landscape.\textsuperscript{114} (Note: The Wildfire hazard is profiled elsewhere in this document.)

Figure below illustrates the mechanisms involved in the generation of Santa Ana winds across Southern California.

Table 5-30: What Drives a Santa Ana Wind?\textsuperscript{115}

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\textbf{What Drives a Santa Ana Wind?}

1. High surface pressure builds over the Great Basin region with lower pressure off Southern Cal Coast. (Fall-mid Spring)

2. Air remains relatively cold across the deserts. As the air extends through the mountain passes...it become compressed and warms. (See lower right map) Lower relative humidity also occurs helping to dry out vegetation and can fan any existing fires.

3. Wind speed increases as it squeezes through the mountain and valley canyons. Wind gusts can vary from 45 to 100 mph depending on the strength of the Santa Ana event.

4. Strong winds create turbulence for area flights and can make interstate travel difficult as well as choppy seas for mariners.

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\textbf{Diablo Winds}. The Diablo wind is another type of topographically-enhanced downslope wind phenomenon that occurs in the North-Central areas of California. Diablo winds are offshore wind events that flow northeasterly over Northern California’s Coast Ranges, often creating high wind speeds downwind of major canyons and over ridges, and

\textsuperscript{115} Retrieved on 07.14.2021 from https://twitter.com/nwslosangeles/status/933049473034579968
extreme fire danger for the San Francisco Bay Area. Diablo winds are driven by a surface pressure gradient that forms in response to an inverted pressure trough that develops over California.116

**Sundowner Winds.** Sundowner winds are significant and potentially damaging downslope wind and warming events that periodically occur along a short segment of the southern California coast in the vicinity of Santa Barbara, CA. The unique topography of this coastal region promotes the development of Sundowner wind events: over a length of about 100 km, the coastline is oriented approximately west–east, with the adjoining narrow coastal plain bounded by a steeply rising (to elevations greater than 1200 m) and coast-parallel mountain range. Called Sundowner winds because they often begin in the late afternoon or early evening, their onset is typically associated with a rapid rise in temperature and decrease in relative humidity, and the winds tend to blow from the north from the Santa Ynez Mountains to the coast of Santa Barbara County, California. During the more intense Sundowner wind events, wind speeds can be of gale force 39-54 miles per hour) or higher, and can even reach hurricane force (≥74 miles per hour) in the most extreme cases. Temperatures over the coastal plain, and even at the coast itself, can rise significantly above 37.8°C (100°F). Seasonally, Sundowner winds peak in March, April, and May, with a minimum during summer and a secondary peak in winter that often corresponds with Santa Ana winds. In addition to causing a dramatic change from the more typical marine-influenced local weather conditions, Sundowner wind episodes have produced significant wind-related property and agricultural damage, as well as conditions of extreme fire danger.117 118 119

**Hail**

Hail is a form of precipitation consisting of solid ice that forms inside thunderstorm updrafts.120 It is roughly round in shape and at least 0.2’ in diameter. Hail develops in the upper atmosphere as ice crystals that are bounced about by high velocity updraft winds; the ice crystals accumulate frozen droplets and fall after developing enough weight. The size of hailstones varies and is a direct consequence of the severity and size of the storm that produces them – the higher the temperatures at the Earth’s surface, the greater the strength of the updrafts and the amount of time hailstones are suspended, and therefore the greater the size of the hailstone.121

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**Lightning**

Lightning is an electrical discharge produced by a thunderstorm. Lightning rapidly heats the air in its immediate vicinity to about 50,000°F - about five times the temperature of the surface of the sun. This compresses the surrounding air and creates a supersonic shock wave, which decays to an acoustic wave that is heard as thunder.¹²²

The discharge may occur within or between clouds, between the cloud and air, between a cloud and the ground, or between the ground and a cloud.¹²³ Lightning that is produced from thunderstorms in which precipitation evaporates before reaching the ground is called “dry lightning.”

**Location of the Hazard**

Severe weather is a non-spatial hazard, and can occur anywhere in the CSU system, including either at the CSU Channel Islands main campus or at satellite campus facilities owned by the school. No one area of the campus – or of the surrounding community – is subject to experiencing severe weather more than any other area.

There is geographic variability among the different types of mountain and valley wind events (as a sub-category of the severe weather hazard). Santa Ana winds occur in Southern California, Diablo winds occur in North-Central California, and Sundowner winds occur almost exclusively in Santa Barbara County, California.

**Extent of the Hazard**

Severe weather hazards are non-spatial hazards that potentially affect all CSU Channel Islands campus areas equally. However, the smallest geographic unit of measurement for almost all official severe weather event data is at the county level. Because the severe weather data used do not exist at the campus level, it is assumed that the same (or similar) severe weather risks to CSU Channel Islands campuses reflect those of the surrounding community and County. As a result, all assets and people at CSU Channel Islands campuses are at risk from the effects of severe weather and can expect to experience at least some (or the complete range of) endemic severe weather hazards. In consideration of the campus’ design, layout, and operations, the severe weather history and degree of severity in the Camarillo (Ventura County) and Goleta (Santa Barbara County) areas, and the history and degree of severity of each severe weather sub-type identified by the extent scales (below), the campus planning committee ranks the overall extent of the Severe Weather hazard as **MODERATE**. See each sub-hazard below for the planning committee’s sub-type extent ranking.

**Wind Hazard: Non-Rotational**

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The Beaufort Scale is an empirical measure that relates wind speed to observed conditions at sea or on land. Its full name is the Beaufort wind force scale. First developed in 1805, it is still used today to estimate wind strengths.

Table 5-31: Beaufort Wind Force Scale

<table>
<thead>
<tr>
<th>Force</th>
<th>Speed (mph)</th>
<th>Speed (knots)</th>
<th>Description</th>
<th>Specifications for use at sea</th>
<th>Specifications for use on land</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0-1</td>
<td>0-1</td>
<td>Calm</td>
<td></td>
<td>Sea like a mirror.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Calm; smoke rises vertically.</td>
</tr>
<tr>
<td>1</td>
<td>1-3</td>
<td>1-3</td>
<td>Light Air</td>
<td>Ripples with the appearance of scales are formed, but without foam crests.</td>
<td>Direction of wind shown by smoke drift, but not by wind vanes.</td>
</tr>
<tr>
<td>2</td>
<td>4-7</td>
<td>4-6</td>
<td>Light Breeze</td>
<td>Small wavelets, still short, but more pronounced. Crests have a glassy appearance and do not break.</td>
<td>Wind felt on face; leaves rustle; ordinary vanes moved by wind.</td>
</tr>
<tr>
<td>3</td>
<td>8-12</td>
<td>7-10</td>
<td>Gentle Breeze</td>
<td>Large wavelets. Crests begin to break. Foam of glassy appearance. Perhaps scattered white horses.</td>
<td>Leaves and small twigs in constant motion; wind extends light flag.</td>
</tr>
<tr>
<td>4</td>
<td>13-18</td>
<td>11-16</td>
<td>Moderate Breeze</td>
<td>Small waves, becoming larger; fairly frequent white horses.</td>
<td>Raises dust and loose paper; small branches are moved.</td>
</tr>
<tr>
<td>5</td>
<td>19-24</td>
<td>17-21</td>
<td>Fresh Breeze</td>
<td>Moderate waves, taking a more pronounced long form; many white horses are formed.</td>
<td>Small trees in leaf begin to sway; crested wavelets form on inland waters.</td>
</tr>
<tr>
<td>6</td>
<td>25-31</td>
<td>22-27</td>
<td>Strong Breeze</td>
<td>Large waves begin to form; the white foam crests are more extensive everywhere.</td>
<td></td>
</tr>
</tbody>
</table>

124 Retrieved on 07.15.2021 from https://www.rmets.org/resource/beaufort-scale
125 Retrieved on 07.15.2021 from https://www.weather.gov/mfl/beaufort
<table>
<thead>
<tr>
<th></th>
<th>32-38</th>
<th>28-33</th>
<th>Large branches in motion; whistling heard in telegraph wires; umbrellas used with difficulty.</th>
</tr>
</thead>
<tbody>
<tr>
<td>7</td>
<td>32-38</td>
<td>28-33</td>
<td>Sea heaps up and white foam from breaking waves begins to be blown in streaks along the direction of the wind.</td>
</tr>
<tr>
<td></td>
<td>34-40</td>
<td>30-26</td>
<td>Whole trees in motion; inconvenience felt when walking against the wind.</td>
</tr>
<tr>
<td>8</td>
<td>39-46</td>
<td>34-40</td>
<td>Moderately high waves of greater length; edges of crests begin to break into spindrift. The foam is blown in well-marked streaks along the direction of the wind.</td>
</tr>
<tr>
<td></td>
<td>41-47</td>
<td>35-31</td>
<td>Breaks twigs off trees; generally impedes progress.</td>
</tr>
<tr>
<td>9</td>
<td>47-54</td>
<td>41-47</td>
<td>High waves. Dense streaks of foam along the direction of the wind. Crests of waves begin to topple, tumble and roll over. Spray may affect visibility</td>
</tr>
<tr>
<td></td>
<td>48-55</td>
<td>42-38</td>
<td>Slight structural damage occurs (chimney-pots and slates removed)</td>
</tr>
<tr>
<td>10</td>
<td>55-63</td>
<td>48-55</td>
<td>Very high waves with long overhanging crests. The resulting foam, in great patches, is blown in dense white streaks along the direction of the wind. On the whole the surface of the sea takes on a white appearance. The tumbling of the sea becomes heavy and shock-like. Visibility affected.</td>
</tr>
<tr>
<td></td>
<td>56-63</td>
<td>49-39</td>
<td>Seldom experienced inland; trees uprooted; considerable structural damage occurs.</td>
</tr>
<tr>
<td>11</td>
<td>64-72</td>
<td>56-63</td>
<td>Exceptionally high waves (small and medium-size ships might be for a time lost to view behind the waves). The sea is completely covered with long white patches of foam lying along the direction of the wind. Everywhere the edges of the wave crests are blown into froth. Visibility affected.</td>
</tr>
<tr>
<td></td>
<td>64+</td>
<td>57+</td>
<td>Very rarely experienced; accompanied by widespread damage.</td>
</tr>
<tr>
<td>12</td>
<td>73+</td>
<td>64+</td>
<td>The air is filled with foam and spray. Sea completely white with driving spray; visibility very seriously affected.</td>
</tr>
</tbody>
</table>
Based on those extent ranking factors identified (above), the planning committee ranks the extent of non-rotational wind hazards as **MODERATE**.

**Extent: Tornado**

Tornadoes have their own severity/extent scale. Until 2007, tornadoes were measured and described according to the Fujita Scale.\(^{127}\)

In February 2007, use of the Fujita Scale was discontinued. In its place, the Enhanced Fujita (EF) Scale is used. The Enhanced Fujita scale considers how most structures are designed and is thought to be a much more accurate representation of the surface wind speeds in the most violent tornadoes. Like the original Fujita scale, the Enhanced Fujita scale is a set of wind estimates (not measurements) based on damage.

It is important to note the **date** that a tornado occurred. Tornadoes that occurred prior to February, 2007 are classified using the original Fujita scale and will not be converted to the Enhanced Fujita Scale.

Table below illustrates the Fujita Scale in use prior to February 2007.

Table 5-32: **Fujita Tornado Scale (Pre-February 2007)** \(^{128}\)

<table>
<thead>
<tr>
<th>F-Scale Number</th>
<th>Intensity Phrase</th>
<th>Wind Speed</th>
<th>Type of Damage</th>
</tr>
</thead>
<tbody>
<tr>
<td>F0</td>
<td>Gale tornado</td>
<td>40-72 mph</td>
<td>Some damage to chimneys; breaks branches off trees; pushes over shallow-rooted trees; damages sign boards.</td>
</tr>
<tr>
<td>F1</td>
<td>Moderate tornado</td>
<td>73-112 mph</td>
<td>The lower limit is the beginning of hurricane wind speed; peels surface off roofs; mobile homes pushed off foundations or overturned; moving autos pushed off the roads; attached garages may be destroyed.</td>
</tr>
<tr>
<td>F2</td>
<td>Significant tornado</td>
<td>113-157 mph</td>
<td>Considerable damage. Roofs torn off frame houses; mobile homes demolished; boxcars pushed over; large trees snapped or uprooted; light object missiles generated.</td>
</tr>
</tbody>
</table>

\(^{127}\) Retrieved on 07.19.2021 from [https://www.weather.gov/tae/ef_scale](https://www.weather.gov/tae/ef_scale)

<table>
<thead>
<tr>
<th>F3</th>
<th>Severe tornado</th>
<th>158-206 mph</th>
<th>Roof and some walls torn off well-constructed houses; trains overturned; most trees in forest uprooted.</th>
</tr>
</thead>
<tbody>
<tr>
<td>F4</td>
<td>Devastating tornado</td>
<td>207-260 mph</td>
<td>Well-constructed houses leveled; structures with weak foundations blown off some distance; cars thrown and large missiles generated.</td>
</tr>
<tr>
<td>F5</td>
<td>Incredible tornado</td>
<td>261-318 mph</td>
<td>Strong frame houses lifted off foundations and carried considerable distances to disintegrate; automobile sized missiles fly through the air in excess of 100 meters; trees debarked; steel reinforced concrete structures badly damaged.</td>
</tr>
<tr>
<td>F6</td>
<td>Inconceivable tornado</td>
<td>319-379 mph</td>
<td>These winds are very unlikely. The small area of damage they might produce would probably not be recognizable along with the mess produced by F4 and F5 wind that would surround the F6 winds. Missiles, such as cars and refrigerators would do serious secondary damage that could not be directly identified as F6 damage. If this level is ever achieved, evidence for it might only be found in some manner of ground swirl pattern, for it may never be identifiable through engineering studies.</td>
</tr>
</tbody>
</table>

Table below illustrates the Enhanced Fujita (EF) Scale, currently in use. Tornadoes that have occurred since February, 2007 are classified using the Enhanced Fujita Scale.
Table 5-33: Enhanced Fujita Scale (February 2007 and Later) \(^\text{129}\)

<table>
<thead>
<tr>
<th>Enhanced Fujita Category</th>
<th>Wind Speed</th>
<th>Potential Damage</th>
</tr>
</thead>
<tbody>
<tr>
<td>EF0</td>
<td>65-85 mph</td>
<td>Light damage. Peels surface off some roofs; some damage to gutters or siding; branches broken off trees; shallow-rooted trees pushed over.</td>
</tr>
<tr>
<td>EF1</td>
<td>86-110 mph</td>
<td>Moderate damage. Roofs severely stripped; mobile homes overturned or badly damaged; loss of exterior doors; windows and other glass broken.</td>
</tr>
<tr>
<td>EF2</td>
<td>111-135 mph</td>
<td>Considerable damage. Roofs torn off well-constructed houses; foundations of frame homes shifted; mobile homes completely destroyed; large trees snapped or uprooted; light-object missiles generated; cars lifted off ground.</td>
</tr>
<tr>
<td>EF3</td>
<td>136-165 mph</td>
<td>Severe damage. Entire stories of well-constructed houses destroyed; severe damage to large buildings such as shopping malls; trains overturned; trees debarked; heavy cars lifted off the ground and thrown; structures with weak foundations blown away some distance.</td>
</tr>
<tr>
<td>EF4</td>
<td>166-200 mph</td>
<td>Devastating damage. Well-constructed houses and whole frame houses completely leveled; cars thrown and small missiles generated.</td>
</tr>
<tr>
<td>EF5</td>
<td>&gt;200 mph</td>
<td>Incredible damage. Strong frame houses leveled off foundations and swept away; automobile-sized missiles fly through the air in excess of 100 m (107 yd); high-rise buildings have significant structural deformation; incredible phenomena will occur.</td>
</tr>
</tbody>
</table>

Based on the extent ranking factors identified (above), the planning committee ranks the extent of tornados as **LOW**.

**Extent: Hail**

The National Oceanic and Atmospheric Administration and the Tornado and Storm Research Organization (TORRO) have combined efforts to create the Hailstorm Intensity Scale. Table below provides details of this scale.

Table 5-34: Combined NOAA/TORRO Hailstorm Intensity Scale

<table>
<thead>
<tr>
<th>Size Code</th>
<th>Intensity Category</th>
<th>Typical Hail Diameter</th>
<th>Approximate Size</th>
<th>Typical Damage Impacts</th>
</tr>
</thead>
<tbody>
<tr>
<td>H0</td>
<td>Hard Hail</td>
<td>Up to 0.33”</td>
<td>Pea</td>
<td>No damage</td>
</tr>
<tr>
<td>H1</td>
<td>Potentially Damaging</td>
<td>0.33” – 0.60”</td>
<td>Marble or Mothball</td>
<td>Slight damage to plants and crops</td>
</tr>
<tr>
<td>H2</td>
<td>Potentially Damaging</td>
<td>0.60” – 0.80”</td>
<td>Dime or grape</td>
<td>Significant damage to fruit, crops, and vegetation</td>
</tr>
<tr>
<td>H3</td>
<td>Severe</td>
<td>0.80” – 1.20”</td>
<td>Nickel to Quarter</td>
<td>Severe damage to fruit and crops, damage to glass and plastic structures, paint and wood scored</td>
</tr>
</tbody>
</table>

---

<table>
<thead>
<tr>
<th>Extent</th>
<th>Ranking</th>
<th>Size (in)</th>
<th>Example Damages</th>
</tr>
</thead>
<tbody>
<tr>
<td>H4</td>
<td>Severe</td>
<td>1.20” – 1.60”</td>
<td>Half Dollar to Ping Pong Ball</td>
</tr>
<tr>
<td>H5</td>
<td>Destructive</td>
<td>1.60” – 2.0”</td>
<td>Silver Dollar to Golf Ball</td>
</tr>
<tr>
<td>H6</td>
<td>Destructive</td>
<td>2.0” – 2.4”</td>
<td>Lime or Egg</td>
</tr>
<tr>
<td>H7</td>
<td>Very Destructive</td>
<td>2.4” – 3.0”</td>
<td>Tennis Ball</td>
</tr>
<tr>
<td>H8</td>
<td>Very Destructive</td>
<td>3.0” – 3.5”</td>
<td>Baseball to Orange</td>
</tr>
<tr>
<td>H9</td>
<td>Super Hailstorms</td>
<td>3.5” – 4.0”</td>
<td>Grapefruit</td>
</tr>
</tbody>
</table>

Based on those extent ranking factors identified (above), the planning committee ranks the extent of the hail hazard as **LOW**.
**Extent: Lightning**

The National Weather Service (NWS) uses a Lightning Activity Level (LAL) scale to indicate the frequency and character of cloud-to-ground (C/G) lightning. The scale uses a range of 1 – 6, with 6 being the high end of the scale. Table 5-XX provides details of the LAL scale.

Table 5-35: Lightning Activity Level (LAL) Scale\(^{131}\)

<table>
<thead>
<tr>
<th>Rank</th>
<th>Cloud and Storm Development</th>
<th>Areal Coverage</th>
<th>Counts C/G per 5 Minutes</th>
<th>Counts C/G per 15 Minutes</th>
<th>Average C/G per Minute</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>No Thunderstorms</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>2</td>
<td>Cumulus clouds are common but only a few reaches the towering stage. A single thunderstorm must be confirmed in the rating area. The clouds mostly produce virga, but light rain will occasionally reach ground. Lightning is very infrequent.</td>
<td>&lt;15%</td>
<td>1-5</td>
<td>1-8</td>
<td>&lt;1</td>
</tr>
<tr>
<td>3</td>
<td>Cumulus clouds are common. Swelling and towering cumulus cover less than 2/10 of the sky. Thunderstorms are few, but 2 to 3 occur within the observation area. Light to moderate rain will reach the ground, and lightning is infrequent.</td>
<td>15% to 24%</td>
<td>6-10</td>
<td>9-15</td>
<td>1-2</td>
</tr>
</tbody>
</table>

\(^{131}\) Retrieved on 07.19.2021 from [https://graphical.weather.gov/definitions/defineLAL.html](https://graphical.weather.gov/definitions/defineLAL.html)
Based on those extent ranking factors identified (above), the planning committee ranks the extent of the lightning hazard as **LOW**.

**Extent: Thunderstorms that Generate Wind, Tornado, Hail, and Lightning Hazard Events**

Thunderstorms are not explicitly identified as a severe weather category for this hazard profile. However, they are responsible for most tornado, lightning, and hail hazard events – as well as a significant number of wind hazard events – across California and the CSU system. While individual thunderstorms affect relatively small areas, there are many instances in which thunderstorms can cluster together and/or travel in a line over long distances, producing significant damage over large geographic areas.

A thunderstorm is classified as “severe” when certain meteorological parameters within the thunderstorm are reached (i.e., damaging winds or speeds of 58 mph (50 knots) or greater, hail 1 inch in diameter or larger, and/or a tornado). However, there is currently no
established, objective severity scale for thunderstorms. That said, according to the *Glossary of Meteorology* published by the American Meteorological Society (AMS), a thunderstorm is reported as *light, medium, or heavy* according to following five (5) characteristics:

- the nature of the lightning and thunder;
- the type and intensity of the precipitation, if any;
- the speed and gustiness of the wind;
- the appearance of the clouds; and
- the effect upon surface temperature.

A thunderstorm may also be classified by the nature of the overall weather situation in which the thunderstorm is produced, including:

- **Airmass Thunderstorm**: A thunderstorm produced by local convection within an unstable air mass;
- **Frontal Thunderstorm**: An individual thunderstorm the initiation of which results from rising motion associated with a front, or a thunderstorm within a convective system generated and organized by frontal rising motion;
- **Squall-line Thunderstorm**: An individual thunderstorm included within a squall line (i.e., a continuous or broken line of active deep moist convection frequently associated with thunder).

Based on the extent ranking factors identified (above) in relation to campus layout and operations, and past event low degree of severity, the planning committee ranks the extent of the thunderstorm hazard as **LOW**.

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132 Retrieved on 07.15.2021 from [https://www.noaa.gov/explainers/severe-storms](https://www.noaa.gov/explainers/severe-storms)
133 Retrieved on 07.15.2021 from [https://www.weather.gov/safety/thunderstorm](https://www.weather.gov/safety/thunderstorm)
History of the Hazard

Severe weather hazards have been an annual occurrence in both Ventura County and Santa County, and on the CSU Channel Islands main campus, satellite campus, and other University-owned facilities. Historical data for these hazards are presented below.

**Historical Storm Data Collection: NCEI Storm Events Database**

Historical information regarding severe weather hazards can be found using The National Centers for Environmental Information (NCEI) Storm Events Database. The Storm Events Database contains searchable, archived National Weather Service (NWS) storm data from January 1950 to April 2021, as entered by NOAA’s National Weather Service (NWS). Due to changes in the data collection and processing procedures over time, there are unique periods of record available depending on the event type.\(^{139}\) For example, from 1950 through 1954, only tornado events were recorded; from 1955 through 1995, only tornado, thunderstorm wind, and hail events were introduced into the database; from 1996 to present, 45 additional event types are recorded, including high wind, strong wind, and lightning events.\(^{140}\) To obtain the most accurate portrayal of severe weather event frequency, searches of the Storm Events Database are conducted using data collected since 01/01/1996. As a reminder, all official severe weather event data is at the county level. Severe weather data do not exist at the campus level. That said, it may be the case that the campus to some degree experiences the severe weather events reported for the surrounding community and County.

**Ventura County**

**Wind Hazards (excluding Tornadoes)**

Information obtained from the NCEI Storm Event Database website shows the number of events (or occurrences) of wind hazard events in Ventura County since 1996.\(^{141}\) Here, wind hazard events include all “High Wind,” “Strong Wind,” and “Thunderstorm Wind” storm reports.\(^{142}\)

- **High Wind:** at least 233 events, or approximately 9.20 events per year\(^{143}\)

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\(^{141}\) National Climatic Data Center. Storm Events Database. Retrieved on 07.29.2021 from https://www.ncdc.noaa.gov/stormevents/


\(^{143}\) National Climatic Data Center. Storm Events Database. Retrieved on 07.29.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28Z%29%2BHigh%2BWind&beginDate_mm=01&beginDate_dd=01&beginDate_yyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyy=2021&county=VENTURA%3A111&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA
- **Strong Wind**: at least 3 events, or 0.12 events per year\(^\text{144}\)

- **Thunderstorm Wind**: at least 10 events, or approximately 0.39 events per year\(^\text{145}\)

- **All Wind Hazard events** (excluding Tornadoes): at least 240 events, or approximately 9.47 events per year.\(^\text{146}\) (Note: This was determined by conducting a simultaneous search of the component wind hazards of high wind, strong wind and thunderstorm wind.)

Overall, in Ventura County, there have been at least **240** wind hazard events since 1996, excluding tornadoes.\(^\text{147}\) That translates to an approximate average historical frequency of occurrence of **9.47** wind hazard events per year.

Please note: Differences between the sums of individual component severe weather hazard event Database searches (i.e., 246 events) and simultaneous Database searches of all severe weather hazard events (i.e., 240 events) may be due to the following factors: (1) multiple event types are in the same record (e.g., "Thunderstorm Wind/Hail" or "Hail/Tornado;" and/or (2) severe weather hazard events such as “Thunderstorm Wind” or “Hail” that are reported for Ventura County have actually taken place hundreds of miles away, but are erroneously recorded as events that have occurred in the County.\(^\text{148}\)

When such a discrepancy arises, the more conservative aggregate hazard wind event value (i.e., 240 events) is used to determine the historical frequency of occurrence for the severe weather hazard. The origin of this discrepancy is unknown at this time.

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\(^\text{144}\) National Climatic Data Center. Storm Events Database. Retrieved on 07.29.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28Z%29+Strong+Wind&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=VENTURA%3A111&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA

\(^\text{145}\) National Climatic Data Center. Storm Events Database. Retrieved on 07.29.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Thunderstorm+Wind&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=VENTURA%3A111&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA

\(^\text{146}\) National Climatic Data Center. Storm Events Database. Retrieved on 07.29.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28Z%29+High+Wind&eventType=%28Z%29+Strong+Wind&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=VENTURA%3A111&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA

\(^\text{147}\) National Climatic Data Center. Storm Events Database. Retrieved on 07.29.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28Z%29+High+Wind&eventType=%28Z%29+Strong+Wind&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=VENTURA%3A111&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA

Historical Wind Hazard Losses for Ventura County since 1996

According to the NCEI Storm Events Database, the wind hazard events that Ventura County has experienced since 1996 have been costly. There has been 1 death associated with wind hazards; however, there have been no injuries, or property and crop damage.\textsuperscript{149}

\textbf{Tornado Wind Hazards}

Information from the NCEI Storm Events Database indicates that since 1996, there have been 5 reported events of tornadoes in Ventura County, which translates to approximately 0.20 tornado events per year.\textsuperscript{150} All tornado reports in Ventura County since 1996 have been of tornadoes with a severity rating of F0/EF0.\textsuperscript{151}

Historical Tornado Hazard Losses for Ventura County since 1996

According to the NCEI Storm Events Database, the tornado hazard events that Ventura County has experienced since 1996 have not generated any known losses; no deaths, injuries, or property or crop damage have been reported in Ventura County from tornado hazard events.\textsuperscript{152}

\textbf{Hail}

Information from the NCEI Storm Events Database indicates that since 1996, there have been three (3) reported events of hail in Ventura County, which translates to approximately 0.12 hail events per year.\textsuperscript{153} (Note: The NCEI Storm Event Database search results for hail indicate that there has been a total of four (4) reports of hail since 1996.)

\begin{footnotesize}
\begin{itemize}
\item \textsuperscript{149} National Climatic Data Center. Storm Events Database. Retrieved on 07.29.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28Z%29+High+Wind&eventType=%28Z%29+Strong+Wind&eventType=%28C%29+Thunderstorm+Wind&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=VENTURA%3A111&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA
\item \textsuperscript{150} National Climatic Data Center. Storm Events Database. Retrieved on 07.29.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Tornado&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=VENTURA%3A111&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA
\item \textsuperscript{151} National Climatic Data Center. Storm Events Database. Retrieved on 07.29.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Tornado&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=VENTURA%3A111&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA
\item \textsuperscript{152} National Climatic Data Center. Storm Events Database. Retrieved on 07.29.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Hail&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=VENTURA%3A111&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA
\item \textsuperscript{153} National Climatic Data Center. Storm Events Database. Retrieved on 07.29.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Hail&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=VENTURA%3A111&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA
\end{itemize}
\end{footnotesize}
However, one (1) entry is for a hail event in San Diego County, hundreds of miles away from Ventura County. The origin of this discrepancy is unknown at this time.

**Historical Hail Hazard Losses for Ventura County since 1996**

According to the NCEI Storm Events Database, the hail hazard events that Ventura County has experienced since 1996 have generated no known losses. There have been no deaths, injuries, or property or crop damage reported.\(^\text{154}\) (Note: The San Diego County hail event that was included erroneously in the search results for hail events in Ventura County accounted for all injuries (i.e., 5) and crop damage estimates (i.e., $300,000) presented in the search results.)

**Lightning**

Information from the NCEI Storm Events Database indicates that since 1996, there have been two (2) reported events of lightning in Ventura County, which translates to approximately \(0.08\) lightning events per year.\(^\text{155}\)

**Historical Lightning Hazard Losses for Ventura County since 1996**

According to the NCEI Storm Events Database, the lightning hazard events that Ventura County has experienced since 1996 have been costly. While there have been no deaths, or property or crop damage, there have been 3 injuries associated with a lightning strike that occurred in 2011.\(^\text{156}\)

**All Severe Weather Hazard Events Recorded by the NCEI Storm Events Database (Ventura County)**

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\(^{154}\) National Climatic Data Center. Storm Events Database. Retrieved on 07.29.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Hail&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=VENTURA%3A111&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA

\(^{155}\) National Climatic Data Center. Storm Events Database. Retrieved on 07.29.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Lightning&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=VENTURA%3A111&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA

\(^{156}\) National Climatic Data Center. Storm Events Database. Retrieved on 07.29.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Lightning&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=VENTURA%3A111&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA
Information obtained from the NCEI Storm Events Database indicates that there have been 250 occurrences of the severe weather hazard in Ventura County. This translates to 9.87 severe weather hazard occurrences per year.\(^{157}\)

Please note: Differences between the sums of individual component severe weather hazard event Database searches (i.e., 256 events) and simultaneous Database searches of all severe weather hazard events (i.e., 250 events) may be due to the following factors: (1) multiple event types are in the same record (e.g., “Thunderstorm Wind/Hail” or “Hail/Tornado;” and/or (2) severe weather hazard events such as “Thunderstorm Wind” or “Hail” that are reported for Ventura County have actually taken place hundreds of miles away, but are erroneously recorded as events that have occurred in the County.\(^{158}\)

When such a discrepancy arises, the more conservative aggregate hazard wind event value (i.e., 250 events) is used to determine the historical frequency of occurrence for the severe weather hazard. The origin of this discrepancy is unknown at this time.

**Historical, Aggregated Severe Hazard Losses for Ventura County since 1996**

According to the NCEI Storm Events Database, the severe weather hazard events that Ventura County has experienced since 1996 have been costly. There has been 1 death and 3 injuries, but no property or crop damage.\(^{159}\) However, it is important to note that for all Ventura County severe weather hazard events recorded on the Storm Events Database, all deaths and injuries have been caused by wind hazard events alone.

**Santa Barbara County**

*Wind Hazards (excluding Tornadoes)*

Information obtained from the NCEI Storm Event Database website shows the number of events (or occurrences) of wind hazard events in Santa Barbara County since 1996.\(^{160}\)

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\(^{157}\) National Climatic Data Center. Storm Events Database. Retrieved on 07.29.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Hail&eventType=%28Z%29+High+Wind&eventType=%28C%29+Lightning&eventType=%28Z%29+Strong+Wind&eventType=%28C%29+Thunderstorm+Wind&eventType=%28C%29+Tornado&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=VENTURA%3A111&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA


\(^{159}\) National Climatic Data Center. Storm Events Database. Retrieved on 07.29.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Hail&eventType=%28Z%29+High+Wind&eventType=%28C%29+Lightning&eventType=%28Z%29+Strong+Wind&eventType=%28C%29+Thunderstorm+Wind&eventType=%28C%29+Tornado&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=VENTURA%3A111&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA

Here, wind hazard events include all “High Wind,” “Strong Wind,” and “Thunderstorm Wind” storm reports.161

- **High Wind:** at least 158 events, or approximately 6.24 events per year162
- **Strong Wind:** at least 1 events, or 0.04 events per year163
- **Thunderstorm Wind:** at least 12 events, or approximately 0.47 events per year164
- **All Wind Hazard events** (excluding Tornadoes): at least 165 events, or approximately 6.51 events per year.165 (Note: This was determined by conducting a simultaneous search of the component wind hazards of high wind, strong wind and thunderstorm wind.)

Overall, in Santa Barbara County, there have been at least 165 wind hazard events since 1996, excluding tornadoes.166 That translates to an approximate average historical frequency of occurrence of **6.51** wind hazard events per year.

Please note: Differences between the sums of individual component severe weather hazard event Database searches (i.e., 171 events) and simultaneous Database searches of all severe weather hazard events (i.e., 165 events) may be due to the following factors: (1) multiple event types are in the same record (e.g., "Thunderstorm Wind/Hail" or "Hail/Tornado," and/or (2) severe weather hazard events such as “Thunderstorm Wind”

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162 National Climatic Data Center. Storm Events Database. Retrieved on 08.04.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28Z%29+High+Wind&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=SANTA%2BBARBARA%3A83&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA
163 National Climatic Data Center. Storm Events Database. Retrieved on 08.04.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28Z%29+Strong+Wind&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=SANTA%2BBARBARA%3A83&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA
164 National Climatic Data Center. Storm Events Database. Retrieved on 08.04.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Thunderstorm+Wind&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=SANTA%2BBARBARA%3A83&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA
165 National Climatic Data Center. Storm Events Database. Retrieved on 08.04.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28Z%29+High+Wind&eventType=%28Z%29+Strong+Wind&eventType=%28C%29+Thunderstorm+Wind&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=SANTA%2BBARBARA%3A83&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA
166 National Climatic Data Center. Storm Events Database. Retrieved on 08.04.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28Z%29+High+Wind&eventType=%28Z%29+Strong+Wind&eventType=%28C%29+Thunderstorm+Wind&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=SANTA%2BBARBARA%3A83&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA
or “Hail” that are reported for Santa Barbara County have actually taken place hundreds of miles away, but are erroneously recorded as events that have occurred in the County. When such a discrepancy arises, the more conservative aggregate hazard wind event value (i.e., 165 events) is used to determine the historical frequency of occurrence for the severe weather hazard. The origin of this discrepancy is unknown at this time.

**Historical Wind Hazard Losses for Santa Barbara County since 1996**

According to the NCEI Storm Events Database, the wind hazard events that Santa Barbara County has experienced since 1996 have been costly. While there have been no deaths, there have been three (3) injuries, and crop damage estimates have totaled approximately $15,000,000; no property damages have been reported.

**Tornado Wind Hazards**

Information from the NCEI Storm Events Database indicates that since 1996, there have been three (3) reported events of tornadoes in Santa Barbara County, which translates to approximately 0.12 tornado events per year. All tornado reports in Santa Barbara County since 1996 have been of tornadoes with a severity rating of F0/EF0.

**Historical Tornado Hazard Losses for Santa Barbara County since 1996**

According to the NCEI Storm Events Database, there have been no deaths, injuries, property damage or crop damage from tornadoes since 1996.
Hail

Information from the NCEI Storm Events Database indicates that since 1996, there have been four (4) reported events of hail in Santa Barbara County, which translates to approximately 0.20 hail events per year.172 (Note: The NCEI Storm Event Database search results for hail indicate that there has been a total of five (5) reports of hail since 1996. However, one (1) entry is for a hail event in San Diego County, almost 200 miles away from Santa Barbara County. The origin of this error is unknown at this time.)

Historical Hail Hazard Losses for Santa Barbara County since 1996

According to the NCEI Storm Events Database, the hail hazard events that Santa Barbara County has experienced since 1996 have been minimal. There have been no deaths and only one (1) injury reported; there have been no reports of property or crop damage.173 (Note: The San Diego County hail event that was included erroneously in the search results for hail hazard events in Santa Barbara County accounted for almost all injuries (i.e., 5) and crop damage estimates (i.e., $300,000) presented in the search results.)

Lightning

Information from the NCEI Storm Events Database indicates that since 1996, there have been no reported events of lightning in Santa Barbara County.174

Historical Lightning Hazard Losses for Santa Barbara County since 1996

Because there have been no lightning hazard events reported in the County since 1996, there have been no lightning-related deaths, injuries, property damage, or crop damage.175

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172 National Climatic Data Center. Storm Events Database. Retrieved on 08.04.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Hail&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=SANTA%2BBARBARA%3A83&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitButton=Search&statefips=6%2CCALIFORNIA

173 National Climatic Data Center. Storm Events Database. Retrieved on 08.04.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Hail&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=SANTA%2BBARBARA%3A83&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitButton=Search&statefips=6%2CCALIFORNIA

174 National Climatic Data Center. Storm Events Database. Retrieved on 08.04.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Lightning&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=SANTA%2BBARBARA%3A83&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitButton=Search&statefips=6%2CCALIFORNIA

175 National Climatic Data Center. Storm Events Database. Retrieved on 08.04.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Lightning&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=SANTA%2BBARBARA%3A83&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitButton=Search&statefips=6%2CCALIFORNIA
All Severe Weather Hazard Events Recorded by the NCEI Storm Events Database

(Santa Barbara County)

Information obtained from the NCEI Storm Events Database indicates that there have been 172 occurrences of the severe weather hazard in Santa Barbara County. This translates to 6.79 severe weather hazard occurrences per year.¹⁷⁶

Please note: Differences between the sums of individual component severe weather hazard event Database searches (i.e., 178 events) and simultaneous Database searches of all severe weather hazard events (i.e., 172 events) may be due to the following factors: (1) multiple event types are in the same record (e.g., "Thunderstorm Wind/Hail" or "Hail/Tornado," and/or (2) severe weather hazard events such as “Thunderstorm Wind” or “Hail” that are reported for Santa Barbara County have actually taken place hundreds of miles away, but are erroneously recorded as events that have occurred in the County.¹⁷⁷ When such a discrepancy arises, the more conservative aggregate hazard wind event value (i.e., 172 events) is used to determine the historical frequency of occurrence for the severe weather hazard. The origin of this discrepancy is unknown at this time.

Historical, Aggregated Severe Hazard Losses for Santa Barbara County since 1996

According to the NCEI Storm Events Database, the severe weather events that Santa Barbara County has experienced since 1996 have been costly. While there have been no deaths or property damage, there have been four (4) injuries, and crop damage estimates have totaled approximately $15,000,000.¹⁷⁸ It is important to note that for all Santa Barbara County severe weather hazard events recorded on the Storm Events Database, almost all injuries and all property damage have been attributed wind hazard events alone.

Wind Hazards Not Included in the NCEI Storm Events Database

Santa Ana Winds

¹⁷⁶ Re National Climatic Data Center. Storm Events Database. Retrieved on 08.04.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Hail&eventType=%28Z%29+HighWind&eventType=%28C%29+Lightning&eventType=%28Z%29+StrongWind&eventType=%28C%29+ThunderstormWind&eventType=%28C%29+Tornado&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=SANTA%2BBARBARA%3A83&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA


¹⁷⁸ National Climatic Data Center. Storm Events Database. Retrieved on 08.04.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Hail&eventType=%28Z%29+HighWind&eventType=%28C%29+Lightning&eventType=%28Z%29+StrongWind&eventType=%28C%29+ThunderstormWind&eventType=%28C%29+Tornado&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=SANTA%2BBARBARA%3A83&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA
Santa Ana wind events occur at least twice per month from October through April.\textsuperscript{179} From 1948 to 2012, total of 2056 events on the 65-year record were recorded in the Southern California region, yielding an average of \textbf{32 occurrences per year}. Typical Santa Ana wind events last 1–2 days and represent 27\% of the occurrences, with events lasting up to 6 days accounting for 90\% of all occurrences. The remaining 10\% are made up almost entirely of events lasting between 7 and 12 days.\textsuperscript{180, 181}

Figure below shows the mean monthly frequency per season of Santa Ana Wind events detected from 1948 to 2012. Extreme Santa Ana wind events are shown in dark red, and are defined as those events that are above the 90th percentile of all events on record.

**Diablo Winds**

Diablo wind events occur approximately **2.5 events per year**. These events are most frequent during the fall and early winter seasons, with the highest frequency of events occurring in October. As a result, the highest risk of Diablo-wind-related damage is in the fall and early winter.\(^{184}\)

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Sundowner Winds

Strong sundowner wind events occur approximately 2-3 times per year. These events can create sharp temperature rises, local gale force winds, and significant weather-related problems. Rare, “explosive” types of sundowner wind events occur about 6 times per century that present dangerous weather situations, generating extremely strong and hot winds that can reach gale force or higher speeds.187

Historical Frequency of All Severe Weather Hazards

Table below shows the average historical frequency of severe weather hazard events for Ventura County since 1996.)

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185 Retrieved on 07.15.2021 from https://www.fireweather.org/diablo-winds
Table 5-36: Severe Weather Hazard Event

Frequencies for Ventura County since 1996.

<table>
<thead>
<tr>
<th>Severe Weather Hazard Category</th>
<th>Average Number of Hazard Events Per Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wind (Includes High, Strong and Thunderstorm Winds ONLY)</td>
<td>9.47</td>
</tr>
<tr>
<td>Tornado</td>
<td>0.20</td>
</tr>
<tr>
<td>Hail</td>
<td>0.12</td>
</tr>
<tr>
<td>Lightning</td>
<td>0.08</td>
</tr>
<tr>
<td>Diablo Wind*</td>
<td>2.5</td>
</tr>
<tr>
<td>Santa Ana Wind</td>
<td>32</td>
</tr>
<tr>
<td>Sundowner Wind</td>
<td>2 to 3</td>
</tr>
</tbody>
</table>

* Note: The Diablo wind hazard is not present in Ventura County; it is included here for information purposes only. The Sundowner wind hazard is close in proximity to the CSU Channel Islands main campus, and directly affects a satellite campus facility in Santa Barbara County owned by the University; therefore, it is considered to be a wind hazard event for CSU Channel Islands.

Table below shows the average historical frequency of severe weather hazard events for Santa Barbara County since 1996.)
Table 5-37: Severe Weather Hazard Event

Frequencies for Santa Barbara County since 1996.

<table>
<thead>
<tr>
<th>Severe Weather Hazard Category</th>
<th>Average Number of Hazard Events Per Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wind (Includes High, Strong and Thunderstorm Winds ONLY)</td>
<td>6.51</td>
</tr>
<tr>
<td>Tornado</td>
<td>0.12</td>
</tr>
<tr>
<td>Hail</td>
<td>0.20</td>
</tr>
<tr>
<td>Lightning</td>
<td>0</td>
</tr>
<tr>
<td>Diablo Wind *</td>
<td>2.5</td>
</tr>
<tr>
<td>Santa Ana Wind</td>
<td>32</td>
</tr>
<tr>
<td>Sundowner Wind</td>
<td>2 to 3</td>
</tr>
</tbody>
</table>

* Note: The Diablo wind hazards are not present in Santa Barbara County. They are included here for information purposes only.

Potential Impacts of the Hazard

The significance (or priority) of a hazard’s potential impacts is based primarily on the frequency and resulting damage caused by the hazard, including deaths/injuries and property, crop, and economic damage. All assets and people within CSU Channel Islands campus areas are at risk from the effects of severe weather hazards.

**Wind Hazards (Including Tornadoes)**

Wind hazard events have the potential to impact people, property, and operations on campuses across the CSU system. People caught in the open during an extreme wind event are exposed to high winds and debris, and could be injured or killed.

The habitability of buildings can be compromised (by damaging roofs, windows, or other weak points in the building envelope), leading to long-term operational issues for the campus. As with most university campuses, space is always at a premium at the CSU Channel Islands campus, and the loss of any currently utilized space due to building or structural damage would likely disrupt operations and the University’s mission.
Extreme wind events can result in power failure, which would impact the operation of the campus. Fallen tree limbs and other potential transportation hazards may also cause disruption to the surrounding community and limit ingress/egress to the campus.

**CSU Channel Islands Main Campus, Camarillo (Ventura County)**

According to the 2015 Ventura County Multi-Hazard Mitigation Plan, the high wind hazard component of “winter storms” is considered to be significant, and may have a moderate potential impact on the County and on the CSU Channel Islands main campus. Because the County is at very low risk from tornadoes, and tornadoes are not included in any hazard profile of the Plan, the potential impacts from tornadoes are considered to be minimal for the County and for the CSU Channel Islands main campus.

**CSU Channel Islands – Extended University Campus, Goleta (Santa Barbara County)**

According to the 2017 Santa Barbara County Multi-Jurisdictional Hazard Mitigation Plan, the County is susceptible to “windstorm” hazards, primarily from Sundowner Winds; as a result, wind hazards (excluding tornadoes) are considered to have moderate potential impact on the County, and therefore on the CSU Channel Islands Extended University Campus. Because the County is at very low risk from tornadoes, the potential impacts from tornadoes are considered to be minimal for the County and for the CSU Channel Islands Extended University Campus.

**Hail**

Hail typically impacts property by damaging structures, cars, and utilities as it falls. Dents in cars, broken glass, and holes in roofs are common impacts of hail. Injuries to people from hail are less common, though they can happen, as hail is a hard object falling in an unpredictable manner at a fairly high rate of speed.

**CSU Channel Islands Main Campus, Camarillo (Ventura County)**

According to the 2015 Ventura County Multi-Hazard Mitigation Plan, the hail hazard component of “winter storms” is considered to be a hazard that may accompany winter storms, but it is not a significant hazard in and of itself. As a result, it has a minimal potential impact on the County and on the CSU Channel Islands main campus.

**CSU Channel Islands – Extended University Campus, Goleta (Santa Barbara County)**

The 2017 Santa Barbara County Multi-Jurisdictional Hazard Mitigation Plan states that while the County is susceptible to hail hazards, there is no current of hailstorms in the County. As a result, hail hazards are considered to be of low significance, and therefore to

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have a minimal potential impact on the County and on the CSU Channel Islands Extended University Campus.\textsuperscript{191}

\textbf{Lightning}

Lightning strikes the United States about 20-25 million times a year.\textsuperscript{192} Although most lightning occurs in the summer months, people can be struck at any time of year. Since 1990, lightning has killed an average of 39 people each year in the United States, and hundreds more have been injured.\textsuperscript{193} Property losses due to lightning have been very costly across the U.S. For example, from 2005 through 2020, U.S. homeowner’s insurance claim payouts for lightning losses totaled approximately $15,334,600,000, or $958,412,500 worth of payouts per year.\textsuperscript{194} (Commercial claim payouts for lightning losses for the U.S. were not available.)

\textbf{CSU Channel Islands Main Campus, Camarillo (Ventura County)}

According to the 2015 Ventura County Multi-Hazard Mitigation Plan, the lightning hazard component of “winter storms” is considered to be a hazard that may accompany winter storms, but it is not a significant hazard in and of itself. As a result, it has a minimal potential impact on the County and on the CSU Channel Islands main campus.\textsuperscript{195}

\textbf{CSU Channel Islands – Extended University Campus, Goleta (Santa Barbara County)}

The 2017 Santa Barbara County Multi-Jurisdictional Hazard Mitigation Plan does not include lightning as a hazard, and only mentions it within the context of wildfire ignition. As a result, lightning hazards are considered to be of low significance, and therefore to have a minimal potential impact on the County and on the CSU Channel Islands Extended University Campus.\textsuperscript{196}

\textbf{Probability of Future Occurrence of the Hazard}

Areas throughout California, including all California State University (CSU) campuses, experience severe weather events every year, and future occurrences of such events are projected to increase in both their frequency and intensity.


\textsuperscript{194} Retrieved on 07.21.2021 from https://www.iii.org/table-archive/20504


CSU Channel Islands Main Campus, Camarillo (Ventura County)

The 2015 Ventura County Multi-Hazard Mitigation Plan states that a “winter storm” with high winds, hail, and lightning can occur every year in the County.\textsuperscript{197} Also, according to the NCEI Storm Events Database, severe weather wind hazard events have occurred in Ventura County considerably more than once per year – at an average of 9.47 events per year since 1996. Furthermore, while the severe weather hazard is a non-spatial hazard that affects all areas of the CSU Channel Islands main campus equally, the smallest geographic unit of measurement for almost all official severe weather event data is at the county level. Because the severe weather data used in this assessment do not exist at the campus level, it is assumed that the severe weather probabilities for the CSU Channel Islands main campus reflect those of the surrounding community and County.

Based on the data available from both the 2015 Ventura County Multi-Hazard Mitigation Plan and the NCEI Storm Events Database, the severe weather hazard is expected to occur on (or otherwise impact) the CSU Channel Islands main campus \textit{at least once on an annual basis}. Therefore, the probability of future occurrence of the severe weather hazard for CSU Channel Islands main campus is \textbf{HIGHLY LIKELY}.

CSU Channel Islands Extended University Campus, Goleta (Santa Barbara County)

The 2017 Santa Barbara County Multi-Jurisdictional Hazard Mitigation Plan states that windstorms are an annual occurrence.\textsuperscript{198} Also, according to the NCEI Storm Events Database, some of these same severe weather hazards have occurred in Santa Barbara County far more than once per year – at an average of 6.51 events per year since 1996. Furthermore, while the severe weather hazard is a non-spatial hazard that affects all areas of the CSU Channel Islands Extended University campus equally, the smallest geographic unit of measurement for almost all official severe weather event data is at the county level. Because the severe weather data used in this assessment do not exist at the campus level, it is assumed that the severe weather probabilities for the CSU Channel Islands Extended University campus reflect those of the surrounding community and County identified in the Table below.

Based on the data available from both the 2017 Santa Barbara County Multi-Jurisdictional Hazard Mitigation Plan and the NCEI Storm Events Database, the severe weather hazard is expected to occur on (or otherwise impact) CSU Channel Islands Extended University campus \textit{at least once on an annual basis}. Therefore, the probability of future occurrence of the severe weather hazard for the campus is \textbf{HIGHLY LIKELY}.


**CSU Channel Islands – All Campus Areas**

The probability of future occurrence of the severe weather hazard for all CSU Channel Islands campus areas is **HIGHLY LIKELY**.

The following tables show the probabilities of future occurrence for component severe weather hazards for CSU Channel Islands campuses and facilities in Ventura County and San Barbara County.

Table 5-38: Severe Weather Hazard Probabilities of Future Occurrence for Ventura County: CSU Channel Islands Main Campus (Camarillo) and Boating Center (Oxnard)

<table>
<thead>
<tr>
<th>Severe Weather Hazard Category</th>
<th>Average Number of Hazard Events Per Year</th>
<th>Probability of Future Occurrence</th>
</tr>
</thead>
<tbody>
<tr>
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<td>Hail</td>
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<td>Possible</td>
</tr>
<tr>
<td>Lightning</td>
<td>0.08</td>
<td>Unlikely</td>
</tr>
<tr>
<td>Diablo Wind**</td>
<td>2.5</td>
<td>Not Rated</td>
</tr>
<tr>
<td>Santa Ana Wind</td>
<td>32</td>
<td>Highly Likely</td>
</tr>
<tr>
<td>Sundowner Wind</td>
<td>2 to 3</td>
<td>Highly Likely</td>
</tr>
<tr>
<td><strong>Severe Weather Hazard</strong></td>
<td></td>
<td><strong>Highly Likely</strong></td>
</tr>
</tbody>
</table>

**Note:** The Diablo wind hazards is not present in Ventura County, and therefore is not rated for probability of future occurrence. It is included here for information purposes only. The Sundowner wind hazard is close in proximity to the CSU Channel Islands main campus, and directly affects a satellite campus facility in Santa Barbara County owned by the University; therefore, it is considered to be a wind hazard event for CSU Channel Islands, and is rated here for probability of future occurrence.
Table 5-39: Severe Weather Hazard Probabilities of Future Occurrence for
Santa Barbara County and CSU Channel Islands – Extended University (Goleta, CA)

<table>
<thead>
<tr>
<th>Severe Weather Hazard Category</th>
<th>Average Number of Hazard Events Per Year</th>
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<td>Diablo Wind**</td>
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<td>Highly Likely</td>
</tr>
</tbody>
</table>

** Note: The Diablo wind hazards are not present in Santa Barbara County, and therefore are not rated for probability of future occurrence. They are included here for information purposes only.

Vulnerability to the Hazard

People, structures, and assets in all CSU Channel Islands campus areas are all vulnerable to the impacts associated with severe weather. Infrastructure can be damaged or destroyed by hail, wind, tornadoes, thunderstorms, and lightning, which can result in service interruptions and outages. Structures can be damaged or destroyed by hail, wind, tornadoes, thunderstorms, and lightning. People can be injured or killed by lightning, flying debris, hail, or extreme wind events. Both CSU Channel Islands campuses also have vehicles and other off-campus facilities that are all vulnerable to a severe weather event.

Estimate of Potential Losses

Severe weather is a non-spatial hazard that affects all CSU Channel Islands campus areas. Each of the hazards associated with severe weather can result in losses throughout the planning area.

All structures within all CSU Channel Islands campus areas at risk from severe weather. There are approximately 62 buildings on the main campus that could be damaged by wind, hail, and/or lightning. If even a fraction of these assets were to be damaged, the resulting estimated losses would still be in the millions of dollars. The total replacement
costs due to severe weather hazard are $179,257,992 for 32 buildings, and unknown for the remaining 30 buildings. An analysis of projected dollar losses to campus buildings from severe weather as a percentage of building replacement costs is also not currently available, though CSU leadership may pursue such data in the future.

The population at the CSU Channel Islands campus varies throughout the day. As of Fall, 2019, CSU Channel Islands had 7,093 students and 994 faculty and staff. All are at risk from severe weather events, with 8,087 being directly vulnerable in this scenario.

Vulnerability Assessment Conclusions

Severe weather presents a variety of hazards to CSU Channel Islands campuses. People, assets, infrastructure, and vehicles can all be damaged by this hazard, and losses can quickly begin to rise. In the aggregate, severe weather is a frequently occurring hazard (mostly in the form of wind hazard events) that presents a variety of risks to CSU Channel Islands.

It is evident that CSU Channel Islands has vulnerabilities to and risks from severe weather hazard incidents, and that pre-event planning, communication, and mitigation efforts should be implemented. Public education and outreach regarding areas of shelter that could be used by campus populations during severe weather events is considered by campus leadership to be one viable mitigation option. The campus planning committee will continue to look for feasible and cost-effective options for the mitigation of severe weather risks going forward.

Identified Data Limitations

Numerous federal agencies maintain a variety of records regarding losses associated with hazards. Unfortunately, no single source is considered to offer a definitive accounting of all losses. The Federal Emergency Management Agency (FEMA) maintains records on federal expenditures associated with declared major disasters. The US Army Corps of Engineers (USACE) and the Natural Resources Conservation Service (NRCS) collect data on losses during the course of some of their ongoing projects and studies. Additionally, the National Oceanic and Atmospheric Administration’s (NOAA) National Centers for Environmental Information (NCEI) collects and maintains data about natural hazards in summary format, as well as occurrences, dates, injuries, deaths, and estimated costs for individual storm events. Many of these databases and other data collection services, including the NCEI, have inherent data limitations when searching for information at a scale as small as a single campus.

The best available data and records have been used throughout this section. Where no data or records exist or could be located, that deficiency is noted.

5.4 Social Resilience Assessment

Overview

While every person is vulnerable to risk, individuals from diverse populations such as those with access and functional needs are disproportionately more vulnerable and may be at a higher risk to harm in a disaster event. In addition to physical vulnerabilities, the intersectionality between physical hazard risks and population social vulnerabilities must be considered to holistically address overall campus risk.

As inclusivity is a high priority for CSU, addressing campus risk and resilience must be done through the lens of inclusion and equity. Every individual of the campus’s richly diverse population group needs to have the capacity, skills, and knowledge in order to understand, access, and participate in risk reduction and disaster response in ways that are meaningful to their own unique situation. In a campus community, having strong social support networks and active involvement in community disaster responses may negatively or positively impact these opportunities and reduce the resilience-building process. This section offers a glimpse into the CSU Channel Islands campus’s unique social construct, population demographics, strengths and concerns and presents a high-level assessment of the resilience, coping capacities and potential social vulnerabilities of students, staff and faculty. The research variables that were asked are often considered sensitive subjects, and few are traditionally included in emergency management/hazard mitigation planning.

This social resilience assessment of college campuses is the first of its kind in the nation. The research methodology unfolded as the interviews with campuses progressed. The assessment data presented are not definitive or authoritative. The answers, analysis, and suggested trends are strictly indicators for potential social risk. They do not represent an accurate data capture as limitations on the data gathering process influenced an ability to provide accuracy. This assessment provides indications of increased risk, not accuracy of response or a true reflection of the situation of the campus. The information presented is to be considered in the context of the more detailed system-wide CSU social vulnerability assessment that is included in the baseline HVRA.
Campus-Identified Populations of Concern

During the campus interview, the following responses were provided when asked, “In considering the diverse population group(s) amongst student body, faculty and staff, which are of the most concern in your emergency management planning?”

Table 5-40: High level summary of campus populations of concern

<table>
<thead>
<tr>
<th>Question</th>
<th>Campus Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>Which population groups amongst the student body, faculty, and staff, are of the most concern for physical and social vulnerabilities in emergency management planning?</td>
<td>• Populations with access and functional needs</td>
</tr>
<tr>
<td></td>
<td>• Latinx students and employees</td>
</tr>
<tr>
<td></td>
<td>• DACA students</td>
</tr>
<tr>
<td>Which population groups are most difficult to reach in an event?</td>
<td>Populations with access and functional needs</td>
</tr>
<tr>
<td>Which population groups have little/limited support networks if impacted by an event?</td>
<td>International students</td>
</tr>
</tbody>
</table>

Resilience Variables Related to Campus Emergency Management

The interviewees were asked to reflect on a set of 12 variables for the campus populations of student, faculty and staff: homelessness (housing insecurity), food security, health and wellness, disability/access and functional needs (AFN), racial equity, digital equity, communications, international students, immigrants/immigration status issues (undocumented, DACA, etc.), LGBTQI (Lesbian Gay Bisexual Transgender Questioning (or queer) Intersex), and transportation dependency. They were also offered an opportunity to add any other factor they wanted to include. The following two questions were asked:
- Is this factor a particular issue of concern for emergency management on your campus? Responses were summarized as **Very High, High, Medium, Low**
- Is this factor reflected in the emergency plans and processes for your campus? Responses were summarized as **Yes, No, In Progress, NA**

In order to provide a high-level qualitative response for the answers, the approach of averaging response was taken. If conflicting answers were expressed by the interviewees, the answer (code) was averaged out. A detailed explanation of the response averaging approach is included in the base HVRA.
Table 5-41: Campus-specific emergency management issues of concern and inclusion in emergency management plans and processes.

<table>
<thead>
<tr>
<th>Issue of Concern</th>
<th>Issue of Concern</th>
<th>Plans &amp; Processes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Homelessness (Housing Insecurity)</td>
<td>Medium</td>
<td>No</td>
</tr>
<tr>
<td>Food Security</td>
<td>Very High</td>
<td>No</td>
</tr>
<tr>
<td>Health &amp; Wellness</td>
<td>Very High</td>
<td>Yes</td>
</tr>
<tr>
<td>AFN</td>
<td>Low</td>
<td>Yes</td>
</tr>
<tr>
<td>Racial Equity</td>
<td>Very High</td>
<td>N/A</td>
</tr>
<tr>
<td>Digital Equity</td>
<td>Low</td>
<td>No</td>
</tr>
<tr>
<td>Comms.</td>
<td>Low</td>
<td>Yes</td>
</tr>
<tr>
<td>International Students</td>
<td>Low</td>
<td>Yes</td>
</tr>
<tr>
<td>Immigrants / Immigration Status</td>
<td>Very High</td>
<td>No</td>
</tr>
<tr>
<td>LGBTQI</td>
<td>Low</td>
<td>No</td>
</tr>
<tr>
<td>Transportation Dependency</td>
<td>Very High</td>
<td>No</td>
</tr>
</tbody>
</table>

Qualitative Narrative: Campus Overview of Potential Resilience Vulnerabilities

The following are interview notes of interest:

- High number of students are on the Autism Spectrum
- Strongly concerned about the number of students with food insecurity though students can reach to a Care Team and be given a voucher
- Mental health issues were noted with concern regarding the community shooting in recent years because many students had friends who died; quite a few students dropped out of school; strong psychology services on the campus have supported
- Issue of racial equity was cited as being a significant issue of concern (and for the campus overall, one of the biggest concerns for the President); not sure about the how it is reflected in the EM plans
- Catch 22 on communications regarding when someone with COVID is in and in a building but folks on campus want to know where the person is but they are not allowed to identify the person or the building
Immigrants/immigration status issues was cited as a very high issue of concern; after recent events when there was going to be a major impact to DACA students, there was much discussion but not part of EM planning

Previously issues with transportation during the wildfires but now involved in the country EM planning which will relieve the issues if evacuation is needed

Campus High Hazards and Potentially Vulnerable Populations

This section provides a brief introduction to the link between socially vulnerable populations and a particular hazard type. While extensive research has been conducted on the impacts of hazards, not all linkages have been documented or published, and details for finding them are beyond the scope of this assessment. It’s important to note, the intersectional nature of what makes an individual’s personal experience and resilience to an event is played out by unique factors for that individual or population. The nuanced social vulnerabilities often come from the social and physical environment in which a person is embedded.

In order to aid in further assessing campus resilience, below is a general description of some the known impacts. From some hazards, the descriptions are robust, while others are only brief introductions.

Table 5-42: CSU Channel Islands *Highly Likely, Likely and Possible* Hazards

<table>
<thead>
<tr>
<th>Hazard</th>
<th>Future Occurrence Probability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Communicable Disease</td>
<td>Highly Likely</td>
</tr>
<tr>
<td>Drought</td>
<td>Highly Likely</td>
</tr>
<tr>
<td>Earthquake</td>
<td>Possible</td>
</tr>
<tr>
<td>Erosion</td>
<td>Highly Likely</td>
</tr>
<tr>
<td>Flood</td>
<td>Likely</td>
</tr>
<tr>
<td>Landslide</td>
<td>Possible</td>
</tr>
<tr>
<td>Power Outage</td>
<td>Likely</td>
</tr>
<tr>
<td>Tsunami</td>
<td>Likely</td>
</tr>
<tr>
<td>Wildfire</td>
<td>Likely (Fire); Possible (Smoke)</td>
</tr>
</tbody>
</table>

*Communicable Diseases*

**TBD**

*Drought*

The 2012-2016 drought had severe effects on two vulnerable sectors of our population: those in low-income brackets, and those, especially Native Americans, who rely on
subsistence fishing for their livelihoods. Water bills increased throughout the state. Due to rising water prices, for the working poor, many have paid four to five percent of their income for water. Since many CSU students are commuters, and many living with families, future drought impacts may potentially affect a percentage of non-resident students. NASA’s modeling shows that future droughts are likely to last longer and be more intense, even leading to “megadroughts” in the western states. Fresh water supplies are predicted to be full of extremes, with both droughts and extreme precipitation events being more severe. The interrelationship between drought and other hazard conditions may lead to a set of secondary impacts. Drought conditions lead to water quality issues due to loss of drinking water, increased fire danger that leads to drought-induced fires and elevated AQI levels, as well as extreme heat or prolonged heat events.

**Earthquake**

Impacts on populations from earthquakes are complex, with long-term implications on social stability for all populations. In addition to the physical impact exposure during a no-notice earthquake event and the social and logistical challenges of a recovering community, an earthquake can have lasting impacts long afterwards due to post traumatic stress disorder (PTSD).

Socioeconomic vulnerabilities of populations at risk were analyzed in the hypothetical yet scientifically realistic earthquake sequence that is being used to better understand hazards for the San Francisco Bay region during and after a magnitude-7 earthquake (mainshock) on the Hayward Fault and its aftershocks. In this study, the at-risk populations located in areas of concentrated damage are anticipated to experience longer recovery trajectories, increased long term housing displacement, and transportation impacts due to dependencies on transit dependencies. When neighborhood schools close, families with school age children may move to other areas to keep their children in schools. Persons with access and functions needs are likely to be more dependent on access to functioning medical, social and personal health care services that would be overwhelmed by the event and therefore increasing their vulnerabilities. For the homeless populations, the loss of social community services and damages to shelters could add to protracted relocations. For the young and mobile populations who rent, the major disruption to housing, jobs and transit will also drive relocation. Widespread housing damage and preexisting housing market constraints will make it “extremely challenging” for the socially and economically vulnerable populations to find alternative housing near their home communities. Those who utilize interim and irregular housing for months and years after a disaster are more vulnerable to physical, social, and mental

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disorders, including suicide, substance abuse, and physical and verbal abuse. Aftershocks and post disaster conditions delay population return and increase outmigration.\textsuperscript{203}

\textit{Erosion}

Risk from erosion relates to earthen and infrastructural losses. The degree of vulnerability to these events and their impacts depends on human behavior and the traditional social factors such as situational awareness, prior knowledge of hazards, social capital and decision-making capabilities, as well as increased vulnerability due to social factors, such as racial and economic disparities.

\textit{Flood}

Risk from floods relates to community risk, exposure and infrastructural losses. The degree of vulnerability to these events and their impacts depends on human behavior and the traditional social factors such as situational awareness, prior knowledge of hazards, social capital and decision-making capabilities. The exposure of humans to floods continues to increase, driven by changes in hydrology and land use. The adverse impacts on socially vulnerable populations are amplified because a disproportionately high number live in flood-prone areas. Research has shown that places of social vulnerabilities are places characterized by housing and racial disparities, such as mobile home parks, structural fragility and poverty, and higher percentages of populations such as Black and Native Americans, and others with shared histories of discrimination, marginalization and exclusion. \textsuperscript{204}

Health impacts from flooding are well recognized due to the extensive history of flooding in California and around the nation. The impacts range from waterborne illnesses from contaminated waters, respiratory illnesses that impact the lungs, throat, and airways from airborne particles, mold on flooded buildings that can trigger asthma, allergies and other illnesses—all which are particularly impactful to older, younger and individuals with pre-existing health condition. Foodborne illnesses can increase if there are issues with power outages or sewer overflows. Individuals with increased mental health concerns can be impacted by the stress or anxiety from the impacts of the flood. Poor quality housing can increase vulnerability to many flood risks, including flood inundation, power outages, mold growth, rodent vectors, and serious health impacts. For those with limited finances, flood inundation and impacts to infrastructure or farmlands may lead to extensive income losses.


The poorest residents suffer disproportionately to flood situations, especially those who have been less able to fund homeowner’s insurance to protect against flood losses. Loss of life is not unusual in flooding situations, as is loss of property, livestock, pets, workplaces, and tourist industries. There is a strong interrelationship between water events and other hazards. Flooding, storms and water quality are related to each other. Drought conditions can exacerbate floods as the surface soils are hardened and not as ready to allow surface water absorption. Extreme heat events can cause snowmelt, inundating waterways and causing flood and water quality issues. Flooding and storm events can have impacts on public health, environmental health, agricultural health and economic system health. Mental health issues are reported for all people who have experience flood losses, including anxiety, fear, anger, sadness and grief. Additionally, waterborne disease outbreaks are reported weeks after the flood events. Mold contamination leads to indoor air issues. Damp indoor environments lead to increased prevalence of asthma, and also upper and lower respiratory symptoms.

These issues may influence the diverse CSU populations, both on and off campus, in a number of ways long after a flood event, or the related hazards impacts, has concluded.

**Landslides**

Although infrastructural losses are of secondary importance to the risk to humans themselves, research investigating the vulnerability of people to landslides is rare. The many reasons for this lack of data are related to the fact that the collapse of occupied buildings which makes it a function of structural vulnerability and therefore, indirect. The degree of vulnerability to landslides by an individual considered at high risk, or even the general populations, also depends on human behavior, including many of the traditional social factors that are difficult to measure such as situational awareness, prior knowledge of hazards, and decision-making capabilities.

Landslides can result in primary lifeline failures through the loss of roads or power and communication lines. Transportation routes are often expensive to clean up, and prolonged obstruction can disrupt the movement of people and goods. Risk from landslide relates to earthen and infrastructural losses. The degree of vulnerability to these events and their impacts depends on human behavior and the traditional social factors such as situational awareness, prior knowledge of hazards, social capital and decision-making capabilities, as well as increased vulnerability due to social factors, such as racial and economic disparities.

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**Power Outage/Public Safety Power Shutdowns (PSPS)**

Loss of power creates economic hardship to a region experiencing regular PSPS events, such as those experienced throughout the state over the recent years. Many businesses close, including gas stations, grocery stores, and local retail establishments. These impacts may deeply impact students dependent on support jobs, as well impacting family members of campus staff and faculty. PSPS increases risks to the public due to inability to use medical devices, spoilage of food and medicines, and disruption to infrastructure, such as supply of clean water and electricity used to run home medical equipment, such as lift chairs and ventilators.

**Tsunami**

**TBD**

**Wildfire**

Increased wildfire threat occurs especially in the end of fall, when conditions are driest, but before the winter rains have come; an east-to-west wind gusts exacerbate fire risk. Wildfire threats have the concomitant threat of Public Safety Power Shutoffs (PSPS). And, in the case of an actual wildfire, danger exists both from fire and from the smoke. Recent wildfires have demonstrated that some demographics are disproportionately affected. Native Americans are six times more likely to be affected than white people. Blacks and Hispanic people are 50 percent more vulnerable. These values take into account the likelihood of a community being affected and the greater difficulty of that community to recover. These statistics reflect the lack of access to resources to pay for insurance, to rebuild and recover, to implement fire safety measures, and to access other resources. Price gouging after a fire (such as documented in Sonoma County after the 2017 Tubbs Fire) further exacerbates the disparity. 207 Furthermore, the disabled and the elderly are at particular risk from extreme wildfire conditions, as they are often not as able to effectively evacuate. Of the 85 people who died in the Camp Fire in Butte in 2018, 62 of them were at least 65 years old.208

Smoke from wildfires creates a significant public health threat. Especially vulnerable are individuals who have heart or lung issues, such heart disease, lung disease or asthma. Those most vulnerable include the medically fragile, elderly and children. Air Quality Indexes track the level of the following:209 particulate matter, surface levels of ozone,

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carbon monoxide, sulfur dioxide, and nitrogen dioxide. All of these can cause respiratory distress and harm lungs.\textsuperscript{210}

The California Department of Public Health reports the increased public health risks, and risk indicators that include: heat-related ED visits, populations living in wildfire areas, adults with multiple chronic conditions, populations living in poverty, race/ethnicity, outdoor workers, public transit access, air conditioner ownership and tree canopy.\textsuperscript{211}

**Hazard Mitigation and Emergency Management Planning**

The goal of this high-level assessment is to provide a starting point to encourage further exploring campus social risks and vulnerabilities, as well as to inform and to enhance holistic emergency management and hazard mitigation decision making, planning processes and future adaptive risk management strategies. By including the social resilience factors, mitigation investments may move beyond standardized planning and regulations, structure and infrastructure projects, and natural systems protections to embrace a more expanded, customized emergency operations plan and an education and outreach program unique to the campus.

A more robust social resilience inquiry is strongly encouraged to develop an accurate picture, based on methodical and scientific research-based data. Such an effort would be envisioned through both nuanced discussions with a variety of campus stakeholders and the invitation of nontraditional stakeholders to join in a collaborative resilience partnership. Such a forward-leaning effort would be directly in keeping with CSU’s commitment to inclusion and equity in risk reduction.


Section 06
California State University, Chico

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6.1 University Profile

University History

California State University, Chico (CSU Chico) was opened in 1889 as a normal school and began awarding baccalaureate degrees in 1924. It became a charter institution of the California State University System in 1972 and changed its name to California State University, Chico. In 2015, CSU Chico became a federally recognized Hispanic-Serving Institution, and maintains that designation today. The school includes seven colleges and is classed as a Master’s College by the Carnegie Institute.

University Governance

The campus president is the chief executive officer who oversees the administration of the entire university. The president manages campus operations and fundraising, sets campus priorities, and oversees the hiring and support of staff and faculty. The president also maintains a close working relationship with the CSU’s systemwide office, reporting to the chancellor and participating in the systemwide Executive Council.

The provost is the chief academic officer of the university, overseeing all academic affairs and programs of the university. The provost reports directly to the president.

The CSU Chico University Advisory Board advises the development of programs and acts as a liaison between the institution, community, legislators, and other groups. It is made up of citizens from throughout the state.

The Academic Senate formulates academic, personnel, and professional policies, including fiscal policies. It consists of thirty-one elected and ten ex officio faculty members, the former of which are elected and may include faculty, staff, administrators, and students. There are more than thirty committees to which the Senate makes appointments.

University Mission

“Through excellence of inquiry, innovation, and experiential learning, we develop students who are critical thinkers, responsible citizens, diverse leaders, and inspired stewards of environmental, social, and economic resources.”

CSU Chico outlines three strategic priorities in support of their goals: Equity, Diversity, and Inclusion; Civic and Global Engagement; and Resilient and Sustainable Systems. These priorities aim to develop a welcoming campus with equitable opportunities, stronger connections with external communities, and sustainable environmental, social, and economic systems.

University Location

The 132-acre CSU Chico campus is located in Chico in central northern California, 90 miles north of Sacramento. Chico, a city of approximately 100,000, is situated between the Sacramento River and Sierra Nevada foothills. In addition to its core campus, the University also manages 800 acres of farmland and 4,043 acres of ecological reserves.
University Population

CSU Chico typically enrolls over 17,000 students per year. During the 2019-2020 school year, the student population was overwhelmingly made up of undergraduate degree seekers, among whom the average age is 22. White/Non-Hispanic students made up 43.6% of all students, with Hispanic/Latino students making up the second most populous group at 34%. Half of all students are first generation.

In addition to the student population, the University is home to 2,048 employees.

6.2 Interim Final Rule for Hazard Vulnerability and Risk Assessment

Requirement §201.6(c)(2): The plan shall include a risk assessment that provides the factual basis for activities proposed in the strategy to reduce losses from identified hazards. Local risk assessments must provide sufficient information to enable the jurisdiction to identify and prioritize appropriate mitigation actions to reduce losses from identified hazards.

Requirement §201.6(c)(2)(i): [The risk assessment shall include a] description of the type...location and extent of all natural hazards that can affect the jurisdiction. The plan shall include information on previous occurrences of hazard events and on the probability of future hazard events.

Requirement §201.6(c)(2)(ii): [The risk assessment shall include a] description of the jurisdiction’s vulnerability to the hazards described in paragraph (c)(2)(i) of this section. This description shall include an overall summary of each hazard and its impact on the community.

Requirement §201.6(c)(2)(ii): [The risk assessment] must also address National Flood Insurance Program (NFIP) insured structures that have been repetitively damaged floods.

Requirement §201.6(c)(2)(ii)(A): The plan should describe vulnerability in terms of the types and numbers of existing and future buildings, infrastructure, and critical facilities located in the identified hazard area.

Requirement §201.6(c)(2)(ii)(B): [The plan should describe vulnerability in terms of an] estimate of the potential dollar losses to vulnerable structures identified in paragraph (c)(2)(ii)(A) of this section and a description of the methodology used to prepare the estimate..

Requirement §201.6(c)(2)(ii)(C): [The plan should describe vulnerability in terms of] providing a general description of land uses and development trends within the community so that mitigation options can be considered in future land use decisions.

Requirement §201.6(c)(2)(iii): For multi-jurisdictional plans, the risk assessment must assess each jurisdiction’s risks where they vary from the risks facing the entire planning area.
6.3 Hazard Identification and Risk Assessment

Overview of California State University, Chico History of Hazards

Numerous federal agencies maintain a variety of records regarding losses associated with hazards. Unfortunately, no single source is considered to offer a definitive accounting of all losses. The Federal Emergency Management Agency (FEMA) maintains records on federal expenditures associated with declared major disasters. The US Army Corps of Engineers (USACE) and the Natural Resources Conservation Service (NRCS) collect data on losses during the course of some of their ongoing projects and studies. Additionally, the National Oceanic and Atmospheric Administration’s (NOAA) National Centers for Environmental Information (NCEI) database collects and maintains data about natural hazards in summary format. The data includes occurrences, dates, injuries, deaths, and estimated costs. Many of these databases and other data collection services, including the NCEI, have inherent data limitations when searching for information at a university scale.

The best available data and records were used throughout this assessment.

Hazard Identification

As part of the initial hazard identification process, the Campus Assessment Team considered potential hazards with the most chance to significantly affect the planning area. The hazards include those that have occurred in the past and may occur in the future. A variety of sources were used to develop the list of hazards considered including national, regional, and local sources such as emergency operations plans, FEMA’s How-To Series, websites, published documents, databases, and maps, as well as discussion among the Campus Assessment Team members.

In the initial phase of the planning process, the Campus Assessment Team considered XX hazards and the risks they create for the University and its material assets, population, and operations. The hazards initially considered, and the determinations as to the treatment of those hazards, are shown in Table 6-1 (following).

Table 6-1: Hazard Identification Determinations

<table>
<thead>
<tr>
<th>Hazard</th>
<th>Determination (Yes/No)</th>
<th>Reason for Determination</th>
<th>Future Occurrence Probability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Communicable Disease</td>
<td>Yes</td>
<td>Hazard of concern for campus</td>
<td>Highly Likely</td>
</tr>
<tr>
<td>Dam and Levee Failure</td>
<td>Yes</td>
<td>Hazard of concern for campus</td>
<td>Unlikely</td>
</tr>
<tr>
<td>Drought</td>
<td>Yes</td>
<td>Hazard of concern for campus</td>
<td>Highly Likely</td>
</tr>
<tr>
<td>Earthquake</td>
<td>Yes</td>
<td>Hazard of concern for campus</td>
<td>Possible</td>
</tr>
</tbody>
</table>
### Future Occurrence Probability

In order to determine the probability of future occurrences of each hazard profiled, the following scale was developed:

- **Highly Likely** - 76-100% that the hazard would occur annually.
- **Likely** - 50-75% that the hazard would occur annually.
- **Possible** - 11-49% that the hazard would occur each annually.
- **Unlikely** - 0-10% that the hazard would occur each annually.

<table>
<thead>
<tr>
<th>Hazard</th>
<th>Occurrence</th>
<th>Concern for Campus</th>
<th>Probability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Erosion</td>
<td>Yes</td>
<td>Hazard</td>
<td>Highly Likely</td>
</tr>
<tr>
<td>Extreme Temperature</td>
<td>Yes</td>
<td>Hazard</td>
<td>Likely (Heat); Unlikely (Cold)</td>
</tr>
<tr>
<td>Flood</td>
<td>Yes</td>
<td>Hazard</td>
<td>Possible</td>
</tr>
<tr>
<td>Hazardous Materials</td>
<td>Yes</td>
<td>Hazard</td>
<td>Possible</td>
</tr>
<tr>
<td>Landslide</td>
<td>Yes</td>
<td>Hazard</td>
<td>Unlikely</td>
</tr>
<tr>
<td>Power Outage</td>
<td>Yes</td>
<td>Hazard</td>
<td>Likely</td>
</tr>
<tr>
<td>Sea Level Rise</td>
<td>No</td>
<td>Not a hazard</td>
<td>N/A</td>
</tr>
<tr>
<td>Tsunami</td>
<td>No</td>
<td>Not a hazard</td>
<td>N/A</td>
</tr>
<tr>
<td>Volcano</td>
<td>Yes</td>
<td>Hazard</td>
<td>Unlikely</td>
</tr>
<tr>
<td>Wildfire</td>
<td>Yes</td>
<td>Hazard</td>
<td>Unlikely (Fire); Likely (Smoke)</td>
</tr>
</tbody>
</table>

---

*Note: The table above provides a summary of the hazards and their likelihood of occurrence on campus.*
Communicable Disease

Description of the Hazard

Communicable diseases are illnesses that occur due to infectious agents or their toxic products and are infectious due to their potential of transmission from one person or species to another by a replicating agent. They may be transmitted from a reservoir to a susceptible host either directly as from an infected person or animal or indirectly through the agency of an intermediate plant or animal host, vector, or the inanimate environment. Communicable diseases are clinically evident illness resulting from the presence of pathogenic microbial agents, including pathogenic viruses, pathogenic bacteria, fungi, protozoa, multi-cellular parasites, and aberrant proteins known as prions. The degree of spread of a communicable disease depends on both the ability of an organism to enter, survive and multiply in the host and the comparative ease with which the disease is transmitted to other hosts.

Some ways in which communicable diseases spread are by:

- Travel through the air, such as tuberculosis, measles, or COVID-19;
- Physical contact with an infected person, such as through touch (staphylococcus), sexual intercourse (gonorrhea, HIV), fecal/oral transmission (hepatitis A), or droplets (influenza, TB, COVID-19);
- Contact with a contaminated surface or object (Norwalk virus), food (salmonella, E. coli), blood (HIV, hepatitis B), or water (cholera); and
- Bites from insects or animals capable of transmitting the disease (mosquito: malaria and yellow fever; flea: plague).

Collectively, the twenty-three (23) campuses and Chancellor’s Office of the California State University (CSU) system have identified nine (9) communicable disease hazards that have had significant impacts on their respective student, faculty, and staff populations. Of these communicable diseases, COVID-19 is considered to be the most prominent and widespread agent across all CSU campuses. (See table below.)

1 California Legislative Information. *Health and Safety Code – HSC*. Print. Retrieved 03.22.2021 from: [https://leginfo.legislature.ca.gov/faces/codes_displaySection.xhtml?lawCode=HSC&sectionNum=120290.#--:text=(2)%20%E2%80%9CInfectious%20or%20communicable,has%20significant%20public%20health%20implications](https://leginfo.legislature.ca.gov/faces/codes_displaySection.xhtml?lawCode=HSC&sectionNum=120290.#--:text=(2)%20%E2%80%9CInfectious%20or%20communicable,has%20significant%20public%20health%20implications)
Table 6-2: Communicable Diseases at Identified CSU Campuses

<table>
<thead>
<tr>
<th>Collective List of Communicable Diseases Identified by All CSU Campuses</th>
<th>Number of CSU Campuses (Including Chancellor’s Office) Identifying Communicable Disease Having Significant Impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>COVID-19 (SARS-CoV-2)</td>
<td>24</td>
</tr>
<tr>
<td>Meningitis</td>
<td>7</td>
</tr>
<tr>
<td>Measles</td>
<td>6</td>
</tr>
<tr>
<td>Influenza (Including H1N1/Swine Flu)</td>
<td>6</td>
</tr>
<tr>
<td>Tuberculosis</td>
<td>5</td>
</tr>
<tr>
<td>Norovirus</td>
<td>4</td>
</tr>
<tr>
<td>Mumps</td>
<td>2</td>
</tr>
<tr>
<td>E. Coli</td>
<td>2</td>
</tr>
<tr>
<td>Sexually Transmitted Diseases (STDs)</td>
<td>2</td>
</tr>
</tbody>
</table>

(Source: Interviews with CSU campus staff at CSU campuses and at CSU Chancellor’s Office.)

With the exception of COVID-19, there is variability among CSU campuses regarding which communicable diseases have had the greatest impact on individual campus communities. Table 6-3 (following) shows the communicable disease hazards that have had the greatest impact on each CSU campus.

Table 6-3: Communicable Disease Hazards at CSU Campuses with Greatest Impact

<table>
<thead>
<tr>
<th>CSU Campus</th>
<th>Identified Communicable Disease Hazards with the Greatest Impact on CSU Campus</th>
</tr>
</thead>
<tbody>
<tr>
<td>CSU Bakersfield</td>
<td>COVID-19, Meningitis</td>
</tr>
<tr>
<td>CSU Channel Islands</td>
<td>COVID-19, Measles</td>
</tr>
<tr>
<td><strong>CSU Chico (Chico State)</strong></td>
<td>COVID-19, Tuberculosis</td>
</tr>
<tr>
<td>CSU Dominguez Hills</td>
<td>COVID-19</td>
</tr>
<tr>
<td>Cal State East Bay</td>
<td>COVID-19, Meningitis</td>
</tr>
<tr>
<td>Fresno State</td>
<td>COVID-19, Meningitis, Tuberculosis</td>
</tr>
<tr>
<td>Cal State Fullerton</td>
<td>COVID-19, Influenza</td>
</tr>
<tr>
<td>Humboldt State</td>
<td>COVID-19, Measles, Norovirus, Influenza, STDs</td>
</tr>
<tr>
<td>Cal State Long Beach</td>
<td>COVID-19</td>
</tr>
</tbody>
</table>
Descriptions of Identified Communicable Disease Hazards at CSU Chico

CSU Chico has identified two (2) communicable disease hazards that have had the greatest impact on campus – COVID-19 and Tuberculosis. The following are brief descriptions of the communicable disease hazards at CSU Chico.

COVID-19 (SARS-CoV-2)

Coronaviruses are a family of viruses that can cause illnesses such as the common cold, severe acute respiratory syndrome (SARS) and Middle East respiratory syndrome (MERS). In 2019, a new coronavirus was identified as the cause of a disease outbreak that originated in China. This virus is now known as the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2). The disease it causes is called Coronavirus Disease 2019 (COVID-19). In March 2020, the World Health Organization (WHO) declared the COVID-19 outbreak a pandemic.

Signs and symptoms of coronavirus disease 2019 (i.e., COVID-19) may appear two to 14 days after exposure. Common signs and symptoms can include fever, cough, and tiredness. Early symptoms of COVID-19 may also include a loss of taste or smell.
The virus that causes COVID-19 spreads easily among people, and more continues to be discovered over time about how it spreads. Data has shown that the COVID-19 virus spreads mainly from person to person among those in close contact (within about 6 feet or 2 meters). The virus is transmitted by respiratory droplets being released when someone with the virus coughs, sneezes, breathes, sings or talks. These droplets can be inhaled or land in the mouth, nose or eyes of a person nearby. In some situations, the COVID-19 virus can spread by a person being exposed to small droplets or aerosols that stay in the air for several minutes (i.e., airborne transmission). It’s not yet known how commonly the virus spreads this way. The COVID-19 virus can also spread if a person touches a surface or object with the virus on it and then touches his or her mouth, nose or eyes; however, this is not considered to be a main form of transmission.

The severity of COVID-19 symptoms can range from very mild to severe. Some people may have only a few symptoms, and some people may have no symptoms at all. Others may experience shortness of breath and pneumonia. People who are older have a higher risk of serious illness from COVID-19, and the risk increases with age. People who have existing medical conditions also may have a higher risk of serious illness. In some cases, the disease can cause severe medical complications and may even lead to death.⁵

**Tuberculosis (TB)**

TB is a potentially serious infectious disease that mainly affects the lungs. TB is caused by bacteria that spread from person to person through microscopic droplets released into the air. This can happen when someone with the untreated, active form of TB coughs, speaks, sneezes, spits, laughs or sings.

Although TB is contagious, it’s not easy to catch. It is more likely for someone to get TB from a close family member or coworker than from a stranger. Most people with active TB who have had appropriate drug treatment for at least two weeks are no longer contagious. However, many strains of TB resist the drugs most used to treat the disease. People with active TB must take several types of medications for many months to eradicate the infection and prevent development of antibiotic resistance.⁶

**Location of the Hazard**

Communicable diseases have the potential to affect the entire CSU-Chico (Chico State) planning area. As a result, this hazard can be found at the CSU Chico campus located in

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Chico, CA (Butte County). Because of the ubiquitous nature of many communicable diseases, students, faculty, staff, and visitors to CSU-Chico are at risk of exposure⁷.

**CSU Student Housing Locations and Populations**

Although CSU-campus-owned student housing opportunities have been severely limited due to the COVID-19 pandemic, this situation is temporary. Eventually, students will be allowed back on campus at full capacity, and many of these students will be living in campus-owned housing. When this occurs, over 53,000 students (i.e., just over 11% of the CSU total enrollment) will be at increased risk of exposure to communicable disease hazards, owing to the “close-quarters” living arrangements in student housing. For CSU – Chico, approximately 12% of its 17,019 enrolled students or 2100 students reside in student housing⁸,⁹.

**Extent of the Hazard**

Various communicable diseases are categorized by the Center for Disease Control and Prevention (CDC) by levels of containment called Biosafety Levels (or BSLs). The higher the BSL, the greater the level of containment and level of effort necessary to prevent transmission of the disease, and therefore the greater the hazard. Biosafety Levels prescribe procedures and levels of containment for a particular microorganism or material (including research involving recombinant or synthetic nucleic acid molecules) and procedures associated with that containment. BSLs also consider primary barriers (e.g., biosafety cabinets), secondary barriers, facility design, air handling, laboratory security, etc. BSLs are graded from 1 to 4; as the BSL increases so does the relative risk of the agent/procedures as well the stringency of procedures and facility design.

Figure 6-1 describes the different BSLs, and provides examples of communicable diseases that would typically fall in to these classifications, as well as the typical protections that would be necessary to prevent transmission of each of the diseases.

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The Extent of CSU Chico Communicable Disease Hazards Except COVID-19:

Before the COVID-19 pandemic, there were cases of Tuberculosis at CSU Chico. Tuberculosis would be classified at either the BSL-2 or BSL-3 containment level.\textsuperscript{11}

The Extent of CSU Chico COVID-19 Communicable Disease Hazard:

As a microorganism, the SARS-CoV-2 (COVID-19) virus requires a high level of containment. It is therefore classified at BSL-3.\textsuperscript{12}

Over an approximately one-year period, from mid-March, 2020 to March 23, 2021, there were a reported \textbf{325} cases of COVID-19 at CSU Chico. CSU-campus-specific COVID-19 case data for CSU Chico can be found in the \textit{History of the Hazard} section below.

\textbf{History of the Hazard}

Most communicable disease data are maintained by the state and at the county levels and are not generally available at the municipal or campus levels, unless (a) the CSU campus falls under the jurisdiction of a city-level health department, or (b) a geographically specific outbreak occurs on campus or in the local community. The exception to this is the current COVID-19 pandemic, where both campus and County-level


\textsuperscript{11} Stanford Environmental Health & Safety. \textit{Biosafety Levels for Biological Agents}. Retrieved 03.31.2021 from: \url{https://ehs.stanford.edu/reference/biosafety-levels-biological-agents}

case data have been collected. As a result, it is important to provide COVID-19 case statistics for both CSU campuses and the counties where CSU campus assets are located. The following table (6-6) includes confirmed COVID-19 cases involving CSU-Chico students, faculty or staff who may have exposed others while working, visiting, attending in-person instruction, or living on campus (student housing) during the illness and total cases and deaths in Butte County.

Table 6-4: Comparison of Cases at CSU Chico and in Butte County (as of 03.22.2021)

<table>
<thead>
<tr>
<th>COVID-19 Cases at CSU Chico</th>
<th>COVID-19 Cases in Butte County, CA</th>
</tr>
</thead>
<tbody>
<tr>
<td>As of 03/22/2021, there were a total of 325 positive COVID-19 cases identified in the Chico State community since August 1, 2020. This total is updated on a weekly basis every Friday afternoon.</td>
<td>Total Cases: 10,975</td>
</tr>
<tr>
<td></td>
<td>Total Deaths: 171</td>
</tr>
</tbody>
</table>

*These case data are updated on at least a weekly basis. (Please note that the COVID-19 case numbers here may not reflect the most recent updates.)*

Potential Impacts of the Hazard

Communicable disease outbreaks and pandemics potentially have (and will continue to have) direct impact on life, health, and safety across the CSU system (including the CSU – Chico campus). The extent of this impact is contingent on the type of infection or contagion, the severity of the outbreak, and the speed at which it is transmitted. Property and infrastructure integrity may be affected if large portions of the campus population contract communicable diseases at the same time and are therefore unable to perform maintenance, operations, and educational tasks. This would be particularly disruptive if those impacted are first responders or other essential personnel. Long-term outbreaks affecting large numbers of CSU – Chico students could result in cancelled classes, delayed matriculation, or other disruptions to the CSU System’s mission. This has already occurred with the current COVID-19 pandemic, and could occur again with more virulent strains of communicable diseases, including COVID-19.

Communicable disease hazards found across the CSU system (including CSU – Chico) vary both by level of containment (BSL) (described previously) and by level of individual/public health risk, or Risk Group (RG) level. While BSLs describe the procedures and required levels of containment in a laboratory setting, Risk Groups (RGs) reflect the potential effects of disease exposure on humans or animals. Like BSLs, RGs range from Level 1 (RG1) to Level 4 (RG4), with Level 1 (RG1) posing minimal risk to healthy individuals and public health and Level 4 (RG4) posing a very serious or extreme


BSLs generally correlate with Risk Group (RG) Levels (e.g., a RG2 agent is worked with at BSL-2), but there are exceptions (e.g., production volumes, high-risk procedures, etc.).

The World Health Organization’s (WHO) Laboratory Biosafety Manual, 3rd ed., NIH Guidelines, categorizes Risk Groups (RGs) in the following way:

Table 6-5: WHO Risk Group Categorization

<table>
<thead>
<tr>
<th>Risk Group (RG)</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>RG1</td>
<td>Rarely associated with disease in healthy adult humans or animals and pose no-to-little public health risk (e.g., Saccharomyces cerevisiae, E. coli K-12 strain derivatives often used for recombinant/molecular biology, many environmental organisms)</td>
</tr>
<tr>
<td>RG2</td>
<td>Associated with mild to moderate disease for which preventative measures or post exposure treatments are often available; public health impact is limited (e.g., Streptococcus pyogenes, Salmonella, hepatitis B virus)</td>
</tr>
<tr>
<td>RG3</td>
<td>Associated with serious to lethal human disease for which preventative vaccines or post-exposure therapies may be scarce. Public health impact is limited-to-moderate (e.g., Mycobacterium tuberculosis, hantaviruses, West Nile virus, SARS)</td>
</tr>
<tr>
<td>RG4</td>
<td>Associated with serious to lethal human disease for which preventative vaccines or post exposure therapies are not usually available. Public health impact is high (e.g., Ebola virus, Marburg virus, smallpox virus, etc.)</td>
</tr>
</tbody>
</table>

Table 6-9 describes the four (4) Risk Group Levels (RGs), and provides examples of communicable diseases that would typically fall in to these classifications, and the typical protections that would be necessary to prevent transmission of the disease. It is important to note that all but two (2) communicable disease hazards identified by CSU campuses fall under either the lower-risk RG1 or RG2 categories. COVID-19 and tuberculosis are the two (2) communicable diseases fall under the higher-risk RG3 category. However, with the advent of the recently-developed COVID-19 vaccine, and with the expectation of an increasingly robust vaccine supply, it is possible that the RG level

---


for COVID-19 could be lowered in the future, thereby reducing both the extent and the potential impact of COVID-19.

Table 6-6: Risk Group Levels (RGs) with Example Diseases and Recommended Precautions

<table>
<thead>
<tr>
<th>Level</th>
<th>Examples</th>
<th>Typical Protection to Prevent Transmission</th>
</tr>
</thead>
<tbody>
<tr>
<td>RG 1</td>
<td>E. Coli</td>
<td>Precautions are minimal, most likely involving gloves and some sort of facial protection. Usually, contaminated materials are left in open (but separately indicated) waste receptacles. Decontamination procedures for this level are similar in most respects to modern precautions against everyday viruses (i.e.: washing one's hands with anti-bacterial soap, washing all exposed surfaces of the lab with disinfectants, etc.).</td>
</tr>
<tr>
<td></td>
<td>Chicken Pox, Hepatitis A, B, C, Lyme disease, Salmonella, Mumps, Measles, Malaria, Malaria, Scrapie, Dengue Fever, HIV</td>
<td>These bacteria and viruses cause mild disease in humans or are difficult to contract via aerosol. Routine diagnostic work with clinical specimens can be done safely at BSL-2, using BSL-2 practices and procedures.</td>
</tr>
</tbody>
</table>

17 CDC/National Institutes of Health. *Biosafety in Microbiological and Biomedical Laboratories, 6th Ed.* Print. Retrieved 05.03.2021 from: [https://www.cdc.gov/labs/BMBL.html](https://www.cdc.gov/labs/BMBL.html)
These bacteria and viruses cause severe to fatal disease in human, but vaccines or other treatments do exist to combat them. Laboratory personnel have specific training in handling pathogenic and potentially lethal agents and are supervised by competent scientists who are experienced in working with these agents. This is considered a neutral or warm zone.

These viruses and bacteria cause severe to fatal disease in humans, for which vaccines or other treatments are not available. When dealing with biological hazards at this level the use of a Hazmat suit and a self-contained oxygen supply is mandatory. The entrance and exit of a BSL-4 lab will contain multiple showers, a vacuum room, an ultraviolet light room, autonomous detection system, and other safety precautions designed to destroy all traces of the biohazard. Multiple airlocks are employed and are electronically secured to prevent both doors opening at the same time. All air and water service going to and coming from a BSL-4 lab will undergo similar decontamination procedures to eliminate the possibility of an accidental release.

**Probability of Future Occurrence of the Hazard**

There are significant data limitations regarding non-COVID-19 communicable disease cases, as the information thereof is outdated, anecdotal, and/or inadequate. As a result, it is not feasible to provide quantitative probabilities of future occurrence for non-COVID-19 communicable disease hazards. However, based on the limited data, it is feasible to present qualitative probabilities of future occurrence based on ranges of communicable disease frequency.

Table 6-10 shows a probability scale of future occurrence for the nine (9) communicable disease hazards profiled in this assessment. This scale is divided into four (4) levels of probability:

<table>
<thead>
<tr>
<th>Likelihood</th>
<th>Parameters for Determining Likelihood</th>
</tr>
</thead>
</table>

Table 6-7: Likelihood of Future Hazard Occurrence
Highly Likely | 76 – 100% probability that hazard will occur annually (high to very high frequency)
Likely | 50 – 75% probability that hazard will occur annually (moderate to high frequency)
Possible | 11 – 49% probability that hazard will occur annually (low to moderate frequency)
Unlikely | 0 – 10% probability that hazard will occur annually (very low to low frequency)

Due to significant data limitations surrounding non-COVID communicable diseases, the probability of future occurrence of CSU-system-wide communicable disease is measured by the proportion of campuses that have identified a particular communicable disease as having an impact on the campus community. In this measure, the more frequent a communicable disease is seen as impactful CSU-wide, the greater the probability of future occurrence.

Note: Each communicable disease’s system-wide probability ranking reflects the ranking at the individual CSU campus level unless noted otherwise.

Table 6-8: Probability of Future Occurrence of Communicable Disease Hazard for CSU Systems

<table>
<thead>
<tr>
<th>Collective List of Communicable Diseases Identified by All CSU Campuses</th>
<th>Number of CSU Campuses (Including Chancellor’s Office) Identifying Communicable Disease Having Significant Impact</th>
<th>Proportion of CSU Campuses Identifying Communicable Disease as Having Significant Impact System-Wide</th>
<th>CSU System-Wide Probability Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>COVID-19 (SARS-CoV-2)</td>
<td>24</td>
<td>1.00</td>
<td>Highly Likely</td>
</tr>
<tr>
<td>Meningitis</td>
<td>7</td>
<td>0.29</td>
<td>Possible</td>
</tr>
<tr>
<td>Measles</td>
<td>6</td>
<td>0.25</td>
<td>Possible</td>
</tr>
<tr>
<td>Influenza (Including H1N1/ Swine Flu)</td>
<td>6</td>
<td>0.25</td>
<td>Possible</td>
</tr>
<tr>
<td>Tuberculosis</td>
<td>5</td>
<td>0.21</td>
<td>Possible</td>
</tr>
<tr>
<td>Norovirus</td>
<td>4</td>
<td>0.17</td>
<td>Possible</td>
</tr>
<tr>
<td>Mumps</td>
<td>2</td>
<td>0.08</td>
<td>Unlikely</td>
</tr>
<tr>
<td>E. Coli</td>
<td>2</td>
<td>0.08</td>
<td>Unlikely</td>
</tr>
</tbody>
</table>
Sexually Transmitted Diseases (STDs)  2  0.08  Unlikely

(Source: Interviews with staff at CSU campuses and at the CSU Chancellor’s Office.)

Vulnerability to the Hazard

Vulnerability to a communicable diseases hazard resides in the population of a given area – both human and animal – not in the infrastructure or physical assets. While CSU assets and infrastructure could be impacted indirectly by the communicable disease hazard, these impacts would be secondary to the impact that the communicable disease hazard would have on students, faculty, staff, and visitors at CSU campuses.

CSU campus settings are geographically diverse, with locations ranging from small towns to medium-sized cities to densely populated urban areas. Hundreds of thousands of people work, study, and/or pass through CSU campuses on any given day. (As of Fall 2019, the CSU System had 480,541 students and 53,763 faculty and staff.)\(^{18,19}\) Each of these persons is vulnerable to communicable disease, particularly if it is a pathogen that individual has not been immunized against, or for which no immunization exists. Prolonged outbreaks could result in a loss of services, failure of infrastructure (from lack of operators or maintenance), and closure of facilities. This exact scenario has played out to some degree on campus in the current COVID-19 pandemic.

Estimate of Potential Losses

**COVID-19 Pandemic Health Impact on CSU Campuses and Surrounding Communities**

The most prescient metric for estimating losses from COVID-19 is loss of life. The nationwide campus-related COVID-19 death rate of 0.02% remains well below the average COVID-19 death rate in the U.S. However, due to data limitations, there is no information on CSU-campus-specific deaths by COVID-19 or by any other communicable diseases. In fact, COVID-19 is the only communicable disease for which case reports have been readily available for CSU campuses.

At some point in the future, CSU campuses will return to full capacity. Without adequate surveillance regarding campus access and student and employee interaction, CSU campuses (including CSU – Chico) are at risk of developing an extreme incidence of COVID-19, and may become “super-spreaders” for adjacent communities.\(^{20}\) The emergence of more virulent COVID-19 variants would only add to the potential for high negative impacts on life safety, operations, and service delivery across the CSU system.

\(^{18}\) The California State University. *Enrollment*. Retrieved 05.03.2021 from: https://www2.calstate.edu/csu-system/about-the-csu/facts-about-the-csu/enrollment/Pages/default.aspx

\(^{19}\) The California State University. *Employee Head Count by Campus*. Retrieved 05.03.2021 from: https://www2.calstate.edu/csu-system/faculty-staff/employee-profile/csu-workforce/Pages/employee-headcount-by-campus.aspx

(Other communicable diseases would also re-emerge, but with low to moderate negative impacts on life safety, operations, and service delivery.)

**Economic Impact of COVID-19 Pandemic on CSU Financial Health**

During the first few months of the COVID-19 pandemic in 2020, the CSU system suffered tremendous negative fiscal impacts. From March through July of 2020 alone, over $146 million worth of revenue losses were sustained across the CSU system due to refunds to students for parking, housing and dining service fees during Spring Semester, 2020. (See Figure 4-5 below for the economic impact to the CSU – Chico campus). Several CSU campuses saw refund losses surpass $10 million. (See Figure 6-2).
Mitigative Relief from Federal Assistance

The $1.5 billion in total federal assistance sent to the CSU system will help relieve the losses of revenues from services like dorms, parking and dining services during a year of mainly empty campuses. (See Table 6-13). However, because of staggering COVID-related revenue losses, the CSU system is planning for three (3) years of fiscal duress.

Table 6-9: Total Federal Assistance to CSU for COVID-19-Related Losses, 2020 – 2021\(^{22,23,24}\)

---

<table>
<thead>
<tr>
<th>Institution</th>
<th>Funding Allocation</th>
</tr>
</thead>
<tbody>
<tr>
<td>California Polytechnic State University</td>
<td>$20,752,799</td>
</tr>
<tr>
<td>California State Polytechnic University, Pomona</td>
<td>$48,614,353</td>
</tr>
<tr>
<td>California State University Channel Islands</td>
<td>$14,288,099</td>
</tr>
<tr>
<td>California State University Maritime Academy</td>
<td>$1,381,700</td>
</tr>
<tr>
<td>California State University - Sacramento</td>
<td>$59,891,260</td>
</tr>
<tr>
<td>California State University, Bakersfield</td>
<td>$22,855,632</td>
</tr>
<tr>
<td>California State University, Chico</td>
<td>$31,603,856</td>
</tr>
<tr>
<td>California State University, Dominguez Hills</td>
<td>$31,843,563</td>
</tr>
<tr>
<td>California State University, East Bay</td>
<td>$24,243,652</td>
</tr>
<tr>
<td>California State University, Fresno</td>
<td>$52,725,317</td>
</tr>
<tr>
<td>California State University, Fullerton</td>
<td>$67,736,949</td>
</tr>
<tr>
<td>California State University, Long Beach</td>
<td>$67,421,424</td>
</tr>
<tr>
<td>California State University, Los Angeles</td>
<td>$61,905,561</td>
</tr>
<tr>
<td>California State University, Monterey Bay</td>
<td>$13,455,716</td>
</tr>
<tr>
<td>California State University, Northridge</td>
<td>$74,004,088</td>
</tr>
<tr>
<td>California State University, San Bernardino</td>
<td>$42,438,131</td>
</tr>
<tr>
<td>California State University, San Marcos</td>
<td>$26,602,684</td>
</tr>
<tr>
<td>California State University, Stanislaus</td>
<td>$22,007,207</td>
</tr>
<tr>
<td>Humboldt State University</td>
<td>$16,130,016</td>
</tr>
<tr>
<td>San Diego State University</td>
<td>$45,914,127</td>
</tr>
<tr>
<td>San Francisco State University</td>
<td>$47,404,409</td>
</tr>
<tr>
<td>San Jose State University</td>
<td>$46,631,939</td>
</tr>
<tr>
<td>Sonoma State University</td>
<td>$13,980,795</td>
</tr>
<tr>
<td><strong>CSU System-Wide Totals</strong></td>
<td><strong>$853,833,277</strong></td>
</tr>
</tbody>
</table>

**Vulnerability Assessment Conclusions**

Before the COVID-19 pandemic, populations at all CSU campuses and CSU-affiliated facilities were substantial. Collectively, as of Fall 2019, CSU campuses had 480,541 students and 53,763 faculty and staff. All were at risk from the communicable disease events, with 534,304 people being directly vulnerable. The COVID-19 pandemic has caused campus population numbers to plummet to a small fraction of full capacity.

At some point in the future, campus population numbers will return to their pre-pandemic levels, and students, faculty, and staff will again be vulnerable to the communicable
disease hazard. If just 10% of the total CSU population were to become ill with a highly infective communicable disease like influenza or another strain of SARS, this would mean that approximately 53,430 people would be sick at the same time. This scenario would likely overwhelm available on-campus medical services could even overwhelm portions of the larger community’s medical resources – especially if there were large numbers of infected people with immune system compromises or other underlying health problems.

See Table 6-10 below for the “10% outbreak scenario” projections for the CSU – Channel Islands campus and for the entire CSU system:

Table 6-10: Scenario of Communicable Disease Hazard Affecting 10% of the CSU Population

<table>
<thead>
<tr>
<th>CSU Campus</th>
<th>Approximate Enrollment Population (Fall 2019)&lt;sup&gt;26&lt;/sup&gt;</th>
<th>Approximate Total FT/PT Faculty/Staff Population (Fall 2019)&lt;sup&gt;26&lt;/sup&gt;</th>
<th>Total Combined Approximate Student and Faculty/Staff Population</th>
<th>10% Outbreak Scenario (Students and Faculty/Staff Combined)</th>
</tr>
</thead>
<tbody>
<tr>
<td>CSU Bakersfield</td>
<td>11,199</td>
<td>1,277</td>
<td>12,476</td>
<td>1,248</td>
</tr>
<tr>
<td>CSU Channel Islands</td>
<td>7,093</td>
<td>994</td>
<td>8,087</td>
<td>809</td>
</tr>
<tr>
<td>CSU Chico (Chico State)</td>
<td>17,019</td>
<td>1,969</td>
<td>18,988</td>
<td>1,899</td>
</tr>
<tr>
<td>CSU Dominguez Hills</td>
<td>17,027</td>
<td>1,761</td>
<td>18,788</td>
<td>1,879</td>
</tr>
<tr>
<td>Cal State East Bay</td>
<td>14,705</td>
<td>1,764</td>
<td>16,469</td>
<td>1,647</td>
</tr>
<tr>
<td>Fresno State</td>
<td>24,139</td>
<td>2,534</td>
<td>26,673</td>
<td>2,667</td>
</tr>
<tr>
<td>Cal State Fullerton</td>
<td>39,868</td>
<td>3,736</td>
<td>43,604</td>
<td>4,360</td>
</tr>
<tr>
<td>Humboldt State</td>
<td>6,983</td>
<td>1,171</td>
<td>8,154</td>
<td>815</td>
</tr>
<tr>
<td>Cal State Long Beach</td>
<td>38,074</td>
<td>4,004</td>
<td>42,078</td>
<td>4,208</td>
</tr>
</tbody>
</table>

<sup>26</sup> The California State University. Enrollment. Retrieved 05.04.2021 from: https://www2.calstate.edu/csu-system/about-the-csu/facts-about-the-csu/enrollment/Pages/default.aspx

<sup>26</sup> The California State University. Employee Head Count by Campus. Retrieved 05.04.2021 from: https://www2.calstate.edu/csu-system/faculty-staff/employee-profile/csu-workforce/Pages/employee-headcount-by-campus.aspx
<table>
<thead>
<tr>
<th>Institution</th>
<th>2021-22</th>
<th>2022-23</th>
<th>2023-24</th>
<th>2024-25</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cal State LA</td>
<td>26,361</td>
<td>2,821</td>
<td>29,182</td>
<td>2,918</td>
</tr>
<tr>
<td>Cal Maritime</td>
<td>911</td>
<td>329</td>
<td>1,240</td>
<td>124</td>
</tr>
<tr>
<td>CSU Monterey Bay</td>
<td>7,123</td>
<td>1,059</td>
<td>8,182</td>
<td>818</td>
</tr>
<tr>
<td>CSUN (Northridge)</td>
<td>38,391</td>
<td>3,832</td>
<td>42,223</td>
<td>4,222</td>
</tr>
<tr>
<td>Cal Poly Pomona</td>
<td>27,914</td>
<td>2,650</td>
<td>30,564</td>
<td>3,056</td>
</tr>
<tr>
<td>Sacramento State</td>
<td>31,156</td>
<td>3,228</td>
<td>34,384</td>
<td>3,438</td>
</tr>
<tr>
<td>Cal State San Bernardino</td>
<td>20,311</td>
<td>2,118</td>
<td>22,429</td>
<td>2,243</td>
</tr>
<tr>
<td>San Diego State</td>
<td>35,081</td>
<td>3,702</td>
<td>38,783</td>
<td>3,878</td>
</tr>
<tr>
<td>San Francisco State</td>
<td>28,880</td>
<td>3,401</td>
<td>32,281</td>
<td>3,228</td>
</tr>
<tr>
<td>San José State</td>
<td>33,282</td>
<td>3,568</td>
<td>36,850</td>
<td>3,685</td>
</tr>
<tr>
<td>Cal Poly San Luis Obispo</td>
<td>21,242</td>
<td>2,871</td>
<td>24,113</td>
<td>2,411</td>
</tr>
<tr>
<td>CSU San Marcos</td>
<td>14,519</td>
<td>1,687</td>
<td>16,206</td>
<td>1,621</td>
</tr>
<tr>
<td>Sonoma State</td>
<td>8,649</td>
<td>1,338</td>
<td>9,987</td>
<td>999</td>
</tr>
<tr>
<td>Stanislaus State</td>
<td>10,614</td>
<td>1,276</td>
<td>11,890</td>
<td>1,189</td>
</tr>
<tr>
<td>Office of the Chancellor</td>
<td>0</td>
<td>673</td>
<td>673</td>
<td>67</td>
</tr>
<tr>
<td>CSU System-Wide</td>
<td>480,541</td>
<td>53,763</td>
<td>534,304</td>
<td>53,430</td>
</tr>
</tbody>
</table>

Note: Enrollment figures do not include non-specific CSU campus International Programs (455 students) or CALStateTEACH Program (933 students).

While the case numbers of COVID-19 have been significantly lower (about 1% of the total CSU population) than those in the 10% scenario, the degree of virulence and resultant morbidity and mortality caused by COVID-19 have led to widespread campus shutdowns, educational disruption, and economic harm to the CSU system (including CSU - Chico). In
short, the real-time COVID-19 communicable disease outbreak scenario has proven far more devastating than the 10% simulated scenario.

**Identified Data Limitations**

There is a wealth of technical information available for communicable disease. However, there is also limited non-COVID-19 communicable disease data available regarding risk or vulnerability of specific populations throughout the CSU. Much of the data that does exist is protected by privacy policies, and therefore cannot be obtained for more specific populations. As a result, performing a detailed quantitative assessment for this hazard is difficult.

Data that could be collected prior to the next update in order to improve this methodology includes:

- Data regarding infection rates at the campus level and for specific populations;
- Data regarding communicable disease case numbers and outcomes, by CSU campus;
- Data regarding projected population changes;
- Data regarding absenteeism; and
- Data regarding increased operating costs as a result of absenteeism (i.e., temporary shifting of duties resulting in business interruption).

**Dam and Levee Failure**

**Description of the Hazard**

A dam failure represents the structural collapse of a dam that stores water in a reservoir behind the dam. These failures are typically the result of structural age, damage to the structure caused by earthquake or flooding, inadequate discharge or spillway capacity, inadequate maintenance, improper construction materials, or extreme inflow of water into the reservoir. Prolonged precipitation may result in overtopping of the dam resulting in structural compromise. The tremendous energy generated by a sudden breach of the dam will have significant downstream effects. Flood damage resulting from dam failures potentially will result in economic losses, environmental damage, destruction of agriculture, and human casualties. This type of incident is extremely dangerous as it can occur rapidly, with no warning resulting in an inability to effectively evacuate threatened communities.

A levee failure is similar to dam failures as the result will be a breach causing flooding on the dry side of the levee. Levees are embankments whose primary purpose is to furnish
flood protection from seasonal high water or divert the flow of water. Most levees in California are intended to withstand peak water levels generated by heavy precipitation or rapid snowmelt in a watershed. Other levees are designed to withstand fluctuating water levels on a continuous basis such as those in the California Delta exposed to tidal influences. Levees routinely extend for lengthy distances immediately protecting communities. Levees can be found throughout the state but are most prominent in the Sacramento and San Joaquin Valleys.

Levee failures can vary from over toppings to small uncontrolled discharge to catastrophic failure. Areas downstream of the failure will be subject to inundation dependent on the volume of water released. These levee failures are also typically the result of structural age, damage to the structure caused by earthquake or flooding, slumping, seepage underneath the levee, high velocity flows eroding the levee, inadequate capacity, inadequate maintenance, improper construction materials, or extreme inflow of water into the system. Flood damage resulting from levee failures potentially will result in economic losses, environmental damage, destruction of agriculture, and human casualties.

A dam or levee failure flooding will vary depending on a number of factors including the extent of the collapse or breach, the volume of water behind the structure, and the nature of the exposed downstream features. This unpredictable flooding presents a threat to life and property in addition to critical infrastructure. Lifelines and supply routes will likely be damaged or made impassible by flood erosion or standing water. Water quality and health concerns would likely be cascading effects of dam or levee failures.

Location of the Hazard

Butte County is home to a variety of flood control facilities and levee systems throughout the county. Chico sits at the base of the northern Sierra Mountains. There are dam facilities in the higher elevations to the east of the city.

The county is additionally downstream of facilities located in other counties. There are additional dam facilities north of the city in Shasta County containing significant amounts of water. Shasta Dam and Whiskeytown Dam feed into the Sacramento River. Failures of these facilities are expected to produce inundations that cover much of the northern Sacramento Valley but are projected to come within 2-3 miles and not enter Chico.

The Feather River feeds into Lake Oroville a reservoir created by the Oroville Dam. The dam is a California Department of Water Resources dam only a few miles upstream from Oroville, California. The Feather River drains a watershed of 3,604 square miles potentially producing tremendous amounts of runoff. This river system flows downstream from and away from Chico. However, important transportation routes from

the Sacramento area are within the inundation area. Additionally, the cities below the Oroville Dam are communities that members of the campus community likely reside.

Levees have been constructed to protect portions of Butte County including Chico. The Chico Creek-Mud Creek Levee System on the north side of the city protects Chico from the Big Chico Creek north to the levee. The CSU Chico campus north of the Big Chico Creek is located within a designated levee protected zone due to the Chico Creek-Mud Creek Levee.
Extent of the Hazard

Dams are classified according to the hazard that they pose to life and property in the event of failure, rather than the likelihood of that failure.

- **High hazard potential dams** may result in loss of human life, and will likely result in economic, environmental, or lifeline losses.

- **Significant hazard potential dams** are not expected to result in loss of life, but are expected to cause economic, environmental, and lifeline losses.

- **Low hazard potential dams** are not expected to result in loss of life, and there is a low expectation of economic, environmental, or lifeline losses. What losses do occur are generally limited to the dam owner.

- Dams classified as high hazard are required to have Emergency Action Plans (EAP). EAPS are formal documents that identify potential emergency conditions at the dam and specify preplanned actions to be followed in case of failure. An EAP is
required for all high hazard dams and is recommended for all significant hazard
dams. Based on these dam failure scenarios listed below, along with the
occurrence of minor spill events (see hazard history below), the planning
committee ranks the extent of the dam failure hazard as Moderate – although
large dams are prevalent in the area, as high-priority critical infrastructure, they
are closely maintained and monitored.

Table 6-11: Butte County Dams in Proximity to CSU Chico

<table>
<thead>
<tr>
<th>River</th>
<th>Dam</th>
<th>Storage</th>
<th>Hazard Severity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Feather</td>
<td>Oroville</td>
<td>3,537,577af</td>
<td>High Hazard</td>
</tr>
<tr>
<td>Dead Horse</td>
<td>California Park</td>
<td>335af</td>
<td>High Hazard</td>
</tr>
<tr>
<td>Little Butte</td>
<td>Magalia</td>
<td>2,900af</td>
<td>High Hazard</td>
</tr>
<tr>
<td>Little Butte</td>
<td>Paradise</td>
<td>11,500af</td>
<td>High Hazard</td>
</tr>
<tr>
<td>Sacramento</td>
<td>Shasta</td>
<td>4,661,860af</td>
<td>High Hazard</td>
</tr>
</tbody>
</table>

- The California Park Lake is a private lake built by an earthen embankment owned
  by the residential community association. The lake contains 335-acre feet of water.
  Water released from a failure of the dam is expected to enter into the Big Chico
  Creek flowing through the CSU Campus, however, is expected to remain within
  the creek channel. The inundation area does include parts of downtown Chico.

- The Paradise and Magalia Dams both are located on the Butte Creek River, a
  tributary to the Feather River. The river and the inundation zones are both
  immediately south of Chico. Inundation water is not expected to be threat directly
to the campus but may compromise California Highway 99 and access to/from the
  south.

- Shasta Lake is a large reservoir located in Shasta County approximately 80 miles
to the north of Chico. The Shasta Dam is a concrete gravity dam containing
4,661,860-acre feet of water on the Sacramento River system. A failure of Shasta
Dam would be catastrophic for much of the northern Sacramento Valley, but is
expected to remain west of Chico and 2 ½ miles from the campus. Transportation
routes would likely be heavily impacted limiting supplies, emergency resources,
and evacuation capabilities.

- The Oroville Dam was constructed to provide flood protection for the Sacramento
  Valley, hydroelectric power, and to provide storage of domestic and agricultural
  water to the region. The dam is subject to potential seismic activity as known fault
  lines extend near the dam including the Cleveland Hill and Swain Hill faults. The
  Oroville Dam is made up of two separate dams including the main dam and the
  service spillway/emergency spillway. The main dam is an earthen embankment
dam that is the tallest dam in the US at 770 feet tall. Oroville Dam complex
  experienced a potential compromise scenario and utilization of its emergency
spillway and implementation of its emergency action plan in February of 2017. The inundation maps for Oroville Dam indicate water flowing to the south away from Chico but covering transportation corridors from the Sacramento area.

Figure 6-4: Inundation Map
Extent – Levee Failure

Levees are used along numerous flood control and irrigation channels in the Chico area. The southern bank of Mud Creek is lined with a levee protecting the northern half of Chico including most of the campus. The CSU Chico campus lies within a levee flood
protected area. In the event Mud Creek was flowing at elevated levels and a failure of a levee were to occur, the CSU Bakersfield campus would likely experience flood related damages. This specific hazard would substantially alter the ability of the campus to maintain operations as damages would be extensive, the campus community would be heavily affected with the loss of life and homes, access to campus would be limited, and student financial capacity to support ongoing education being diminished. Based on these conditions, the planning committee ranks the extent of the levee failure hazard as **Moderate**.

**History of the Hazard**

California has witnessed only a small number of dam failures over past half century. There have been no occurrences of dam failures in Butte County. However, there have been instances of various levels of dam compromises in Butte County. The following examples did not threaten Chico directly but did result in numerous secondary impacts including the receipt and care of evacuees, community economic disruptions, and road closures.

- 1965, concrete spalled and cracked on the Lost Creek Dam. The dam did not fail and was repaired.
- July 5, 1997, a gate failure occurred on the Cresta Dam. This sent a surge of water down the Feather River into Lake Oroville causing a four-inch rise.
- February 11, 2007, heavy precipitation as a part of the series of powerful 2017 storms raised the Lake Oroville until overflowing the emergency spillways. The main spillway was damaged as a result of the heavy rains. The overflow of the emergency spillway caused extensive erosion and threatened to further undermine and collapse the concrete weir. A collapse did not occur, but the damage was extensive. The threat of collapse resulted in the evacuation of 188,000 people.

California has an extensive network of levees primarily throughout the Central Valley. These levees have been constructed using a variety of methods and often were built decades ago. Statewide, levee failures have occurred more frequently than dam failures. **In Butte County, there have been no instances of levee failure.**

**Potential Impacts of the Hazard**

Dam Failure Impacts - Water that is released due to a dam that has failed generates tremendous energy and force causing a flood that will be catastrophic to life and property. Water levels from the failed dam could be significantly higher than those experienced in worst case scenario flood events. Areas closer to the failed dam will be more likely to experience complete devastation while other areas within the inundation

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zone will see varying levels of flood waters. The extent of the impacts of a failed dam would vary based on a number of factors such as the volume of water released, the base flow of the river, the time of the failure, the amount of warning provided, and the distance from the dam. Impacts resulting from a dam failure include:

- Loss of life
- Property destruction or damage
- Loss of property contents
- Infrastructure damage
- Flooded or destroyed lifelines/supply routes
- Damaged or destroyed utilities
- Loss of community economic base
- Employment losses
- Agricultural (crops and livestock) damages or destruction
- Environmental damage
- Floods generating threats to public health
- Flood-generated debris

The areas near the CSU Chico campus are mostly out of any dam inundation zone of significance. The portions of the Chico region that would experience the most extensive threat to dam failure would include the western portions of the city in the event of a Shasta Dam failure, downtown areas of Chico from the California Park neighborhood dam, and the extreme southern portions of Chico in the event of a Paradise or Magalia Dam failure. Members of the campus community who reside or are employed in these areas would be most impacted. As a large-scale dam failure would cause wide-spread impacts, the campus may experience evacuees or emergency services requesting the use of campus facilities.

**Levee Failure Impacts**

A levee failure may result in substantial amounts of water to enter into developed areas protected by the levee. The force and volume of water that is generated by a levee failure may cause extensive structural damage in close proximity to the breach and effects of flooding spreading well beyond the point of the failure. The extent of the impacts would vary based on a number of factors such as the volume of water released, the time of the failure, the amount of warning provided, the location of the breach, elevation, and distance from the breach. Potential impacts resulting from a levee failure include:

- Loss of life
- Property destruction or damage
- Loss of property contents
- Infrastructure damage
- Public health hazards resulting from mold, mildew, and disease due to flood water
- Flooded or destroyed lifelines/supply routes
- Damaged or destroyed utilities
- Loss of community economic base
- Employment losses
- Agricultural (crops and livestock) damages or destruction
- Environmental damage
- Prolonged periods of necessary dewatering
- Disruptions to education delivery to community

**Probability of Future Occurrence of the Hazard**

Butte County is determined to be at risk from dam and levee failure in many parts of the county. The location of the CSU Chico remains outside of a dam inundation zone; however, the Inundation Zone for the Paradise and High dams lies immediately south of the Chico city limits. The Inundation Zone for the large Shasta Dam is immediately to the west of the Chico city limits. This demonstrates that the potential exists for future dam related issues in relatively close proximity to the campus. There are no official recurrence intervals that have been calculated for dam or levee failures. The probability of future occurrence for both dam and levee failures is **Unlikely**.

**Vulnerability to the Hazard**

The CSU Chico campus is subject to the effects of flooding resulting from compromised dams and levees. The Shasta, Whiskeytown, and Oroville Dams upstream from the campus presents the potential for catastrophic flooding and damage through large swaths of the Sacramento Valley. The campus is vulnerable to failures of these facilities directly in remote situations and indirectly as transportation routes, utilities, critical infrastructure, and other services supporting the campus would be severely impacted. In the case of dam failure, the amount of time to respond to the needs of the campus community prior to inundation will be limited.

The most significant challenge regarding dam failures is they generally result in catastrophic outcomes. Inundation mapping provides estimates of locations in the path of water released during a failure. Any breach along a levee is impossible to predict where a failure may occur. It is likely that response action will not be fully implemented until the incident situational intelligence provides adequate information as to compromised locations. These variables place all those working and living within the dam inundation and flood protection zones in vulnerable locations.
The dam inundation zones remain mostly outside of Chico. However, everyone downstream of the dam and within the inundation zone will be vulnerable to the effects of floods and forces of moving water. The levee systems presenting a threat to Chico exist along Mud Creek north of the city and along extending diversion irrigation channels scattered throughout the region. The distributed placement of levees, many near development may expose significant vulnerabilities to other areas of the region even if the campus is unaffected. There is potential the campus community will be affected as a breach may cause flooding and damages to the homes of students, faculty, and staff or to access/supply routes, utilities, or other critical services. The potential for flood damaged structures being left uninhabitable including academic buildings, operational support facilities, and campus residence halls will result in numerous displaced individuals. Property damage to campus facilities and equipment below the level of flood waters will likely occur. The lack of flood insurance will cause extreme financial burdens on those affected.

Vulnerability to a dam or levee failure on the CSU Chico campus will vary depending on when the failure was to occur. The risk to the campus population will be lessened during periods when classes are not in session or during periods of breaks. Conversely, during the days and hours that classes are in session and staff are at their workplaces, the human vulnerability increases. However, in region-wide events this vulnerability may be shared with the homes and workplaces of members of the campus community and their families.

Certain campus populations will experience greater challenges to a post-flood / failure environment. Vulnerable populations will likely need to navigate through flood generated debris, face extreme health safety issues from flood waters, experience extreme stresses of a disaster, an inability to communicate to or gain access to support networks, and find difficulty in accessing equipment or supplies to aid in a specific need.

**Estimate of Potential Losses**

Estimates of potential losses will be influenced by a variety of factors. The volume and force of the water will determine the scale of damages affecting campus infrastructure, equipment, and other impacted features. The proximity to the failure and elevation above flood waters will affect the level of damage and individuals exposed. The time of the academic year, the day of week, and hour in which the failure was to occur will influence the number of people on campus and potential casualties. Losses will be generated by the physical damages, the loss of revenue, loss of academic research, loss of building contents, and community wide economic reductions.

Based on estimate replacement costs of facilities and structures on campus, the total replacement costs due to dam or levee failure are $344,244,561. However, it is unlikely for a dam or levee failure event to cause catastrophic destruction at CSU Chico.

**Vulnerability Assessment Conclusions**
With the exception of the Oroville incident, occurrence of dam and levee failures have not been historically relevant near the CSU Chico campus, the potential for hazards related to the region’s levees and dams still exist. The presence of earthquake faults in proximity to the Oroville Dam, the county’s largest reservoir, presents a valid danger to the dam structure in the event of an earthquake. The consequences of a dam failure would generate catastrophic results to downstream communities. The potential for dam or levee failure further generates the added potential for a number of cascading effects such as disruptions to the local economy, utility failures, disruptions to providing for the needs of the community, and development of public health hazards. These effects would be exacerbated by effects of seasonal flooding, ongoing heavy precipitation, or excessive run-off from the watershed contributing to the river system. The potential for widespread flooding and damage of structures due to the force of water has exponentially powerful impacts on particular populations among the campus community including those with access or functional needs, international students, the homeless, and students residing in the residence halls.

Identified Data Limitations

Missing campus structural replacement costs and complete inventory of building construction features or mitigation efforts to lessen the impact due to flood inundation.

**Drought**

Description of the Hazard

Drought is defined as a condition where moisture levels fall significantly below normal for an extended period of time over a large area that adversely affects plants, animal life, and humans. Drought is a gradual phenomenon. Although droughts are sometimes characterized as emergencies, they differ from typical emergency events. Most natural disasters, such as floods or forest fires, occur relatively rapidly and afford little time for preparing for disaster response. Droughts occur slowly, over a multi-year period, and it is often not obvious or easy to quantify when a drought begins and ends.

Throughout California, one dry year does not normally constitute a drought. California’s extensive system of water supply infrastructure (reservoirs, groundwater basins, and conveyance assets) mitigates the effect of short-term dry periods for most water users. Defining when a drought begins is a function of drought impacts to water users. Drought in one location may not constitute a drought for all water users, as some users in relative proximity may have a different water supply. For example, individual water suppliers may use a combination of sources such as rainfall/runoff, water in storage, or expected supply from a water wholesaler to define their water supply conditions.

Drought can be characterized as one or more of the four following types:

- **Meteorological drought** is defined on the basis of the degree of dryness (in comparison to some “normal” or average amount) and the duration of the dry period. A meteorological drought must be considered as region-specific since the
atmospheric conditions that result in deficiencies of precipitation are highly variable from region to region.

- **Hydrological drought** is associated with the effects of periods of precipitation (including snowfall) shortfalls on surface or subsurface water supply (e.g., streamflow, reservoir and lake levels, ground water). The frequency and severity of hydrological drought is often defined on a watershed or river basin scale. Although all droughts originate with a deficiency of precipitation, hydrologists are more concerned with how this deficiency plays out through the hydrologic system. Hydrological droughts are usually out of phase with or lag the occurrence of meteorological and agricultural droughts. It takes longer for precipitation deficiencies to show up in components of the hydrological system such as soil moisture, streamflow, and ground water and reservoir levels. As a result, these impacts are out of phase with impacts in other economic sectors.

- **Agricultural drought** focus is on soil moisture deficiencies, differences between actual and potential evaporation, reduced ground water or reservoir levels, and so forth. Plant water demand depends on prevailing weather conditions, biological characteristics of the specific plant, its stage of growth, and the physical and biological properties of the soil.

- **Socioeconomic drought** refers to when physical water shortage begins to affect health, well-being, and quality of life of people, or when the drought starts to affect the supply and demand of an economic product that relies on water.

The drought issue in California is further compounded by water rights. The central challenge is how to prioritize water usage among a broad variety of contexts. It is for this reason that water is a commodity possessed and utilized under a variety of legal doctrines. As such, many competing sets of interests create a dynamic prioritization process between, for example, farming and federally protected fish habitats and water supply for municipal/public use (including usage for CSU - Chico) versus water usage for wildfire abatement or natural resource protection.

**Location of the Hazard**

Drought conditions have been identified in Butte County and the city of Chico where CSU - Chico is located. Drought is not a location-specific hazard and affects the entire planning area equally. Drought location is not isolated to each campus footprint but occurs as a geographic sub-set of drought conditions occurring at larger scales. From 2000-2020, drought conditions existed continuously somewhere in the state, with 80-100% of the state impacted for 12 of the last 20 years.29

That said, most of drought locations relate to groundwater sources; the water table is receding at the university farm.

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Extent of the Hazard

Given the historical occurrence of severe drought impacts throughout Butte County (including the planning area) and across the state and the potential future impact exacerbated by climate change, the CSU Planning Committee recognizes that drought will continue to pose a high degree of risk, potentially impacting crops, livestock, water resources, the natural environment at large, buildings and infrastructure (from land subsidence), and local economies. In addition, although drought affects the entire planning area, the potential impacts may be variable and specific to each campus/jurisdiction, depending on contextual factors such as the degree of assets and activities, historically impacted by drought within each jurisdiction. In addition, land subsidence has occurred and will continue in areas where the groundwater basin has been subject to overdraft and long-term recharge is inadequate to maintain the water table elevation, leaving underground voids. Subsidence levels in California have been measured up to 30-feet with subsidence bowls covering hundreds of square miles. As such, drought-related subsidence may result in serious structural damage to buildings, roads, irrigation ditches, underground utilities, and pipelines. These effects though rare, are issues of concern for the campus over the long term.30

The U.S. Drought Monitor developed tables of impacts reported during past droughts in California in order to depict the extent of drought risk for each level of drought on the U.S. These possible extent conditions for California complement the general impacts column of the U.S. Drought Monitor Classification Scheme.

Table 6-12: Impacts of Drought Levels as Determined by US Drought Monitor31

<table>
<thead>
<tr>
<th>Category</th>
<th>Impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>D0</td>
<td>Soil is dry; irrigation delivery begins early</td>
</tr>
<tr>
<td>D1</td>
<td>Dryland pasture growth is stunted; producers give supplemental feed to cattle</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Category</th>
<th>Impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>D2</td>
<td>Producers increase water efficiency methods and drought-resistant crops</td>
</tr>
<tr>
<td></td>
<td>Fire season is longer, with high burn intensity, dry fuels, and large fire spatial extent; more fire crews are on staff</td>
</tr>
<tr>
<td></td>
<td>Wine country tourism increases; lake- and river-based tourism declines; boat ramps close</td>
</tr>
<tr>
<td></td>
<td>Trees are stressed; plants increase reproductive mechanisms; wildlife diseases increase</td>
</tr>
<tr>
<td></td>
<td>Water temperature increases; programs to divert water to protect fish begin</td>
</tr>
<tr>
<td></td>
<td>River flows decrease; reservoir levels are low and banks are exposed</td>
</tr>
<tr>
<td>D3</td>
<td>Livestock need expensive supplemental feed, cattle and horses are sold; little pasture remains, producers find it difficult to maintain organic meat requirements</td>
</tr>
<tr>
<td></td>
<td>Fruit trees bud early; producers begin irrigating in the winter</td>
</tr>
<tr>
<td></td>
<td>Federal water is not adequate to meet irrigation contracts; extracting supplemental groundwater is expensive</td>
</tr>
<tr>
<td></td>
<td>Dairy operations close</td>
</tr>
<tr>
<td></td>
<td>Marijuana growers illegally tap water out of rivers</td>
</tr>
<tr>
<td></td>
<td>Fire season lasts year-round; fires occur in typically wet parts of state; burn bans are implemented</td>
</tr>
<tr>
<td></td>
<td>Ski and rafting business are low, mountain communities suffer</td>
</tr>
<tr>
<td></td>
<td>Orchard removal and well drilling company business increase; panning for gold increases</td>
</tr>
<tr>
<td></td>
<td>Low river levels impede fish migration and cause lower survival rates</td>
</tr>
<tr>
<td></td>
<td>Wildlife encroaches on developed areas; little native food and water is available for bears, which hibernate less</td>
</tr>
<tr>
<td></td>
<td>Water sanitation is a concern, reservoir levels drop significantly, surface water is nearly dry, flows are very low; water theft occurs</td>
</tr>
<tr>
<td></td>
<td>Wells and aquifer levels decrease; homeowners drill new wells</td>
</tr>
<tr>
<td></td>
<td>Water conservation rebate programs increase; water use restrictions are implemented; water transfers increase</td>
</tr>
<tr>
<td>Category</td>
<td>Impact</td>
</tr>
<tr>
<td>---------</td>
<td>--------</td>
</tr>
<tr>
<td>Water is inadequate for agriculture, wildlife, and urban needs; reservoirs are extremely low; hydropower is restricted</td>
<td></td>
</tr>
<tr>
<td>Fields are left fallow; orchards are removed; vegetable yields are low; honey harvest is small</td>
<td></td>
</tr>
<tr>
<td>Fire season is very costly; number of fires and area burned are extensive</td>
<td></td>
</tr>
<tr>
<td>Many recreational activities are affected</td>
<td></td>
</tr>
<tr>
<td>Fish rescue and relocation begins; pine beetle infestation occurs; forest mortality is high; wetlands dry up; survival of native plants and animals is low; fewer wildflowers bloom; wildlife death is widespread; algae blooms appear</td>
<td></td>
</tr>
<tr>
<td>Policy change; agriculture unemployment is high, food aid is needed</td>
<td></td>
</tr>
<tr>
<td>Poor air quality affects health; greenhouse gas emissions increase as hydropower production decreases; West Nile Virus outbreaks rise</td>
<td></td>
</tr>
<tr>
<td>Water shortages are widespread; surface water is depleted; federal irrigation water deliveries are extremely low; junior water rights are curtailed; water prices are extremely high; wells are dry, more and deeper wells are drilled; water quality is poor;</td>
<td></td>
</tr>
</tbody>
</table>

**History of the Hazard**

Although previous occurrence of drought is not identified specifically for the campus, historically, drought has been so prevalent in California that its presence is almost continuous. According to the US Drought Monitor, Time Series data, Butte County has experienced 7 periods of drought from 2000 – 2021.

Figure 6-7: Periods of Drought in Butte County, CA, 2001 – 2021

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According to the National Drought Mitigation Center, over 3,500 reports and publications covering 370 drought-related events took place across the state (many of which were statewide events) between 2000-2020. In addition, the National Center for Environmental Information (NCEI) reports more than 500 events statewide during this same time period. These events produced a comprehensive range of impacts to water supply, regulations and allocations to businesses and municipalities, budgets and resources for firefighting, water law and policy, and physical impacts to built and natural environments. As such, data records of previous occurrences can be viewed as separate time and event demarcations for a hazard almost continuously in effect across the state with cascading impact potential.

Best available data does not identify a timeline of historical occurrences specific to the campus, but the water table at the campus farm is receding, indicating the recent occurrence of drought on campus.

According to the Department of Water Resources, droughts exceeding three years are relatively common in Southern California, but relatively rare in Northern California - the region is the geographic source of much of the state’s developed water supply. The 1929-34 drought established the criteria commonly used in designing storage capacity and yield of large Northern California reservoirs.33

According to the US Drought Monitor’s time series data, from 2000-2021 (with the exception of a 2–3-month period in 2000 and 2011), some degree of drought conditions have been continuously in effect somewhere in California. In fact, 80% - 100% of the state has been subjected to drought conditions for 12 of the last 20 years, with the most severe drought being the 100% state-wide event from 2012-2017.

Figure 6-8: Periods of Drought in State of California, 2001 – 202134


Given the extent of the drought risk in California, the following drought event was selected as an exemplar due to its broad and significant impacts on the state and (according to the US Drought Monitor, Time Series data) on Butte County which includes the Chico State campus planning area:

2012 – 2017 – Drought produced severe impacts to water wells throughout the state of California, with a high number of wells running dry. Land subsidence due to increased groundwater pumping also occurred in numerous areas of the state such as the San Joaquin and Central Valleys. Crop damage was widespread as well. Water allotments were drastically reduced in many towns and water agencies, with extremely high costs for procuring water. In addition, job loss occurred with many families requiring food supply assistance, and water supply assistance provided to home-owners with dry wells. According to a report released by the UC Davis Center for Watershed Sciences, the 2012 – 2017 period of the California drought cost the state’s agriculture industry about $1 billion in lost revenue, with a total statewide economic cost of the drought calculated to be $2.2 billion. The report says, “it is responsible for the greatest water loss ever seen in California agriculture - about one third less than normal.” The report calls the groundwater situation in California “a slow-moving train wreck.” Spring snowpack at Donner Summit reached record low levels in 2014, exceeded in 2015 by a remarkable April 1 snow-water-equivalent value of only 5% of average. Decreased precipitation since contributed to near-record low levels in the Shasta Reservoir. The ongoing drought has contributed to declines in crop values across the state. For example, crops including cotton, corn silage and barley (the field crop category) fell by 42 percent.

Potential Impacts of the Hazard

Drought impacts are wide-reaching and may be economic, environmental, and/or societal. This assessment of its impact recognizes that historic occurrences of drought throughout the planning area are a sub-set of larger and inter-connected local and

regional droughts, and that the (related) historic impacts provide a sound basis for understanding potential (future) impacts.

The most significant potential impact associated with drought across the Chico State campus planning area is a reduction in water availability for the municipal area tied to each campus. In fact, groundwater reductions have resulted in a decreased water table at the campus farm. Other impacts include crop loss and damage to trees and other natural resources (See Tree Mortality below). The footprint of Chico State to some extent includes these vulnerable resources based on the campus landscape (trees) and the presence (and footprint size) of any agricultural research crops and/or field stations.

As a secondary impact of drought, wildfire is directly attributable to dry atmospheric conditions. Wildfires almost always coincide with drought in California, though not limited to such. However, the wildfire hazard is analyzed separately in this plan. (See wildfire section).

In reviewing the occurrences of drought for Chico State and Chico, CA, the US Drought Monitor and the National Drought Mitigation Center report that tens of millions of trees died during the (2012-2017) state-wide drought disaster. Though data sources do not provide data for tree mortality specific to Chico State the broad geographic extent of the impact makes it likely that tree mortality occurred to some degree on the campuses. Due to the lasting and ongoing effects of drought on the landscape, trees will continue to be impacted within the municipalities, counties and regions wherein lies the CSU campus system as long as drought conditions continue to occur in the future.

Given the absence of data, in order for the CSU Committee to assess the impact of tree mortality, it is useful to view it as a risk sub-set to the probability, location, extent, severity and duration of the drought hazard within each campus-located municipality, county and region. Regarding potential impacts, standing dead trees could fall, posing a risk to people, buildings, power lines, roads and other infrastructure. In addition, drought-impacted trees become susceptible to diseases and insect infestations (bark beetle) further adding to the risk of tree mortality and related potential impacts. No data is currently available for tree mortality on campus, however, the CSU Planning Team will pursue data on this issue in the future.

As a potential tertiary impact, prolonged and repeated drought conditions over time can produce land subsidence and the risk of damage to building foundations and infrastructure on campus resulting from ground instability and collapse. Land subsidence is defined as the vertical sinking of the land over manmade or natural underground voids. Subsidence is often the direct result of groundwater over-extraction in response to drought conditions, as well as oil and gas extraction. Weight can accelerate the process of subsidence resulting from surface development and infrastructure such as roads and buildings, vibrations from construction blasting and heavy truck or train traffic. For example, the State Water Project’s 444-mile-long California Aqueduct has required repairs

such as the raising of canal linings, bridges, and water control structures on the Aqueduct – in the Central Valley a five-mile reach of the Eastside Bypass was impacted by subsidence, and the Department of Water Resources estimated that it may cost in the range of $250 million to acquire flowage easements and levee improvements to restore the design capacity of the subsided area.\textsuperscript{38}

At present, drought-related damage to campus buildings and infrastructure at Chico State has not been reported, but the potential for such impacts is possible. With regard to overall potential impact, water supply/availability for Chico State is ultimately tied to broader inter-dependent, and more intensive modes of water use at local and regional scales such as agriculture and ranching, wildfire protection, larger metropolitan/municipal usage, manufacturing and commerce, tourism, recreation, and wildlife preservation. During drought periods, the State of California’s regulated water allocations are modified and often reduced, which can result in reduced water availability for all usage contexts, including Chico State. A reduction of electric power generation and water quality deterioration are also potential impact factors.

Table 6-13: Summary of Drought Impacts on Water Resources\textsuperscript{39}

<table>
<thead>
<tr>
<th>Resource</th>
<th>Type of Impact</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sea Level</td>
<td>Direct</td>
<td>Sea level is rising and will likely impact coastal areas</td>
</tr>
<tr>
<td>Soil Moisture</td>
<td>Direct</td>
<td>Prolonged dry seasons can lead to decreases in soil moisture; drier vegetation</td>
</tr>
<tr>
<td>Vegetation</td>
<td>Indirect</td>
<td>Longer and more intense fire season with increased extent of area burned</td>
</tr>
<tr>
<td>Stream Conditions</td>
<td>Direct</td>
<td>Increases in water temperature; potential effects on fish</td>
</tr>
<tr>
<td>Snowpack</td>
<td>Indirect</td>
<td>Increases in temperature will lead to decreases in snowpack</td>
</tr>
<tr>
<td>Runoff</td>
<td>Direct</td>
<td>Warmer temperatures are likely to lead to a shift in peak runoff from spring to winter and a likely decrease in summer base flow</td>
</tr>
<tr>
<td>Hydropower</td>
<td>Indirect</td>
<td>Decreased summer flows resulting from earlier snowmelt and a shift in peak runoff could affect hydropower generation during summer months</td>
</tr>
</tbody>
</table>


Precipitation | Direct | Warmer winter temperatures will result in a greater percentage of precipitation falling as rain rather than as snow
---|---|---
Groundwater | Indirect | Reduction in snowpack and extended periods of drought are likely to increase dependency on groundwater

Probability of Future Occurrence of the Hazard

**Highly Likely** — The US Drought Monitor’s time series data (2000-2020) indicates that some degree of drought has nearly a 100% probability of occurrence in the state in any given year. Given that Chico State lies within a drought impacted region, it is prudent to extend this likelihood of occurrence to the planning area.

Vulnerability to the Hazard

In California, rising temperatures are projected to increase the average lowest elevation at which snow falls, reducing water storage in the snowpack, particularly at those lower mountain elevations which are now on the margins of reliable snowpack accumulation. Higher spring temperatures will also result in earlier melting of the snowpack. The shift in snow melt to earlier in the season is critical for California’s water supply because flood control rules require that water be allowed to flow downstream and that water cannot be stored in reservoirs for use in the dry season. As such, state-level drought risk factors that have led to drought’s state-wide severity and extent, and potential impacts also create drought vulnerabilities at the level of the Chico State campus.

Moreover, climate change will likely adversely impact the vulnerability of watersheds and ecosystems in their ability to deliver important ecosystem services. These changes may limit the natural capacity of healthy forests to capture water and regulate stream flows. Sierra Nevada mountain winters and springs are warming, and on average, precipitation as snowfall relative to rain is decreasing. A warming climate with reduced snowpack will result in earlier snowmelt and will subsequently reduce downstream water availability during summer and early fall.

As such, the state and the Chico State planning area stakeholders potentially have less capacity to address future drought risks due to projected temperature increases and shortages in water; ground-water withdrawals have been occurring at a deficit rate of 1 – 2 million acre feet per year, where the impacts of drought include decreased availability of water for agriculture and environmental uses. In forested and other vegetated areas, prolonged drought decreases the moisture content of forest fuels and increases the risk of high severity wildfires.

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It should be pointed out that California is the single most productive agricultural state and its agricultural industry relies heavily on reservoir water supplied by snowmelt and rainfall runoff. Yearly variations in snowpack depths have implications for water availability as snowmelt from the winter snowpack feeds a network of reservoirs. Spring snowpack at Donner Summit reached record low levels in 2014, exceeded in 2015 by a remarkable April 1 snow-water-equivalent value of only 5% of average. Decreased precipitation since 2011 has contributed to near-record low levels in the Shasta Reservoir.\textsuperscript{41}

**Vulnerability of Populations**

The historical and potential impacts of drought on California’s population include agricultural sector job loss, secondary economic losses to local businesses and public recreational resources, increased cost to local and state government for large-scale water acquisition and delivery, and water rationing and water wells running dry for individuals and families. As drought is often accompanied by prolonged periods of extreme heat, negative health impacts such as dehydration can also occur, where children and elderly are most susceptible. Air quality often declines in times of drought which can affect those with respiratory ailments. These same vulnerabilities apply to the students, faculty and staff of the Chico State campus.

**Property Vulnerability**

The historical and potential impacts of drought on property include crop loss, injury and death of livestock and pets, and damage to infrastructure, homes and other buildings resulting from the secondary drought impact of land subsidence. The related drought impacts of tree mortality and land subsidence pose risks to vulnerable critical infrastructure and property. These same vulnerabilities apply to the properties of the Chico State campus.

**Natural Environment Vulnerability**

The historical and potential impacts of drought on the natural environment are widespread throughout public and private lands within the state, including tree mortality, impacts to all flora and fauna, and destabilization (subsidence) of land along streams and rivers, and within watersheds.

The core issue shaping drought vulnerabilities throughout California is water supply and demand. Several factors play into the issue including groundwater basins, surface water run-off, public and agricultural demand, and surface water storage water sheds. A USGS led analysis was first conducted in 2010 through the Forest and Rangeland Assessment and ongoing through the USGS Forest and Rangeland Ecosystem Science Center to identify threats and assets where water supply would benefit from environmental

\textsuperscript{41} National Oceanic and Atmospheric Administration National Centers for Environmental Information. *State Climate Summaries: California*. Retrieved 05.04.2021 from: https://statesummaries.ncics.org/chapter/ca/
management designed to protect or enhance water resources, the key effort which, in part, both defines and mitigates the severity of drought risk and vulnerabilities.

With regard to overall threat and asset findings shaping the potential severity of drought, the watersheds in the Sierra region contribute most greatly to the state’s water supply, but are under threat from climate change, wildfire and development. In addition, groundwater basins in the San Joaquin Valley and Sacramento Valley bioregions are an abundant resource that is heavily threatened by over pumping.

**Critical Facilities Vulnerabilities**

Drought vulnerabilities for Chico State’s critical facilities include water shortfalls for facility operations and critical functions, and potential structural destabilization and damage resulting from land subsidence.

**Estimate of Potential Losses**

An estimate of potential losses from drought has not been calculated for the campus or the CSU system as a whole. However, drought related losses to the City of Chico and the surrounding region such as crop loss and cost increases for water resources have re-occurred over time. Please consult city and county level government, and/or state agricultural agencies for data on the financial impacts from drought.

**Vulnerability Assessment Conclusions**

The CSU Planning Committee understands that the high degree of vulnerability posed by drought will be exacerbated by greater climate variation in the future and therefore greater variation and uncertainty regarding the availability of water supplies which are already under tremendous stress. In response to such vulnerability, state legislation passed in 2014 requires local governments to regulate pumping and recharge to better manage groundwater supplies, and groundwater-dependent regions are required to halt overdraft and bring basins into sustainable levels of pumping and recharge by the early 2040s. That said, the Committee will continue to work with local, regional and state partners and stakeholders to explore solutions for mitigating the drought hazard on its campuses by accessing the best available data and resources on climate change and its relationship to drought.

**Identified Data Limitations**

Data is limited concerning campus-related agricultural assets and data on tree mortality.
Earthquake

Description of the Hazard

An earthquake is a sudden motion or shaking caused by the release of pressure accumulated along the edge of tectonic plates covering the earth. These huge plates are constantly moving and move ever so slowly under, over, or by passing one another. This movement is gradual however the plates may lock together accumulating enormous amounts of energy. When this energy builds, stress develops, and the adjoining plates will eventually break free and result in ground shaking – an earthquake.

Large earthquakes may result in fissuring, ground settlement, and/or vertical or horizontal displacement. Earthquakes occur without warning and can result in extensive damages and human casualties. Damages associated to earthquake generated ground shaking is normally confined to a narrow area along fault trend from the earthquake epicenter. However, seismic waves may generate ground shaking resulting in damages in areas outside of the fault trend.

Fault Rupture – The rupture of faults is the differential movement of the two sides of the earth’s plates at the point of the fault. Horizontal or vertical displacement may be significant and occur over great distances. The movement and energy that occurs along a fault is released in waves resulting in ground shaking. The intensity of ground shaking varies based on the magnitude of the earthquake, the proximity to the earthquake epicenter, the composition of the ground sediment or rock the waves travel through, and the depth of the earthquake.

Liquefaction – In addition to the primary fault rupture that occurs right along a fault during an earthquake, the ground many miles away can also fail during intense shaking. As seismic waves travel through saturated granular soil; the soil begins to liquefy and act as a fluid. Soil strength and stability is lost causing the effects of ground shaking to intensify and for ground deformation to occur. These water saturated soils when shaken quickly lose the ability to support buildings, bridges, utilities, and other structures. Areas susceptible to liquefaction include places where sandy sediments have been deposited by rivers along their course or by wave action along beaches. The greater the magnitude of an earthquake and longer duration of strong ground shaking will result in an enhanced potential for liquefaction to occur. Settlement can cause damage when the amount settlement varies significantly across the length of a structure. Lateral spreading occurs when liquefaction occurs on gently sloping ground and the liquefied material at depth allows the area to slide, often toward a vertical discontinuity or “free face” such as a creek or stream channel. Liquefaction can occur in susceptible soils below bodies of water, and settlement and lateral spreading can damage structures built on or adjacent to these areas. Transportation bridges across water bodies, wharves, piers and other structures at ports and harbors, and underwater utility lines can be severely damaged by this hidden hazard.
**Subsidence** - Changes in the local environment that cause subsidence or sinkholes are called triggering mechanisms. Water is the primary factor that affects the local environment and causes subsidence. Water level decline, changes in groundwater flow, increased loading, and deterioration (such as abandoned mines) are all triggering mechanisms. Water level decline may occur naturally, or it may be the result of human action. Factors that lead to water decline are pumping (from wells), localized drainage (for construction activities), dewatering, or drought. Changes in groundwater flow can result from an increase in the velocity of groundwater movement, and increase in the frequency of water table fluctuations, and changes in discharge (either increase or decrease). Increased loading can cause pressure in the soil, leading to the failure of underground cavities and space, such as caves. Vibrations from earthquakes, heavy machinery, and blasting may result in structural collapse, followed by surface resettlement.

**Location of the Hazard**

The State of California is particularly vulnerable to earthquake activity due to California’s location residing between two large tectonic plates. Chico is located in the northern portion of the Sacramento Valley along the eastern edge at the base of the Sierra Nevada Mountains. In general, fault systems occur to the west and east of Chico. Throughout the valley the ground is saturated with sediment eroded from the mountains and foothills via multiple stream and river channels.

The Pacific Plate and the North American Plate come together at the San Andreas Fault 110 miles west of the CSU Chico campus. In addition to the San Andreas Fault, Butte County is home to or near additional fault systems with the potential to generate strong ground shaking. The Cleveland Hills Fault traverses along the foothills 25 miles southeast of the CSU Chico campus. The Big Bend Fault extends approximately 20 miles in length from Paradise eastward 15 miles east of the CSU Chico campus. The 120-mile-long Bartlett Creek Fault extends from Lake Berryessa to the northwest along the Coastal Range 60 miles west of the CSU Chico campus. The Maacama Fault follows US Highway 101 through Mendocino County 85 miles from the campus. The Mohawk Valley Fault extends in a north-south direction on the east side of the Sierra Nevada Mountains 65 miles to the east.
Extent of the Hazard

The extent or severity of earthquake damage is expressed in terms of magnitude, intensity and duration. The amount of energy released during an earthquake is normally conveyed as a magnitude measured from a seismogram. Magnitude is expressed in numbers and decimals representing the physical size of the earthquake. The strength and effect of the shaking on the surface of the earth is classified as the intensity. Intensity is further defined from the effects the earthquake has on people, structures, and the natural environment. The intensity of an earthquake in terms of measuring magnitude and evaluating its effects is generally expressed using the Modified Mercalli (MM) Intensity Scale. Duration is the length of time the earthquake’s energy is released. Based on the fact that all of Butte County is at moderate risk to seismic activity, but has a minimal history of significant earthquakes resulting in damages, the planning committee ranks the extent of the earthquake hazard as Moderate.
The Richter magnitude scale was developed in 1935 by Charles F. Richter of the California Institute of Technology as a mathematical device to compare the size of earthquakes. The Richter Scale is the best-known scale for measuring the magnitude of earthquakes. The magnitude value is proportional to the logarithm of the amplitude of the strongest wave during an earthquake. A recording of 7, for example, indicates a disturbance with ground motion 10 times as large as a recording of 6. The energy released by an earthquake increases by a factor of 31 for every unit increase in the Richter scale.

Table 6-14: Earthquake Intensity and Frequency Comparisons

<table>
<thead>
<tr>
<th>Magnitude</th>
<th>Mercalli Intensity</th>
<th>Potential Damage</th>
<th>Global Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 2.0</td>
<td>I</td>
<td>None</td>
<td>Continually</td>
</tr>
<tr>
<td>2.0 - 2.9</td>
<td>I to II</td>
<td>None</td>
<td>&gt; IM per year</td>
</tr>
<tr>
<td>3.0 - 3.9</td>
<td>II to IV</td>
<td>Light</td>
<td>&gt; 100,000 per year</td>
</tr>
<tr>
<td>4.0 - 4.9</td>
<td>IV to VII</td>
<td>Light</td>
<td>10K to 15 K per year</td>
</tr>
<tr>
<td>5.0 - 5.9</td>
<td>VI to VII</td>
<td>Moderate</td>
<td>1K to 1,500 per year</td>
</tr>
<tr>
<td>6.0 - 6.9</td>
<td>VII to X</td>
<td>Heavy</td>
<td>100 to 150 per year</td>
</tr>
<tr>
<td>7.0 - 7.9</td>
<td>VII &lt;</td>
<td>Very Heavy</td>
<td>10 - 20 per year</td>
</tr>
<tr>
<td>8.0 - 8.9</td>
<td>VII &lt;</td>
<td>Very Heavy</td>
<td>1 per year</td>
</tr>
<tr>
<td>&gt; 9.0</td>
<td>VII &lt;</td>
<td></td>
<td>1 per 10-50 years</td>
</tr>
</tbody>
</table>

The Modified Mercalli Intensity Scale provides descriptive values of earthquake intensity that may provide greater meaning to the broader population as the description of intensity refers to the effects actually experienced. This scale uses an arbitrary ranking based on observed earthquake effects. The scale is composed of increasing levels of intensity ranging from shaking that is not recognizable to intense shaking resulting in catastrophic damages and casualties. The Modified Mercalli Intensity Scale is demonstrated below:
Table 6-15: Modified Mercalli Intensity Scale

<table>
<thead>
<tr>
<th>Intensity</th>
<th>Shaking</th>
<th>Description / Damage</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Not felt</td>
<td>Not felt except by a very few under especially favorable conditions.</td>
</tr>
<tr>
<td>II</td>
<td>Weak</td>
<td>Felt only by a few persons at rest, especially on upper floors of buildings.</td>
</tr>
<tr>
<td>III</td>
<td>Weak</td>
<td>Felt quite noticeably by persons indoors, especially on upper floors of buildings. Many people do not recognize it as an earthquake. Standing motor cars may rock slightly. Vibrations similar to the passing of a truck. Duration estimated.</td>
</tr>
<tr>
<td>IV</td>
<td>Light</td>
<td>Felt indoors by many, outdoors by few during the day. At night, some awakened. Dishes, windows, doors disturbed; walls make cracking sound. Sensation like heavy truck striking building. Standing motor cars rocked noticeably.</td>
</tr>
<tr>
<td>V</td>
<td>Moderate</td>
<td>Felt by nearly everyone; many awakened. Some dishes, windows broken. Unstable objects overturned. Pendulum clocks may stop.</td>
</tr>
<tr>
<td>VI</td>
<td>Strong</td>
<td>Felt by all, many frightened. Some heavy furniture moved; a few instances of fallen plaster. Damage slight.</td>
</tr>
<tr>
<td>VII</td>
<td>Very strong</td>
<td>Damage negligible in buildings of good design and construction; slight to moderate in well-built ordinary structures; considerable damage in poorly built or badly designed structures; some chimneys broken.</td>
</tr>
<tr>
<td>VIII</td>
<td>Severe</td>
<td>Damage slight in specially designed structures; considerable damage in ordinary substantial buildings with partial collapse. Damage great in poorly built structures. Fall of chimneys, factory stacks, columns,</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Magnitude</th>
<th>Intensity</th>
<th>Damage Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>IX</td>
<td>Violent</td>
<td>Damage considerable in specially designed structures; well-designed frame structures thrown out of plumb. Damage great in substantial buildings, with partial collapse. Buildings shifted off foundations.</td>
</tr>
<tr>
<td>X</td>
<td>Extreme</td>
<td>Some well-built wooden structures destroyed; most masonry and frame structures destroyed with foundations. Rails bent.</td>
</tr>
</tbody>
</table>

The graph below illustrates the increasing intensity of energy that is released and as the measured magnitude increases. While each whole number increases in magnitude represents a tenfold increase in the measured amplitude, it represents an increasing rate of 32 times more energy released in the same increase in magnitude. As the magnitude of an earthquake is measured higher, the intensity of the earthquake worsens progressively from one category to the next.
Given the campus’ relatively far distance from fault systems, the history of minor events and the probability of future events being fairly low for somewhat distant fault lines, the planning committee ranks the extent of the hazard for the campus as **Low**.

### History of the Hazard

The State of California has a long history of chronic and destructive earthquakes throughout the state. On average, earthquakes strong enough to result in structural damages occur three to four times a year in California, while earthquakes Magnitude 6.0 to 6.9 occur once every two to three years. Butte County has a limited history of earthquake activity. The entire area of Butte County is at moderate risk to seismic activity and has a minimal history of significant earthquakes resulting in damages.

#### Table 6-16: Historic Earthquakes Occurring Near Chico, CA

<table>
<thead>
<tr>
<th>Date</th>
<th>Location</th>
<th>Magnitude</th>
<th>Damages</th>
</tr>
</thead>
<tbody>
<tr>
<td>9/12/1966</td>
<td>Truckee (Nevada County)</td>
<td>5.9</td>
<td>Damage to Infrastructure</td>
</tr>
<tr>
<td>8/1/1975</td>
<td>Oroville</td>
<td>5.7</td>
<td>Moderate property damage</td>
</tr>
</tbody>
</table>

---


The August 1, 1975 Oroville Earthquake estimated a Magnitude 5.7 earthquake struck resulting in the greatest amount shaking experienced in Butte County. The earthquake occurred just southeast of Oroville 26 miles to the southeast of Chico. The earthquake resulted in numerous surface ruptures along a 3.8 km zone. Minor structural damage occurred throughout the Oroville area including broken windows, cracked or toppled chimneys, loosened walls, and other structural damages. The shaking was strong enough to felt throughout northern California and western Nevada.

Potential Impacts of the Hazard

The shaking of the ground from earthquakes can result in building collapse, bridge failure, utility disruptions and other structural collapse. Large earthquakes can additionally cause natural gas lines to break resulting in structure fires. The proximity to the alluvial soils surrounding the campus presents a moderate potential for liquefaction creating greater ground instability during seismic events. A major earthquake in the Chico area would likely result in region-wide social disruptions in addition to structural damages. The region-wide structural damages may disrupt lifelines and supply chain routes limiting the campus from effective evacuation routes and receiving necessary supplies or equipment.

Most injuries resulting from earthquakes are from collapsing walls, flying glass, or other objects moved by ground shaking. The lack of warning allows individuals minimal time to react and find areas of safety. A moderate earthquake occurring near Chico could cause injuries or fatalities to members of the campus community or support networks the campus relies on. These earthquake effects might be aggravated by collateral incidents such as fire, flooding, hazardous material spills, dam/levee compromises, and other cascading events. A catastrophic earthquake could result in extensive casualties. expansive structural damages, panic, widespread utility outages, communication failures, and secondary emergencies such as fire. A catastrophic earthquake would certainly affect the broader Chico region limiting immediate assistance that the campus may normally expect.

Local impacts to the CSU Chico campus caused by an earthquake could include:

- Damage to nearby refineries and petrol-chemical plants
- Damage and secondary fires to industrial buildings to the east of campus
- Potential hazardous material releases on and off campus
- Infrastructure damage to freeway system
- Structural damage to bridges over waterways and flood control channels
- Potential isolation of campus from community
- Potential isolation among on-campus residents
- Structural damage to levees
- Structural damage to campus academic and support buildings
- Structural damage to residence halls resulting in displaced student populations
- Structural damage to nearby residences
- Community members arriving on campus for refuge from damaged homes
- Damaged university communications, computer systems, and networks
- Considerable stress and fear among community
- Closure or reduction of service to campus operations
- Reduction of campus revenue

Probability of Future Occurrence of the Hazard

The Working Group on California Earthquake Probabilities (WGCEP), a collaboration between the United States Geological Survey (USGS), the Southern California Earthquake Center (SCEC), and the California Geological Survey (CGS) develops Uniform California Earthquake Forecasts (UCERFs) using the best currently available science and technology. The UCERF version 3 provides a three-dimensional view of the likelihood a region in California will experience a Magnitude 6.7 or greater earthquake in the next 30 years. The likelihood for the fault systems surrounding Butte County and Chico is included in the following table.

Table 6-17: Major Potentially Active Faults in Proximity to CSU Chico

<table>
<thead>
<tr>
<th>Fault Zone</th>
<th>Recurrence</th>
<th>Distance From Chico</th>
<th>UCERF3 Likelihood</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bartlett Springs</td>
<td>Historic: Unknown</td>
<td>61 miles</td>
<td>10-12%</td>
</tr>
<tr>
<td>Battle Creek</td>
<td>Historic: Unknown</td>
<td>48 miles</td>
<td>5%</td>
</tr>
</tbody>
</table>


While seismic activity is not common in Butte County, counties to the west and east are at higher risk for earthquakes. The fault systems described above each reside outside of the county but have the potential to effect Butte County. Based on the earthquake shaking potential in the areas east and west of the Butte County area, the distance from fault systems listed in the above table, the probability of seismic ground shaking generating damage is considered Possible.

Vulnerability to the Hazard

A considerable challenge regarding earthquakes is they generally occur without warning. The fault systems surrounding the region all cross major transportation routes potentially reducing the availability of access and the supply chain. The geographic location of Chico sits at the base of river systems that have deposited sediment from the surrounding mountains. In many cases, these sediment-based soils are loose and expose the potential for liquefaction. The majority of Chico has identified a moderate risk of liquefaction including the campus.

The known fault systems generating the threat to Chico generally exist to the east and west of the city but do not cross into the city including the CSU Chico campus. However, the proximity and potential for large earthquake development from these surrounding systems expose significant vulnerabilities. The potential for earthquake damaged structures being left uninhabitable including campus residence halls will result in numerous displaced individuals and households. The lack of earthquake insurance will cause extreme financial burdens on those affected. Campus buildings and equipment

Elements of the vulnerability to a major earthquake on the CSU Bakersfield campus will vary depending on when the earthquake were to strike. The primary basis of vulnerability is based on the population affected and the built environment exposed. In general, newer construction will be more earthquake resistant than older buildings as building codes and construction technology have improved. A locally centered earthquake, even from moderate events, would have the potential for more damaging results when associated with the moderate liquefaction zones of the city. This would particularly be seen with greater damages to unreinforced masonry buildings.

The risk to the campus population will be lessened during periods when classes are not in session or during periods of breaks. Conversely, during the days and hours that classes are in session and staff are at their workplaces, the human vulnerability increases. Generally, people are safer when at home in wood frame structures as earthquakes tend to generate less structural damage to wood construction than in commercial or industrial facilities. The greater number of people on campus at the time of an earthquake will result in more people being exposed to effects from damaged campus facilities or

<table>
<thead>
<tr>
<th>Cleveland Hills</th>
<th>Historic: Unknown</th>
<th>25 miles</th>
<th>6%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Great Valley</td>
<td>Varies: 20-300 years</td>
<td>52 miles</td>
<td>3%</td>
</tr>
<tr>
<td>Swain Ravine</td>
<td>Historic: Unknown</td>
<td>25 miles</td>
<td>3%</td>
</tr>
</tbody>
</table>

6-57
equipment and require greater evacuation assistance. However, in region-wide events this vulnerability may simply shift to the homes and workplaces of members of the campus community and their families.

The aftermath of a major earthquake will likely result in widespread search and rescue operations for trapped and injured individuals. The demand on emergency services will be great, potentially requiring the campus community to be prepared for these scenarios and initiate response actions as needed. There will be needs for emergency medical care, shelter, water, and food for individuals who have been displaced by the earthquake. In earthquakes causing significant damages, there may be a necessity to provide assistance with identification and support to local agencies in mass fatality management.

There may be a need to evacuate members of the campus community from the campus and to other locations that are deemed to be safer locations. Certain campus populations will experience greater challenges to a post-earthquake environment. Vulnerable populations including those that rely on specific services, require electrical power, homeless students, experience disabilities, non-English speakers, those whose age make evacuating difficult, and others will be most affected. These individuals will likely need to navigate through earthquake generated debris, extreme stresses of a disaster, an inability to communicate to or gain access to support networks and find difficulty in accessing equipment or supplies to aid in a specific need.

Estimate of Potential Losses

Estimates of potential losses will be influenced by a variety of factors. The intensity of the earthquake will determine what scale of damages affecting campus infrastructure, equipment, and other impacted features. Losses will be generated by the physical damages, the loss of revenue, loss of academic research, loss of building contents, and community wide economic reductions.

Based on estimate replacement costs of facilities and structures on campus, the maximum total replacement costs due to earthquake are $344,244,561.

Vulnerability Assessment Conclusions

It is difficult to predict the severity of casualties, property, and cascading impacts generated by future seismic events affecting the Chico region and the CSU Chico campus. Each of the earthquake generated effects will vary widely based on the intensity of the earthquake, location of the epicenter, proximity to people and development, time of day and year, the soil composition under the impacted structures, building construction, among others. In any case, the potential for a major earthquake exists affecting the campus and causing extensive challenges to the CSU Chico campus and community.

In the event that a major earthquake was to strike along the fault systems surrounding Chico, the effects could be significant to the campus community and campus operations. The widespread impacts generated by a major earthquake would extend the effects of casualties, damages, and other impacts to the broader Chico region creating large-scale regionwide needs for critical assistance and a heavy demand on limited emergency
resources. The threat and impacts presented to the campus will be shared with the campus community from their homes and places of work. The campus will likely be required to address critical needs independently during early phases of the disaster.

The campus population are additionally vulnerable to the effects of major ground shaking that are far reaching. The psychological and social impacts a major earthquake will give rise to will potentially harm individuals and cause tremendous fear. The willingness to return indoors may be hampered especially as after-shock continue. These effects are magnified for populations having specific vulnerabilities or access limitations.

**Identified Data Limitations**

Missing campus structural replacement costs and an inventory of building construction types to include status of earthquake retrofitting. HAZUS generated analysis is focused on the broader community level versus finetuning the analysis to the micro-level for facilities such as a university campus.
**Erosion**

**Description of the Hazard**

The US Geological Survey (USGS) defines erosion as “the process whereby materials of the earth’s crust are loosened, dissolved, or worn away and simultaneously moved from one place to another.” Erosion may occur in areas of streams and rivers, along bluffs, around immovable objects (such as buildings or bridge abutments), or as a cascading result of other natural hazards, such as earthquakes or wildfires. When erosion occurs along bodies of water, the removal of material causes the shore to move further landward.

Forces such as sea level rise and changes in sediment supply impact erosion gradually and can be difficult to recognize. In contrast, the impacts of short-term events, such as storms and flooding, can be severe and are immediately recognizable.

**Location of the Hazard**

Erosion is a relatively non-spatial hazard that can occur in any location with conducive soil structure and a source of movement such as water or wind. As such, for the purpose of this campus-level analysis, the erosion hazard poses a consistent risk across the terrain of the CSU-Bakersfield campus with erosion-prone characteristics. An area’s potential for erosion is determined by several factors, including rainfall, topography, soil characteristics, and vegetative cover. Streambank and bluff erosion can occur near any riverine area, such as the Big Chico Creek, which flows through the campus, or the Little Chico Creek, which is proximal to the campus. While erosion conditions are known to exist on campus generally, other than the locations identified under History of the Hazard (below) no additional locations have been identified. A comprehensive assessment of erosion conditions/locations campus-wide may be conducted in the future if campus leadership determines it is needed.

**Extent of the Hazard**

If conditions are favorable, erosion is likely to occur. The City of Chico considers the severity of streambank erosion to be limited and present in 10-50% of the city.

Given the occurrence of erosion on campus, the planning committee ranks the extent of this hazard as Moderate.

**History of the Hazard**

Erosion has occurred in the facilities yard on campus and is being exacerbated by a homeless encampment between Nord Avenue and the railroad. There is also an existing

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bank erosion project in Big Chico Creek west of Nord Avenue, intended to diminish the flow of water.

**Potential Impacts of the Hazard**

Erosion causes instability in soil. During high-intensity rain events, for example, eroded areas will continue to erode, resulting in additional loss of soil and ground stability in the area. This removal of sediment can result in damage to infrastructure, public health, and safety. On campus, areas of erosion can create pedestrian and transportation hazards, and structures may become unsafe if erosion is not controlled.

In agricultural areas, the erosion of soil degrades the quality of the soil, which can lead to reduced crop yields. At the Paul L. Byrne Memorial University Farm, soil erosion can create significant concerns for agriculture and research. Eroded test plots can negatively impact experiments and tests, resulting in a loss of knowledge and data.

**Probability of Future Occurrence of the Hazard**

Erosion is an on-going and dynamic process that occurs regularly. As climate change induces more frequent and intense weather events, such as wildfires and flooding, erosion may generally become more widespread or severe. These events can cause erosion or exacerbate areas already experiencing erosion. As a result, and in consideration of the current and potential extent of erosion on campus, the probability of future occurrence is High.

**Vulnerability to the Hazard**

Topography, soil structure, land use, and precipitation are all factors of erosion. CSU Chico infrastructure, buildings, and agriculture located on steep slopes, in areas with little vegetation, or in areas with conducive soil types are more vulnerable to erosion. CSU leadership would consider performing an analysis to identify such at-risk buildings, infrastructure, slopes and soil types in the future.

In the wider Chico community, erosion vulnerabilities include agricultural sector job loss, degradation of riverine ecosystems, and loss of water quality.

**Estimate of Potential Losses**

The historic and potential impacts of erosion on property statewide include reduced agricultural productivity, lower surface water quality, and damaged drainage networks. Current modeling is not precise enough to allow for an assessment of potential losses to buildings and infrastructure on campus.

**Vulnerability Assessment Conclusions**

While the ability to predict future erosion on the CSU Chico campus is limited, the core issues shaping erosion vulnerability on campus are flora and landscaping. If left

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unchecked, erosion can cause significant damage to campus infrastructure and the surrounding environment.

Identified Data Limitations

The complex interactions between soil erosion factors make predictive modeling, determination of hazard areas, and quantification of loss difficult. Localized data on this hazard is also limited, resulting in more generalized findings.
**Extreme Temperatures (Includes Extreme Cold and Extreme Heat)**

**Heat**

**Description of the Hazard**

What is considered an excessively hot temperature varies according to the normal climate for that region. However, when temperatures are extremely high, people are at higher risk for heat-related illnesses, such as dehydration, heat exhaustion, heat stroke, and in severe cases, death.49

Hazards from extreme heat are made worse when high temperatures are accompanied by high levels of humidity, which is defined as the amount of moisture in the air.50 As the temperature climbs, the air is able to hold more moisture. High humidity prevents the human body from cooling down naturally, which leads people to perceive that the temperatures “feels” hotter. The combination of temperature and humidity is known as the heat index.51

Heat stroke, the most serious heat-related illness, occurs when the body is unable to control its temperature. Body temperature rises rapidly, the sweating mechanism fails, and the body cannot cool down.52 In extreme causes, heat stroke can cause confusion and unconsciousness, so the victim is unable to seek treatment without assistance.

There are several groups of people who are uniquely vulnerable to the effects of extreme heat, such as infants and children, older adults aged 65 and up, athletes and outdoor workers, low-income households, and individuals with certain chronic medical conditions.53

**Location of the Hazard**

Extreme heat events are a non-spatial hazard and may occur throughout the Chico State campus.

**Extent of the Hazard**

Extreme heat has a wide range of extent and severity markers and characteristics. Monthly average maximum temperatures in June through October range approximately from the high 80s to mid-90s in the City of Chico. According to data from the National Climatic Data Center (NCDC), the highest daily temperature recorded at the Chico University Farm Station was 114° F on September 14, 1988. Given the historical

51 Ibid.
occurrence of extreme heat events, and that there have been many days when the actual air temperature in Chico reached 100° F or greater, the planning committee ranks the extent of the hazard as **Moderate**.

The National Weather Service issues a Heat Advisory when the heat index value is expected to reach 100° – 104° F within the next 12 to 24 hours. Excessive Heat Warnings are issued when there is an anticipated heat index of 105° F or greater that will last for two (2) or more hours. Excessive Heat Warnings are issued by the county when any location in the county is expected to reach that criteria.\(^{54}\) In anticipation of an Excessive Heat Warning, an Excessive Heat Watch may be issued 1 to 2 days in advance, when the Heat Warning criteria is 50 – 79% likely to occur.

Figure 6-11 (following) depicts the National Weather Service’s methodology for determining the heat index, using the % humidity and the actual temperature.

Figure 6-11: Methodology for Determining Heat Index

![Figure 6-11: Methodology for Determining Heat Index](attachment:heat_index_methodology.png)

As the heat index rises, so does the potential danger to people and animals. Table xx (following) shows the health hazards associated with extreme heat.

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<table>
<thead>
<tr>
<th>Category</th>
<th>Heat Index</th>
<th>Health Hazards</th>
</tr>
</thead>
<tbody>
<tr>
<td>Extreme Danger</td>
<td>130° F or higher</td>
<td>Heat stroke / sunstroke is likely with continued exposure.</td>
</tr>
<tr>
<td>Danger</td>
<td>105° – 129° F</td>
<td>Sunstroke, heat cramps, and/or heat exhaustion is likely with prolonged exposure and/or physical activity.</td>
</tr>
<tr>
<td>Extreme Caution</td>
<td>90° – 104° F</td>
<td>Sunstroke, heat cramps, and/or heat exhaustion is possible with prolonged exposure and/or physical activity.</td>
</tr>
<tr>
<td>Caution</td>
<td>80° – 89° F</td>
<td>Fatigue is possible with prolonged exposure and/or physical activity.</td>
</tr>
</tbody>
</table>

**History of the Hazard**

Data gathered from the National Centers for Environmental Information (NCEI) Storm Events Database shows two excessive heat events that have impacted Butte County (in 2017 and 2018), but no excessive heat events that have affected the City of Chico specifically. However, NCDC data indicates that there have been many days when the actual air temperature in Chico reached 100° F or greater.

**Potential Impacts of the Hazard**

Chico State may experience impacts from extreme heat due to cancelled classes or postponed outdoor events in order to protect students, faculty, and staff from the weather.

In addition to the threat extreme heat poses to humans, high temperatures also pose a threat to utility production, which in turn threaten facilities and operations that rely on utilities. As temperatures rise, more people stay indoors, increasing the demand for air conditioning, fans, and other electronics. This puts a strain on the electrical grid, which can cause temporary outages. These outages can impact operations throughout campus, resulting in interruptions and delays in service. Outages may also negatively impact research efforts on campus, as the inability to maintain a steady, constant temperature may impact research specimens and experimental results.

**Probability of Future Occurrence of the Hazard**

There have been two extreme heat events in Butte County within the last four years. In addition, NCDC data indicates that there have been many days when the actual air temperature in Chico reached 100° F or greater. As such, it is **Likely** that the hazard will occur annually.

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Vulnerability to the Hazard

When dealing with an extreme heat event, the most common impacts are those generally felt by the people living in the targeted area. For people in particular, heat can kill when the body is pushed beyond its limits. Most heat disorders occur because the victim has been overexposed to heat. As discussed, the major human risks associated with extreme heat include dehydration, sunburn, fatigue, heat exhaustion, heat stroke, and in severe cases, death.

Some portions of the population are more at risk to the effects of extreme heat. The very young, the elderly, and certain groups with chronic medical conditions (such as asthma or other pulmonary illnesses, heart disease, poor blood circulation, neurological illnesses, and obesity) are generally more vulnerable to the effects of extreme heat, and are more likely to suffer illness or death as a result.56 This is especially true if exposure is extended for a period of time and preventative measures are not taken immediately.

CSU Chico is aware of the potential for extreme heat events. During the early months of the fall semester, the campus will issue its own heat warnings (in addition to any warning issued by the City of Chico) for students’ safety. When it comes to staff safety, supervisors are reminded of Occupational Safety and Health Administration (OSHA) regulations that protect workers from extreme heat. Under OSHA law, employers must provide workplaces free of known safety hazards, which includes protecting workers from extreme heat, and any employer with workers exposed to high temperatures should establish a heat illness prevention program that includes monitoring workers for signs of illness and providing them with water, rest, and shade.57

In addition, CSU Chico has considered the possibility of opening a cooling center on campus that would be open to students as well as the public.

Therefore, while this is a hazard that the campus may experience with regularity, the campus has ample familiarity with in order to handle the risks and vulnerabilities.

Estimate of Potential Losses

Based on the previous historical occurrences of extreme heat events, annualized losses are considered to be negligible. In an extreme heat event, loss of human life or health impacts are a greater concern than is property damage.

Vulnerability Assessment Conclusions

While the ability to predict future heat events at the CSU Chico campus is limited, the effects of climate change may provide some information. According to the Environmental Protection Agency (EPA), areas north of Sacramento have warmed approximately 1.5 – 2

degrees on average over the last century, with less rainfall. This may lead to stronger heat events, drought, and an increased risk of wildfires.\textsuperscript{58}

**Cold**

**Description of the Hazard**

What is considered an excessively cold temperature varies according to the normal climate for that region. However, when temperatures are far below normal, with higher wind speeds, heat leaves the human body more rapidly, which increases the possibility of negative effects from these extreme temperatures.\textsuperscript{59}

The greatest danger from extreme cold is to people, as prolonged exposure can cause frostbite or hypothermia, and can become life threatening. When someone is suffering from hypothermia, body temperatures can become so low that they affect the brain, making it difficult for the victim to think clearly or move well. In the case of frostbite, the frozen tissue becomes numb and the victim may be unaware that anything is wrong until someone else notices.\textsuperscript{60} This makes hazards from extreme cold particularly dangerous, as people may not understand what is happening to them or what to do about it.

The primary hazards from extreme cold are frostbite and hypothermia. Frostbite is caused by freezing of the skin and underlying tissue. It causes a loss of feeling and color in the affected areas of the body, and most often affects the nose, chin, fingers, or toes.\textsuperscript{61} It can be permanently damaging if not treated promptly and can lead to infection, nerve damage, or amputation in severe cases.\textsuperscript{62} The risk of frostbite is increased in people with preexisting conditions, the elderly, people with reduced blood circulation, and people who are not dressed warmly enough for the conditions.

Hypothermia occurs when the body loses heat faster than it can produce heat, causing a dangerously low body temperature. A normal body temperature is around 98.6° F. Hypothermia occurs when your body temperature falls below 95° F.\textsuperscript{63} As this happens, the heart and other essential organs cannot work properly. If hypothermia is not treated, it can lead to heart failure, respiratory failure, and eventually to death.

Excessive or extreme cold can accompany severe winter weather, or it can occur without severe weather. For this reason, extreme cold is a separate hazard from severe winter storms.


\textsuperscript{59} National Weather Service. *Stay Safe in the Extreme Cold.* Retrieved 01.29.21 from: https://www.weather.gov/dlh/extremecold


\textsuperscript{61} Mayo Clinic. *Frostbite: Overview.* Retrieved 01.29.21 from: https://www.mayoclinic.org/diseases-conditions/frostbite/symptoms-causes/syc-20372656

\textsuperscript{62} Ibid.

\textsuperscript{63} Mayo Clinic. *Hypothermia: Overview.* Retrieved 01.29.21 from https://www.mayoclinic.org/diseases-conditions/hypothermia/symptoms-causes/syc-20352682
Location of the Hazard

Extreme cold events are a non-spatial hazard and may occur anywhere at the Chico State campus.

Extent of the Hazard

Extreme cold has a wide range of extent and severity markers and characteristics. Average nighttime winter temperatures in the City of Carson are typically in the mid-30s to high 30s. According to data from the National Climatic Data Center (NCDC), the lowest daily temperature recorded in Chico was 12° F on January 22, 1990.

Given that Butte County has had 11 cold/wind chill or frost/freeze events, dating back to 1998, but no extreme cold hazards, the planning committee ranks the extent of the hazard as Low.

The National Weather Service issues Extreme Cold Warnings when the temperature feels like it is -30° F or colder across a wide area for a period of at least several hours. When possible, these advisories are issued a day or two in advance of the conditions.64

The most common extent/severity marker for extreme cold is the Wind Chill scale. Figure 6-12 (following) depicts the National Weather Service’s methodology for determining the wind chill, using wind speed and actual temperature. Although wind chill is not necessarily related to extreme cold as a single cause, the advisory system that the NWS currently uses relies on wind chill to relay warning and advisory information to the public. Extreme cold severity is a function of wind chill and other factors, such as precipitation amount (rain, sleet, ice, and/or snow). Given the historical and potential occurrence of freezing temperatures, but a low probability of extreme cold, the planning committee ranks the extent of the hazard as Low to Moderate.

In 2011, the National Weather Service introduced an experimental program that issued warnings for extreme cold events, independent of other severe weather warnings. The test areas included North and South Dakota and Minnesota. However, in 2012, after a single season of use, the program was abandoned, based on reports of confusion among test audiences.65

History of the Hazard

Based on data gathered from the National Centers for Environmental Information (NCEI) Storm Events Database, Butte County has had 11 cold/wind chill or frost/freeze events, dating back to 1998, but no extreme cold hazards. [Records for this hazard were first recorded in 1996].

Potential Impacts of the Hazard

Should an extreme cold event occur, Chico State might experience impacts due to cancelled classes.

In addition to the threat posed to humans, extreme cold weather poses a significant threat to utility production, which in turn threatens facilities and operations that rely on utilities, specifically climate stabilization. As temperatures drop and stay low, increased demand for heating places a strain on the electrical grid, which can lead to temporary outages. These outages can impact operations throughout the campus, which can result in interruptions and delays in services. These outages may also negatively impact research efforts throughout the campus, as the inability to maintain a steady, constant temperature may result in unintended effects on research specimens.

**Probability of Future Occurrence of the Hazard**

The City of Chico has experienced cold/wind chill and freeze/frost events, but has never experienced an extreme cold event. Although the City experiences a wide variance of temperatures, due to the City’s location and its temperate climate, it is **Unlikely** that an extreme heat event will occur annually.

**Vulnerability to the Hazard**

When dealing with an extreme cold event, the most common impacts are those generally felt by the people living in the targeted area. For people in particular, extreme cold can kill when the body is pushed beyond its limits. Most danger due to the cold is because the victim has been overexposed to low temperatures. As discussed, the major human risks associated with extreme cold include frostbite, hypothermia, and in severe cases, death.

Some portions of the population are more at risk to the effects of extreme cold. The elderly, those with certain preexisting conditions (hypothyroidism, diabetes, and high blood pressure, just to name a few), those with poor blood circulation, and people who are not dressed warmly enough for the cold are generally more vulnerable and are more likely to suffer illness or death as a result.\(^{66}\) This is especially true if exposure is extended for a period of time and preventative measures are not taken immediately.

CSU Chico is aware of the potential for extreme cold events, and is one of the CSU campuses facing the greatest variance in temperatures. During freeze/frost events, the campus will issue warnings to students and staff about keeping the heat running at a certain temperature in order to protect pipes from freezing and bursting.

**Estimate of Potential Losses**

CSU Chico sponsors a large (three-acre) organic vegetable garden, which grows 50 varieties of vegetables to supply the Community Supported Agriculture (CSA) membership and also regularly provides fresh food to the university’s food pantry. A frost/freeze or extreme cold event during the growing season could negatively impact the harvest. However, the vegetable garden is just a small part of CSU Chico’s 800-acre Paul L. Byrne Memorial University Farm. The farm includes:

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• 70 acres of almonds, including 30 acres dedicated to an almond variety trial in conjunction with the California Almond Board
• 75 acres of walnuts
• 10 acres of pecans
• 10 acres of olives
• A peach orchard
• Livestock (pigs, cows, sheep)
• Five greenhouses
• An arboretum
• A rose garden

Freeze/frost events are still relatively rare in Chico, but potential losses to the university’s Agricultural Institute could be substantial if the cold event was prolonged. However, based on the previous historical occurrences of extreme cold events, annualized losses are considered unlikely.

Vulnerability Assessment Conclusions

While the ability to predict future extreme cold events at the CSU Chico campus is limited, the effects of climate change may provide some information. According to the Environmental Protection Agency (EPA), areas north of Sacramento have warmed approximately 1.5 – 2 degrees on average over the last century, with less rainfall. This may lead to fewer frost/freeze events in the future.67

Identified Data Limitations

Numerous public and private actors conduct research, acquire data and disseminate meteorological information and forecasting to the general public, including the CSU university system. Currently, it is assumed that, apart from regular access to climate change models on changes to temperature extremes over time, the CSU community maintains sufficient access to the data needed to plan for, respond to, and mitigate the effects of extreme heat and cold.

Flood

Description of the Hazard

The incredible geographic diversity in California presents tremendous challenges for flood planning and response. The state is home to extensive mountain ranges such as the Sierra Nevada, Cascades, Klamath, Coastal Ranges, and the Southern California Transverse Range all creating tremendous watersheds. Large river systems drain the mountains traveling through populated communities including the Sacramento and San Joaquin Rivers draining into the California Delta. The state has a complex system of reservoirs, dams, and levees providing water storage and flood protection. Finally, California’s 840-mile coastline exposes the coastal regions to tidal influences.

Floods are characterized by the rising and overflowing of excess water from a water source such as a stream, river, lake, canal, or coastal body onto an area of normally dry floodplain. A floodplain is a lowland area downstream and adjacent to water bodies that are subject to flood events. Flooding is a naturally occurring event that become hazardous when populations and property are affected.

Flooding can result from excessive precipitation from weather systems generating prolonged rainfall, excessive snowmelt from watersheds upstream from the floodplain, infrastructure failure, exceeding the capacity of dams or levees, tidal influences, or a combination from any of the previous factors.

Floods represent one of the costliest and most frequent natural disasters that influences human suffering and economic impact in the United States. Flooding will likely result in significant damage to structures, infrastructure, utilities, landscapes, and the environment. Erosion of stream banks, roadways, other feature may result from the movement of flood waters. The saturated ground resulting from standing flood waters may cause ground instability, collapse, erosion, or other damages. Further, floods will often generate substantial debris that will accumulate and be deposited throughout the flooded areas.

Flooding can be either slow-rise or rapid onset floods. With slow rise floods, there is often warning preceding water rise by hours or days before dangerous conditions present themselves. Slow rise floods that are expected to enter into populated areas generally allow for some time to initiate evacuation and sand bagging efforts. Flooding that occurs rapidly conversely are water events that present with extremely limited warning times and a limited ability to take response actions until flooding has already begun to occur.

Flooding may take on different forms:

- **Flash Flooding** – Flash flooding is typically characterized by a rapid rise, short duration, and large volume of water in a localized area. Heavy rainfall in areas that have limited drainage capacities often contribute to flash flooding conditions. These flooding events frequently occur with limited notice requiring immediate evacuation or rapid response efforts such as sand bagging. Flash flooding may arrive with fast moving water creating added hazardous conditions.
Riverine Flooding – Riverine flooding is usually caused by prolonged rainfall or rainfall combined with heavy snowmelt. When soils are already saturated, the ability for the ground to absorb water is minimized. In a riverine flood, the water way exceeds channel capacity and extends into areas outside of the channel, often in developed communities. In California, riverine flooding is most likely to occur from November through April. The duration of riverine floods may vary from a period of hours to weeks.

Localized Flooding – Localized flooding is commonly the result of stormwater drainage systems being overwhelmed by unusually heavy rainfall. These flooding events frequently occur in areas that are urbanized or developed with greater amounts of impervious surfaces not allowing ground absorption. This generates added runoff into the drainage systems and onto roadways creating backups.

Infrastructure Failure – Failures of dams or levees presents a serious flooding concern for areas downstream from the compromised structure. This situation may result in a catastrophic flood with limited warning time and widespread areas affected.

Coastal Flooding – Coastal flooding can occur in multiple areas along the California coastline. Flooding may result from intense storms coming from the Pacific Ocean that generate elevated water levels or storm surge. The size, duration, winds generated, and intensity of the storm will influence the effect the waves will have on the shoreline. Periods of high tide can aggravate the conditions allowing greater wave impingement into coastal areas.

Atmospheric River

California, including the location of this campus, is subject to the effects of a phenomenon referred to as atmospheric rivers. These weather events consist of long, narrow regions in the atmosphere transporting tremendous amounts of water vapor from the tropics. These weather regions behave like rivers in the sky. They can carry heavy volumes of water vapor compared to the amount of water flow at the mouth of the Mississippi River. As these atmospheric rivers arrive into California they tend to generate significant rain and snow.

Atmospheric rivers can arrive in many different shapes and sizes. The larger events are able to generate extreme rainfall amounts resulting in flooding. They can stall over watersheds vulnerable to flooding, often saturated with heavy snow amounts. The atmospheric rivers known as a “Pineapple Express” coming from the tropics and arriving with warmer air may produce heavy rains that will melt ground snow adding to the water volume that will be added in the flood runoff.

These events can produce heavy amounts of precipitation creating extensive damages. However, these events may present as weaker systems that produce precipitation that is enough to be beneficial for the local water supply. At the higher elevations in the California mountains, these events have the potential to generate a tremendous snowpack providing a source of water during the dry summer months.
Location of the Hazard

The Big Chico Creek, Little Chico Creek, and Lindo Channel have been identified as the primary flood sources for the City of Chico including the CSU Chico campus. The Big Chico Creek flows through the campus separating campus buildings and facilities. The Little Chico Creek is located ½ mile to the south of the campus opposite on the opposite side of downtown Chico. The Lindo Channel is a mile to the north of campus opposite of a residential neighborhood. The CSU Bakersfield campus sits entirely within a Zone X (Minimal Flood Hazard Area) designation on the Flood Insurance Rate Map. The Zone X designated areas are subject to inundation by a 0.2-percent annual chance that a flood event will occur.

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Figure 6-14: Flood Hazard Areas at CSU Chico
Extent of the Hazard

The CSU Chico campus is located in a designated Zone X. The Big Chico Creek flowing through campus is designated as Zone AE but is confined to the boundaries of the creek channel. Portions of downtown Chico to the south of campus are Zone X and Zone AO. Although comprehensive campus-level flood data is not available, given that 12 Federal and State declared flood disasters have occurred in/near the city of Chico from 1982 - present, along with the creek’s AE Zone and related potential impacts, although no flood events have taken place on campus, the planning committee ranks the extent of the flood hazard on campus as Moderate.
In support of the NFIP, FEMA identifies those areas that are more vulnerable to flooding by producing Flood Hazard Boundary Maps (FHBM), Flood Insurance Rate Maps (FIRM), and Flood Boundary and Floodway Maps (FBFM). Several areas of flood hazards are commonly identified on these maps, including the 1% annual chance flood zone. Flood zones are further delineated by risk and are assigned a letter signifier. The flood zone designations are defined and described in the following table.

Table 6-19: Flood Zone Designations and Descriptions

<table>
<thead>
<tr>
<th>Zone Designation</th>
<th>Percent Annual Chance of Flood</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Zone V</td>
<td>1%</td>
<td>Areas along coasts subject to inundation by the 1% annual chance of flooding with additional hazards associated with storm-induced waves. Because hydraulic analyses have not been performed, no BFEs or flood depths are shown.</td>
</tr>
<tr>
<td>Zones VE and V1-30</td>
<td>1%</td>
<td>Areas along coasts subject to inundation by the 1% annual chance of flooding with additional hazards associated with storm-induced waves. BFEs derived from detailed hydraulic analyses are shown within these zones. (Zone VE is used on new and revised maps in place on Zones V1-30.)</td>
</tr>
<tr>
<td>Zone A</td>
<td>1%</td>
<td>Areas with a 1% annual chance of flooding and a 26% chance of flooding over the life of a 30-year mortgage. Because detailed analyses are not performed for such areas, no depths or base flood elevations are shown within these areas.</td>
</tr>
<tr>
<td>Zone AE</td>
<td>1%</td>
<td>Areas with a 1% annual chance of flooding and a 26% chance of flooding over the life of a 30-year mortgage. In most instances, base flood elevations derived from detailed analyses are shown at selected intervals within these zones.</td>
</tr>
<tr>
<td>Zone AH</td>
<td>1%</td>
<td>Areas with a 1% annual chance of flooding where shallow flooding (usually areas of ponding) can occur with average depths between 1 – 3 feet.</td>
</tr>
<tr>
<td>Zone AO</td>
<td>1%</td>
<td>Areas with a 1% annual chance of flooding, where shallow flooding average depths are between 1 – 3 feet.</td>
</tr>
<tr>
<td>Zone X (shaded)</td>
<td>0.2%</td>
<td>Represents areas between the limits of the 1% annual chance of flooding and 0.2% chance of flooding.</td>
</tr>
</tbody>
</table>
Areas outside of the 1% annual chance floodplain and 0.2% annual chance floodplain, areas of 1% annual chance sheet flow flooding where average depths are less than 1 foot, areas of 1% annual chance stream flooding where the contributing drainage area is less than 1 square mile, or areas protected from the 1% annual chance flood by levees. No BFE or depths are shown within this zone.

History of the Hazard

Flooding in Chico and the broader Butte County region have typically occurred during the winter months when Pacific storms are more common. The occurrences of significant flooding typically have been the result of successive intense storms with heavy precipitation. The region has experienced flood events that have caused tens of millions of dollars in damages and numerous fatalities. Though no campus flooding records are reported, the following table (6-25) provides insight into information of past flooding events that are significant to the CSU Chico campus.

Table 6-20: Historic Flood Events Near Chico

<table>
<thead>
<tr>
<th>Date</th>
<th>Event</th>
<th>Declaration</th>
<th>Declaration</th>
</tr>
</thead>
<tbody>
<tr>
<td>11/21/1950</td>
<td>Flood</td>
<td>State</td>
<td>OCD 50-01</td>
</tr>
<tr>
<td>12/23/1955</td>
<td>Flood</td>
<td>Federal</td>
<td>DR-47</td>
</tr>
<tr>
<td>4/4/1958</td>
<td>Flood; Heavy Rains</td>
<td>Federal</td>
<td>CDO 58-03</td>
</tr>
<tr>
<td>10/24/1962</td>
<td>Flood; Heavy Rains</td>
<td>Federal</td>
<td>DR-138</td>
</tr>
<tr>
<td>12/24/1964</td>
<td>Flood; Heavy Rains</td>
<td>Federal</td>
<td>DR-183</td>
</tr>
<tr>
<td>1/26/1969</td>
<td>Flood; Winter Storms</td>
<td>Federal</td>
<td>DR-253</td>
</tr>
<tr>
<td>2/16/1970</td>
<td>Flood</td>
<td>Federal</td>
<td>DR-283</td>
</tr>
<tr>
<td>2/9/1982</td>
<td>Flood; Winter Storms</td>
<td>Federal</td>
<td>DR-677</td>
</tr>
<tr>
<td>2/18/1986</td>
<td>Flood; Winter Storms</td>
<td>Federal</td>
<td>DR-758</td>
</tr>
<tr>
<td>2/22/1990</td>
<td>Flood; Winter Storms</td>
<td>State</td>
<td>GP 989-06</td>
</tr>
<tr>
<td>1/13/1995</td>
<td>Flood; Winter Storms</td>
<td>Federal</td>
<td>DR-1044</td>
</tr>
<tr>
<td>3/12/1995</td>
<td>Flood; Winter Storms</td>
<td>Federal</td>
<td>DR-1046</td>
</tr>
<tr>
<td>1/4/1997</td>
<td>Flood; Winter Storms</td>
<td>Federal</td>
<td>DR-1155</td>
</tr>
<tr>
<td>2/19/1998</td>
<td>Flood; El Nino 1998</td>
<td>Federal</td>
<td>DR-1203</td>
</tr>
</tbody>
</table>

Potential Impacts of the Hazard

A flood will potentially result in extensive amounts of water entering onto developed areas. The force and volume of water that is generated by a flood may cause extensive structural damage in areas subject to standing or moving water. The effects of flooding may spread over significant distances covering large areas of land. The extent of the impacts would vary based on a number of factors such as the volume of water flooding, the time of the flood event, the amount of warning provided, the location and extent of the flood boundary, facility elevation, and distance from the flood source. Potential impacts resulting from flooding include:

- Injuries or loss of life
- Property destruction or damage
- Loss of property contents
- Infrastructure damage including roadways, bridges, other transportation means
- Public health hazards resulting from mold, mildew, and disease due to flood water
- Flooded or destroyed lifelines/supply routes
- Damaged or destroyed utilities
- Loss of community economic base
- Employment losses
- Agricultural (crops and livestock) damages or destruction
- Environmental damage
- Prolonged periods of necessary dewatering
- Flooding erosion may alter natural drainage channels
- Societal and community impacts
- Psychological impacts of impacted populations
- Disruptions to education delivery to community
Additionally, individuals who were unable to evacuate in time or refused to leave will likely need assistance or rescue from the flooded area. Remaining in or being trapped by flood waters places individuals in significant risk of injury or death. The impacts extend beyond the danger placed upon the affected individual and places greater resource demands on agencies and organizations making efforts to rescue trapped individuals.

Probability of Future Occurrence of the Hazard

The location of the CSU Chico campus mostly resides outside of any Special Flood Hazard Area. However, the Big Chico Creek (Zone AE) flows through the middle of the campus, and one block to the south of the campus are areas designated as a Special Flood Hazard Area Zone A (1% annual chance for flooding). As such, the potential also exists for flooding due to heavy precipitation.

Based on the above factors, along with some occurrences of flooding near the campus, the probability of future occurrence for flooding is Possible.

Vulnerability to the Hazard

The CSU Chico campus is subject to the effects of limited, small-scale flooding resulting from excessive precipitation, snowmelt, river/levee overflow, or a combination of these. The Big Chico Creek, Little Chico Creek, and Lindo Channel present the greatest potential for flooding and damage on campus and surrounding residential and commercial areas of Chico. The channels and extending irrigation channels that surround the campus have limited storage or volume capacities.

Vulnerability to flooding on the CSU Chico campus will vary depending on when the flood were to occur and on the location of people and/or assets located within any low-lying areas on campus. The risk to the campus population will be lessened during periods when classes are not in session or during periods of breaks. Conversely, during the days and hours that classes are in session and staff are at their workplaces, the human vulnerability increases. However, in region-wide events this vulnerability may be extended to the homes and workplaces of members of the campus community and their families.

During low probability, severe flood events, some campus buildings and infrastructure in low lying areas, might be vulnerable to large-scale flooding if it reaches the university. Campus utilities and communication capabilities could be impacted by flood waters rendering them disabled. A rare flood covering a large portion of the city might affect communication capabilities well beyond the boundaries of the campus. Remaining flood waters will leave behind molds and other health concerns in affected campus buildings and facilities likely requiring extensive restoration or demolishing. The residents of the on-campus residence halls, if located in low lying, flood-prone areas, may have transportation limitations requiring evacuation procedures to be implemented if populated. In such areas, flood waters may result in damage to campus equipment, communication systems, protected documents, artwork, academic materials, computer systems, research, and other critical activities on lower levels of buildings.
Certain campus populations will experience greater challenges to a post-flood / failure environment. Vulnerable populations will likely need to navigate through flood generated debris, face extreme health safety issues from flood waters, experience extreme stresses of a disaster, an inability to communicate to or gain access to support networks, and find difficulty in accessing equipment or supplies to aid in a specific need. Students remaining on campus such as those residing in the residence halls would be particularly vulnerable especially those without access to adequate transportation.

Estimate of Potential Losses

Estimates of potential losses will be influenced by a variety of factors. The volume and force of the water will determine the scale of damages affecting campus infrastructure, equipment, and other impacted features. The location and elevation above flood waters will affect the level of damage and individuals exposed. The time of the academic year, the day of week, and hour in which the flooding was to occur will influence the number of people on campus and potential casualties. The severity of the storms producing precipitation, the speed of the storms moving across the area, the level of snowpack in the higher elevations, and amount of resulting snowmelt will produce varying effects on damages produced and costs incurred. Losses will be generated by the physical damages, the loss of revenue, loss of academic research, loss of building contents, and community wide economic reductions.

Based on estimate replacement costs of facilities and structures on campus, the maximum total replacement costs due to earthquake are $344,244,561. However due to one portion of the campus being located in levee protected area, it is unlikely for flood to cause destructive losses to the entire campus.

Table 6-21: Special Flood Hazard Area (SFHA) Estimated Losses

<table>
<thead>
<tr>
<th>Zone Designation</th>
<th>No. of Buildings</th>
<th>Maximum Replacement Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Zone V</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Zone VE &amp; V 1-30</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Zone A</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Zone AE</td>
<td>2</td>
<td>$5,731</td>
</tr>
<tr>
<td>Zone AH</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Zone AO</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Zone X</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Zone X Minimal Risk</td>
<td>38</td>
<td>$344,238,830</td>
</tr>
<tr>
<td>Not in a SFHA</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>No Building Value Data *</td>
<td>28</td>
<td>Unknown</td>
</tr>
</tbody>
</table>

*Buildings with no value defined are also included in the respective Zones they are found in.
Vulnerability Assessment Conclusions

While the campus is located in an area of minimal flood potential (Zone X), the primary vulnerabilities to flood on campus are people and assets in low lying areas exposed to mostly localized flooding and ponding from overflow of campus creeks or low probability, large-scale storms that produce heavy amounts of precipitation directly over the campus and surrounding neighborhoods. In addition, the campus’ proximity to the Big Chico Creek, Little Chico Creek, Lino Channel, and Mud Creek in addition to the levees providing a barrier between the campus and the river, presents other hazard risk factors for the campus.

The potential for flooding on the campus and the surrounding area generates the potential for a number of cascading effects such as disruptions to the local economy, utility failures, disruptions to providing for the needs of the campus and the community, and development of public health hazards. These effects would be exacerbated by effects of seasonal flooding, ongoing heavy precipitation, or excessive run-off from the watershed contributing to the river system. The potential for widespread flooding and damage of structures due to the force of water, while unlikely, has exponentially powerful impacts on particular segments of the campus community including those with access or functional needs, international students, the homeless, and students residing in the residence halls.

Identified Data Limitations

Missing campus structural replacement costs and complete inventory of building construction features or mitigation efforts to lessen the impact due to flood inundation. HAZUS generated analysis is focused on the broader community level versus finetuning the analysis to the micro-level for facilities such as a university campus.
**Hazardous Materials**

Description of the Hazard

A hazardous material is defined in California’s State Hazardous Materials Incident Contingency Plan (1991) as “a substance or combination of substances which, because of quantity, concentration, physical, chemical, or infectious characteristics may: cause, or significantly contribute to an increase in deaths or serious illnesses; and/or pose a substantial present or potential hazard to humans or the environment.”

Hazardous materials are one or more of the following: flammable, corrosive or an irritant, oxidizing, explosive, toxic (poisonous or infectious), thermally unstable or reactive, or radioactive. Hazardous materials are ubiquitous in modern society and may be found at all stages of production, consumption, and disposal.

Federal and state laws permit the intentional release of some hazardous materials into the environment such that the risk to human health and the environment is thought to be acceptable. However, sometimes releases are unintentional, resulting from leaks, accidents, or natural hazards. This section focuses on such accidental releases and fall into the following key categories:

**Fixed Hazardous Materials Incident:** A fixed hazardous materials incident is the accidental release of chemical substances or mixtures during production or handling at a fixed facility.

**Transportation Hazardous Materials Incident:** A transportation hazardous materials incident is the accidental release of chemical substances or mixtures during highway, waterway or air transport. Populations, built and natural environments are potentially impacted.

**Pipeline Incident:** A pipeline transportation incident occurs when a break in a pipeline creates the potential for an explosion or leak of a dangerous substance (oil, gas, etc.) possibly requiring evacuation. An underground pipeline incident can be caused by environmental disruption, accidental damage, or sabotage. Incidents can range from a small, slow leak to a large rupture where an explosion is possible. Inspection and maintenance of the pipeline system along with marked gas line locations and an early warning and response procedure can lessen the risk to those near the pipelines.

Hazardous materials can also be classified according to worker safety and health. Information provided by California Division of Safety and Health includes guidelines related to:

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71 California Department of Industrial Relations. *Worker Safety and Health During Fire Cleanup.* Retrieved 04.18.2021 from: [https://www.dir.ca.gov/dosh/wildfire/Worker-Health-and-Safety-During-Fire-Cleanup.html](https://www.dir.ca.gov/dosh/wildfire/Worker-Health-and-Safety-During-Fire-Cleanup.html)
- **Safety hazards**: fire and fire byproducts, electricity, flammable gases, unstable structures, demolition, sharp or flying objects, excavations
- **Health hazards**: carbon monoxide ash, soot, and dust; asbestos; hazardous liquids; other hazardous substances; heat illness

**Natural-Technological Incidents (Natechs)**

During the past two decades, increasing attention has been given to hazardous materials releases resulting from Natechs or a natural disaster event that triggers a technological hazard event. Natechs are of particular concern for the following reasons:

- They can produce a simultaneous effect on many industrial facilities
- Can overwhelm response capacity
- Containment systems may fail
- May produce cascading disasters
- Response may be hindered by a disaster’s impact on the physical environment

**Location of the Hazard**

Hazardous materials and infrastructure such as fuel tanks, rail lines, chemicals, hazardous waste sites and gas pipelines to varying degrees are located within the CSU system and/or within its surrounding communities. At larger scales (beyond the campus planning area) hazardous materials are located throughout the city of Chico and Butte County, and reflect different types, configurations and scales dispersed across these geographic areas. Based on the Figure below, Chico State is located adjacent to a hazardous waste site and railroad infrastructure.

Extent of the Hazard

There is no comprehensive statewide vulnerability assessment available at this time. As such, the true extent of the hazardous materials risk in California and its communities is not known, meaning no overarching conclusions have been reached which have been able to integrate all qualitative and quantitative risk factors to produce a comprehensive measure of the extent of the hazard. However, for the CSU – Chico planning committee, based on the types and levels of hazardous materials on or near the campus (see hazmat mapping), the history of hazmat events on and near the campus, and because the assessment of risk is so complex, it is prudent to rank the extent of the hazard for the CSU – Chico campus as High and to consider worst case scenarios as the main driver of policy in order to fully mitigate all possible hazardous materials event outcomes.

For example, according to the 2018 CA State Hazard Mitigation Plan, 400 hazardous materials problems are tied to 32 past earthquakes, including more than 495 documented
hazardous materials releases due to the Loma Prieta Earthquake alone (this number excludes innumerable leaks in Pacific Gas & Electric’s natural gas distribution system). That said, it is likely that many such hazardous materials releases have received little attention in the past because public authorities, the media, and the public have overlooked them in the rush to address and recover from immediate disaster threats, and that responsible parties may have an incentive to understate the extent of releases or not to report them at all.

History of the Hazard

According to the CA Governor’s Office of Emergency Services’ Hazardous Materials Spill Report, the state experiences from 10 to 30 spill events daily. As of April 2021, a total of 2,096 spill events had occurred so far this year. Such events have occurred in all the cities and/or counties where CSU campuses are located.

With regard to hazmat incidents on the CSU – Chico campus, several chemical spill events have originated on site, and several events (including a chemical polymerization accident) have required response from the Butte County hazmat team. In addition, CSU property purchases for the campus have required on-site chemical remediation.

Potential Impacts of the Hazard

A large hazardous materials release could affect an entire community or city under certain conditions related to direction of air flow (air-based chemical release) and population density or the contamination of a community’s main water supply. Either type of release could necessitate large scale evacuation. By contrast, in the rural unincorporated areas where population densities are low, even in the event of a large release, the number of homes that may need to be evacuated would be significantly lower than in an urban environment. The occurrence of a hazmat incident can also result in the shut-down of transportation corridors which can last for hours at a time while the impacted area is stabilized.

The release of some toxic gases may cause immediate death, disablement, or sickness if absorbed through the skin, injected, ingested, or inhaled. Contaminated water resources become unsafe and unusable, depending on the amount of contaminant. Some chemicals cause painful and damaging burns if they come in direct contact with skin. Prolonged and concentrated exposure to such chemicals can produce severe long-term impacts to respiratory, endocrine and nervous systems, heart and brain health.

In addition to the historical event impacts, the potential impacts of chemicals and toxic gases discussed here also apply to the students, staff and environment on the CSU – Chico campus.

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With regard to the natural environment overall, contamination of air, ground, or water may result in harm to fish, wildlife, livestock, and crops. The release of hazardous materials into the environment may cause debilitation, disease, or birth defects over a long period of time. Loss of livestock and crops may lead to economic hardships within the community.

Recent California examples include the 2016 Aliso Canyon methane gas leak\textsuperscript{77}, which caused evacuation of nearby residents, many of whom experienced temporary health problems such as difficulty breathing and eye irritation; and the 2016 Fruitland metal recycle plant fire in Maywood, which released heavy metals such as lead, magnesium, copper, aluminum, antimony, calcium, iron, sulfur, tin, potassium, and zinc which pose severe risks to public health.\textsuperscript{78} Health effects from exposure to these metals included short-term symptoms such as irritation to the eyes, nose, throat, and lungs.

**Potential Impact of the Hazard (Natechs)**

Natural disasters, including earthquake, flood, and fire also pose risks to public health and the environment. For example, following the Northridge Earthquake, California State University (CSU) Northridge laboratories and chemical storage rooms experienced multiple chemical spills. Such incidents, triggered by a natural disaster, pose a significant risk to students, faculty, staff, and first responders. At a minimum, all CSU campuses with a science lab (including CSU – Chico) is at risk of potential impact from a natural-technological (combined impact) event.

In a severe flood event, floodwaters are often contaminated with hazardous materials posing a threat to public and animal health, groundwater, and other parts of the environment. These hazardous materials may be released from damaged or flooded underground tank sites (e.g., gas stations or chemical storage facilities), propane tanks, manure or human waste handling facilities, fertilizer and pesticide storage, agricultural sites, and household hazardous waste.

In a fire event, (such as the October 2017 Northern California firestorms which destroyed approximately 6,000 residences) entire neighborhoods can be burned to the ground. Hazardous material release creates public health concerns which can delay the initial steps of fire recovery, including reopening burned areas to residents and initiating debris removal activities. The post-fire “toxic sweep” poses a risk of coming into contact with toxic substances due to the presence of synthetic and hazardous materials.

**Probability of Future Occurrence of the Hazard**

The probability of occurrence for a hazmat event on the CSU – Chico campus can be viewed in two different ways: the history of occurrence serves as a sound predictor of


future probability assuming current risk and vulnerability factors remain somewhat constant. For the purposes of the current estimate, no current data clearly indicates otherwise. As such, the probability of occurrence is possible because the CSU – Chico campus has experienced several hazmat events requiring hazmat team response. That said, hazmat occurrences are largely based on human error, and any changes in risk and vulnerability factors such as a decreased vigilance in materials oversight and handling practices or changes in the amount of chemicals or exposure will likely increase the probability on campus.

**Vulnerability to the Hazard**

Hazardous materials pose a risk to the CSU – Chico campus. As identified by the campus planning committee and on the hazmat map, the following vulnerabilities are present on campus: a rail line runs north and south through campus which poses a risk of hazmat release from a rail accident, and poses risks to students who frequently walk across the tracks; a propane tank farm is located adjacent to the campus; and, chemical experiments are conducted on campus, both of which hold potential for chemical release and exposure to staff, students, and the campus environment.

Although it is quite difficult to produce a quantitative measure of vulnerability because (unlike natural hazards) the probability of occurrence is dependent on human error, which itself is variable based upon a fluctuating set of interrelated factors, some of which lack prediction or control, given the complexity of how all natural and built environments and hazmat risks factors interrelate at the local or campus level, it is prudent to assume for planning purposes that the campus’ vulnerability is a sub-set of the larger community’s vulnerability. As such, the CSU – Chico leadership maintains vigilance to mitigate the campus’ vulnerabilities identified above at a minimum.

**Estimate of Potential Losses**

As discussed previously, it is difficult if not impossible to produce an accurate quantitative measure of vulnerability because of the variable nature of a hazardous materials spill. For example, the release of a toxic airborne chemical in a populated area has severe impact potential, whereas the impact potential of a small chemical spill in a remote or rural area is most likely limited to remediation of soil. And, in both cases, the probability of occurrence is dependent on human error, which itself is variable based upon a fluctuating set of interrelated factors, some of which lack prediction or control. In all cases, different types and amounts of hazardous materials interact with fluctuating combinations of human error to produce different event outcomes with variable impact costs.

**Vulnerability Assessment Conclusions**

It is well understood that with regards to hazmat vulnerability, each campus and its surrounding community (including CSU – Chico) operates through a complex and dynamic interaction between industrial and commercial inputs and outputs and the natural and built environment. Such activity produces hazardous materials that move
through the environment along both convergent and divergent routes and across all levels of land-use from site to campus to city and county and beyond. It is also clear from a review of the Butte County hazard mitigation plan and Cal OES’ records of hazardous material spills, that such events occur with great frequency and varying degrees of severity across jurisdictions statewide. As such, in assessing the vulnerability of the CSU – Chico campus, campus-level risks and vulnerabilities are not discreet or isolated, but can become exacerbated or augmented through connections to broader community-level hazmat risks and vulnerabilities.

Finally, in order to draw conclusions on vulnerability, it should be noted that any identified vulnerabilities at the campus level and/or community level are circumscribed and potentially reduced by targeted policy and program interventions. Numerous policies and programs have been established in recent years in response to California’s widespread and complex and integrated hazardous materials risks - California established the Unified Program which consolidates and integrates the administrative requirements, permits, inspections, and enforcement activities of the following environmental and emergency response programs: the Aboveground Petroleum Storage Act (APSA) Program, Area Plans for Hazardous Materials Emergencies, the California Accidental Release Prevention (CalARP) Program, the Hazardous Materials Release Response Plans and Inventories (Business Plans), Hazardous Material Management Plan (HMMP) and Hazardous Material Inventory Statement (HMIS) requirements (California Fire Code), the Hazardous Waste Generator and Onsite Hazardous Waste Treatment (tiered permitting) Programs, and the Underground Storage Tank Program.

Identified Data Limitations

The CSU – Chico planning committee has provided information on campus-level hazmat materials and risks. Data limitations pertain to a comprehensive understanding of human activity and error related to materials control over the long term.
**Landslide**

**Description of the Hazard**

A landslide is a down-slope movement of soil, rock, or other debris, and can also be referred to as a mass movement or slope failure.\(^79\) These geological hazards can range in size from a few feet to over a mile in length and width and, when heavy and rapidly moving, can cause serious damage and loss of life.

Landslides are classified based on the type of material and type of movement involved. They can range from slow-moving earth flows to fast-moving debris flows, though many large slope failures involve more than one type of movement. The primary natural triggers of slope failures are water, seismic activity, and volcanic activity. Slope saturation by water can occur from intense rainfall, snowmelt, changes in ground-water levels, and surface-water level changes along coastlines. In winter months, El Nino storms or other high rainfall events may saturate soils and trigger slope failure.

**Deep-Seated Landslides**

Deep-seated landslides, ranging in depth from ten to several hundred feet, occur as a result of geologic and hydraulic changes, such as earthquakes or increased levels of groundwater. These landslides can move slowly or quickly and can cause extensive property damage, but rarely result in loss of life.

**Debris Flows Related to Shallow Landslides**

Shallow landslides may mobilize into rapidly moving debris flows and typically occur after sudden saturation of the ground. These types of debris flows are typically more dangerous because they move rapidly, causing both property damage and loss of life.

Debris flows may also occur as a result of post-fire conditions, where wildfires have left barren ground exposed to heavy rainfall. Intense rainfall, generally greater than .5 inch per hour, has the potential to trigger a post-fire debris flow.\(^80\) These landslides may impact lives and properties within the deposition zone and can result in downstream flooding. Post-fire debris flows often occur during the fall and winter following major summer fires.

**Location of the Hazard**

The susceptibility of an area to landslides depends on several variables, including magnitude of slope gradients, water content, ground cover, presence of erosion, and slope material and structure. However, landslides are most prevalent in terrain with weak material and steep slopes, and the highest risk is found in areas with high rainfall or high earthquake potential. Slope failures are also most likely to occur in areas where they have

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occurred in the past. In California, the most landslide-prone areas are found along the coast and in the northern Franciscan Formation.

General landslide vulnerability can be estimated from the distribution of weak rocks and steep slopes as seen in the Figure below. As seen on the map, CSU – Chico is not located in or near any area susceptible to landslides.

Figure 5-16: Deep-Seated Landslide Susceptibility Surrounding CSU Chico

Extent of the Hazard

Landslides are most likely to occur in the foothills and steep slopes east of Chico, where people and structures are not likely to be significantly exposed to the impacts. However, the indirect impacts of landslides in the region may cover a larger geographical extent. Based on the location of the campus outside the landslide risk area, the planning committee ranks the extent of the hazard as **Low**.

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History of the Hazard

FEMA has declared seven major disasters in Butte County involving landslides, mudslides, or mud flows since 1983. Five debris flow events were recorded by NOAA in the County from 2017 to 2019. All of these events occurred in the Sierra Nevada mountains to the east. A 2018 debris flow, occurring as a result of heavy rainfall in a burn scar area, blocked cars traveling to Chico on Honey Run Road. The event caused $100,000 of property damage. No landslide events have occurred on the campus.

Potential Impacts of the Hazard

CSU Chico may be impacted by the disruption of services as a result of landslides in the region. Landslides can result in physical damage to buildings and property and have the potential to significantly effect infrastructure. As a landslide moves, it distresses structural foundations by settlement, cracking, and tilting. Fast-moving flows can remove entire structures in one instance, while other types of flows can cause damage gradually.

Transportation and utility infrastructure are particularly vulnerable to landslides, since the failure of any component can disrupt service over a large area. The loss of power and communication and disruption of transportation can have cascading effects throughout an area, including impaired disposal of sewage, contamination of water supplies, and the release of flammable fuels. Transportation routes are also often expensive to clean up, and prolonged obstruction can disrupt the movement of people and goods for long periods of time.

Probability of Future Occurrence of the Hazard

Slope failures are often triggered by other natural hazards such as heavy rainfall and earthquakes, so landslide frequency is somewhat related to the frequency of these other hazards. As climate change impacts the frequency and intensity of triggers such as rain events and fires, landslides may generally occur more often. Historically, landslides have occurred occasionally in the foothills to the east of Chico and therefore are likely to occur in the future. However, given the location of the campus well beyond landslide risk zones, the planning committee ranks the probability of the landslide hazard for the campus as Unlikely. That said, based on the occasional occurrence of landslides to the east, the probability of experiencing secondary effects of a landslide such as loss of power or transportation disruption is Possible.

Vulnerability to the Hazard

The City of Chico considers their vulnerability to landslides to be “medium.”82 There is potential for landslides in the foothill portions of the community. Landslides and mudslides are minimal, except in the burn scar areas in the Upper Bidwell Park region.

82 Butte County, California. Local Hazard Mitigation Plan 2019. Retrieved 02.06/2021 from: http://www.buttecounty.net/oem/mitigationplans
The vulnerability of the built environment to landslides depends on exposure and is more likely to incur damage as a result of proximity, rather than inferior structural design. The structures most vulnerable to landslides are buildings and utility/transportation lifelines, which can be impacted by either impact or ground deformation. Utilities and transportation infrastructure are particularly vulnerable, due to their geographic extent and susceptibility to physical distress. Any population proximal to a landslide when it occurs is vulnerable to its impacts. That said, the campus’ vulnerability is limited to secondary effects of a landslide such as power outage or transportation disruption.

**Estimate of Potential Losses**

There are no current models for estimating potential losses from a landslide directly impacting the campus.

Although the economic impact of landslide damage can exceed that of the direct repair costs, there are currently no applicable methods for estimating indirect costs related to CSU Chico.

**Vulnerability Assessment Conclusions**

Community exposure to landslides varies depending on their physical locations – whether in flat plains or on steep hillsides – and on their dependence on critical infrastructure located in landslide hazard zones.

Landslides could impact the campus in a variety of ways, primarily related to indirect impacts to transportation and utilities. Utility outages can impact health, particularly for vulnerable populations, and can cause interruptions in operations. Interruptions may impact student and employee’s ability to travel to campus and the delivery of classes and events.

**Identified Data Limitations**

The ability to predict future landslides at the CSU Chico campus is limited. However, the USGS estimates that climate change-induced shifts in weather will increase the frequency of post-wildfire landslides, which are expected to occur almost every year in California.
Power Outage

Description of the Hazard

Chico State University is located in Butte County on the northeast edge of the Sacramento Valley. The Sierra Nevada mountains, where they lie to the east and south, with Chico’s city limits venturing several miles into the foothills. Chico State is the center point of the college town where the South Campus is densely populated with an overwhelming population of young renters who are mostly students at Chico State.

Most aspects of modern life rely on the near continuous availability of utilities, such as electricity, water, and natural gas. Chico State is a highly populated community within one of the country’s largest suburban layouts. An interruption in the supply or distribution of these services can leave highly populated areas, like Butte County, without electricity or sanitation. These interruptions can produce cascading effects from other hazards, such as a major windstorm, leading to an intentional disruptions of transmission lines due to safety concerns.

A power outage event can interrupt day-to-day operations of the campus, like in-person classes, impede, or limit digital, telephonic, or radio communications, create traffic jams around the busy avenues and boulevards surrounding the campus, close the student health center, and close restaurants around campus and outside the campus. Additionally, thousands of Chico State student residents in on-campus housing would also be affected by a power outage on campus and in the area. Additionally, a severe outage to Butte County or the City of Chico would also directly affect the campus and the community.

An electric power disruptions and outages fall into two categories: intentional and unintentional.

The four types of intentional disruptions:

- Planned: Some disruptions are intentional and can be scheduled based maintenance or upgrading needs.
- Unscheduled: Some intentional disruptions must be done "on the spot" in response to an emergency.
- Demand-Side Management: Some customers (i.e., on the demand side) have entered into an agreement with their utility provider to curtail their demand for electricity during periods of peak system loads.
- Load Shedding: When the power system is under extreme stress due to heavy demand and/or failure of critical components, it is sometimes necessary to intentionally interrupt the service to selected customers to prevent the entire system from collapsing. These intentional interruptions result in rolling blackouts.
**Unintentional** or unplanned disruptions are outages that come with essentially no advance notice or warning. This type of disruption is the most problematic. The following are categories of unplanned disruptions:

- Accident by the utility, utility contractor, or others.
- Malfunction or equipment failure.
- Equipment overload (utility company or customer).
- Reduced capability (equipment that cannot operate within its design criteria).
- Tree contact other than from storms.
- Vandalism or intentional damage.
- Weather, including lightning, wind, earthquake, flood, and broken tree limbs taking down power lines.
- Wildfire that damages transmission lines.

**Location of the Hazard**

Although power outages can take place within a certain area, it has the potential to affect the entire planning area equally.

**Extent of the Hazard**

In order to anticipate outage conditions and reduce impacts, campus facility managers and others keep track of conditions and data provided by the media, municipal utilities and the California Independent System Operator (CAISO) which is tasked with managing the power distribution grid that supplies most of California, except in areas served by municipal utilities. CAISO is thus the entity that coordinates statewide flow of electrical supply. CAISO uses a series of stage alerts to the media based on system conditions. The alerts are as follows:

- Stage 1 - reserve margin falls below 7 percent.
- Stage 2 - reserve margin falls below 5 percent.
- Stage 3 - reserve margin falls below 1.5 percent.

Rotating blackouts become a possibility when Stage 3 is reached. Utility agencies aim to advise affected areas approximately 48 hours in advance of a potential PSPS event and will attempt notification again approximately 24 hours before power is shut off. Campus staff respond accordingly.

Given the prevalence of rolling blackouts and other power outages in California, the campus maintains safety precautions, situational awareness, access to emergency power generators and other protocols for managing campus power outages. That said, only one recorded outage has taken place on campus. As such, the planning committee ranks the extent of the power outage hazard as **Minimal**.
History of the Hazard

Chico State has experienced power outages for various reasons. The university worked with the community’s local electric utility company, PG&E, to restore energy to the campus for its facilities, assets, resident halls, and classrooms. The following are examples of power outage events experienced over the last 10 years:

On December 5, 2020, PG&E experienced a power outage that impacted Chico State. The power outage occurred due to a squirrel that contacted equipment inside of a substation. The incident affected 5,458 students.

Several classes were canceled due to a power outage on April 6, 2015. The outage was caused by an insulator at the Table Mountain Station experiencing a system failure. The power outage resulted in affecting approximately 79,000 customers in Butte County.

Potential Impacts of the Hazard

Instructors, campus residents, staff and administration rely on electricity for basic survival and operations. During a widespread power failure, it may take days to restore operations. Electrical power may be the only cooling source for many individuals around the campus and its community, and long-term outages can potentially put people’s health and life at risk. Disruptions in the supply of heating fuel may put people and property at risk during extremely cold weather if it relies on electric generation or heating mechanisms instead of gas. Additionally, many medical devices, communications devices, and security rely on power to maintain their functions.

During a power outage at Chico State buildings on campus cannot continue regular functions at normal levels. Chico State has access to emergency generators on campus that can be utilized to power egress lights and elevators to evacuate buildings in the event of a power outage.

Climate Change and Energy Shortage

Climate change is expected to bring more frequent and intense natural disasters. These changes have created variability at a rate that makes historical data a poor predictor of future climate. For example, the warmest years on record in California occurred in 2014, 2015, and 2016. The 2016-2017 year broke the record as the wettest ever recorded in the northern Sierra Nevada Mountains.

Changes in temperatures, precipitation patterns, extreme events, and sea-level rise have the potential to decrease the efficiency of thermal power plants and substations, decrease the capacity of transmission lines, render hydropower less reliable, spur an increase in electricity demand, and put energy infrastructure at risk of flooding.

With climate warming, higher costs from increased demand for cooling in the summer are expected to outweigh the decreases in heating costs in the cooler seasons. Hotter temperatures in California will mean more energy (typically measured in “cooling-degree days”) needed to cool homes and businesses both during heat waves and daily, during
the daytime peak of the diurnal temperature cycle. During future heatwaves, historically cooler coastal cities (e.g., San Francisco and Los Angeles) are projected to experience greater relative increases in temperature, such that areas that never before relied on air conditioning will experience new cooling demands.

Secondary impacts of energy shortages are most often felt by vulnerable populations. For example, those who rely on electric power for life-saving medical equipment, such as respirators, are extremely vulnerable to power outages. Also, during periods of extreme heat emergencies, the elderly and the very young are more vulnerable to the loss of cooling systems requiring power sources.

**Probability of Future Occurrence of the Hazard**

The probability of California experiencing a power outage can be difficult to quantify but is a hazard that occurs yearly during the same seasonal periods of variance throughout the calendar year - The City of Chico and the surrounding area experience such outages on a regular basis. Climate models suggest summer global temperatures are likely to increase while changes between temperature extremes would be more pronounced. As such, it is expected that power outages will occur more frequently in the future. Therefore, the planning committee ranks the probability of future occurrence on campus as **Likely**

**Vulnerability to the Hazard**

Based on the data available, and in consideration of the increasing effects of climate change, the campus remains vulnerable to power outages in terms of impacts to people, power infrastructure and campus operations. Nonetheless, as discussed campus leadership works to reduce vulnerabilities through consistent use of safety and operational protocols and emergency power sources to ensure it is able to mitigate an interruption to electrical power.

**Estimate of Potential Losses**

The data provided by Chico State does not report any value for potential losses due to power outage.

**Vulnerability Assessment Conclusions**

The primary concern for campus leadership is that a loss of power can lead to potential hazards to students, faculty, and staff at Chico State University. Safety and operations protocols center on the following “direct impact” set of concerns:

Elevators, entry ways, air filtration systems and lighting provide the campus community with the necessary infrastructure and systems to function and navigate through the campus and to, maintain a safe campus environment and visibility during nighttime hours. The vulnerable population, especially students with physical disabilities may be the most heavily affected by loss of power as they rely on elevators, entry ways with automatic doors and locks and lights may impede on a disabled student’s ability to travel and utilize the campus and its structures safely.
The use of communication devices, billing, records, and electrical tools may also become unusable due to a loss of electricity. Many records and billing items may have to revert to “by-hand” procedures and paper copies may be needed for continuity of operations. Additionally, classrooms may not be usable if lighting equipment is not functioning impacting a semester or quarter’s progress for the academic year.

**Identified Data Limitations**

Chico State did not report any monetary or life losses due to a power outage. Also, the campus did not report any incidents involving a power outage directly affecting the campus community and operations.
Volcano (Associated Air Quality)

Description of the Hazard

The US Geological Service defines volcanoes as “openings or vents where lava, tephra (small rocks), and steam erupt on to the Earth’s surface. Through a series of cracks within and beneath the volcano, the vent connects to one or more linked storage areas of molten or partially molten rock (magma). This connection to fresh magma allows the volcano to erupt over and over again in the same location.”

A volcanic eruption occurs when magma, lighter than surrounding rock, is driven upwards by its buoyancy and by pressure from the dissolved gases contained within it. Gases are released from magma as it reaches the surface and pressure decreases. Magma can be erupted in several ways and violent eruptions typically cause tiny pieces of tephra (ash) to be carried away by the wind. This ash is hard, does not dissolve in water, is extremely abrasive and mildly corrosive, and conducts electricity when wet.

The gases released in an eruption include carbon dioxide, sulfur dioxide, hydrogen sulfide, and hydrogen halides. Depending on their concentration, these are potentially hazardous to people, animals, agriculture, and property.

Location of the Hazard

There are eight volcanic areas located throughout California. Seven of these - Medicine Lake Volcano, Mount Shasta, Lassen Volcanic Center, Clear Lake Volcanic Field, Long Valley Volcanic Region, Coso Volcanic Field, and Salton Buttes – are considered active volcanoes. A small portion of Butte County is within the Lassen Volcanic Center ash hazard zone.

Extent of the Hazard

Volcanic hazards are most severe within a few miles of the volcano vent and the severity generally decreases with distance. Ash impact zones can range from tens to hundreds of miles from the vent source. The US Geological Survey has estimated zones surrounding active volcanoes wherein 2 inches or more of ashfall following an eruption is possible. A portion of Butte County is located within a volcano hazard zone. While CSU Chico does not fall within an estimated ashfall zone, lighter dustings of ash outside of that zone may directly or indirectly impact the campus. As such, the planning committee ranks the extent of the hazard for the campus as Low.
The dashed lines in Figure 6-17 enclose areas where two inches or more of ashfall are possible. However, it should be noted that hazard maps are dynamic and updated periodically as research adds new information.

History of the Hazard

No historical eruption events in California have affected the campus. Over the last 1,000 years, there have been at least 12 eruptions in California. The most recent volcanic eruption in California occurred at Lassen Peak about 100 years ago, when a major explosion delivered windborne ash over 275 miles away.

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Potential Impacts of the Hazard

The specific impacts vary widely and depend on which type of volcano erupts, the style of explosion, the volume of lava, the eruption duration, and the local water conditions. As CSU Chico is not proximal to an active volcano, only the potential impacts of ashfall and gases have been detailed. While both these hazards can be widespread, their most severe impacts are generally seen closer to the volcanic source.

Although ashfall is typically a nonlethal volcanic hazard, it is the most widespread and disruptive. Falling ash can damage crops, electronics, and machinery. It can also impact human health by irritating the respiratory tract, eyes, and skin. The particles may enter drinking water and structures and may cause structure failure if it is thick and heavy enough. Even a fine layer of ash can disrupt utilities. A portion of California’s major electric transmission lines, aerial telecommunication lifelines, transportation corridors, and water storage and conveyance lie within the state’s volcano hazard zones. Impacts to any of these can impact operations at CSU Chico.

The potential impacts of gases released during volcanic eruptions are as follows:

- Carbon dioxide typically becomes diluted very quickly and is not life threatening. However, it can become trapped in higher concentrations in low-lying areas and has the potential to be fatal.
- Sulfur dioxide can cause acid rain and air pollution downwind of a volcano.
- Hydrogen sulfide can cause irritation of the upper respiratory tract. At high concentrations it can cause unconsciousness and death.
- Hydrogen halides can coat ash particles and, once deposited, poison drinking water, agricultural crops, and grazing land.

Probability of Future Occurrence of the Hazard

The US Geological Survey, based on the record of volcanic activity in California, estimates that the probability of another small- to moderate-sized eruption in the next thirty years is about 16 percent. Lassen Volcanic Center has a .5 percent chance of eruption in the next thirty years. As such, the annual probability of future occurrence for the campus is ranked by the committee as *Unlikely*.

Vulnerability to the Hazard

Populations living near volcanoes are the most vulnerable to eruptions and lava flows. However, volcanic ash can travel and affect populations miles away. The location and thickness of ash in any given area is a function of the severity of the eruption and wind speed and direction. For CSU Chico, there is low vulnerability to the immediate impacts of volcanic eruptions due to the limited area affected and remote potential of an eruption. In the event of a widespread ashfall event, the elderly, infants, and populations with existing respiratory disease will be at higher risk.
Estimate of Potential Losses

Impacts to critical infrastructure, agriculture, and property from ashfall have the potential to cause widespread disruption, damage, and economic loss throughout the state. In the event of a widespread ashfall event, impacts will be immediate.

Current modeling is not precise enough to allow for an assessment of potential losses from ashfall to structures or infrastructure on or surrounding the campus.

Vulnerability Assessment Conclusions

CSU Chico is unlikely to experience the direct impacts of a volcanic event. While the campus may be indirectly impacted by ashfall elsewhere in the state, direct ashfall impacts are generally unlikely but possible in a widespread event. However, the likelihood of any volcanic eruption in the state impacting the campus is very low.

Identified Data Limitations

Not all active volcanoes in California have been zoned for hazards by the US Geological Survey. This, together with the infrequent occurrence of volcanic explosions and number of factors determining type and extent of impacts, make the quantification of potential loss difficult.
Wildfire

Description of the Hazard

While wildfires are a natural part of California’s ecosystem, wildfires in California represent a hazard that presents one of the greatest probabilities of destruction along with a demonstrated history of catastrophic fire events in recent years. The destructive fire seasons of 2017 to 2020 illustrated the destructive forces fire presents to communities across the state. Wildfires may result in the structural loss, infrastructure loss, dangerous air quality, environmental damages, economic impacts, injuries, and loss of life. In many communities throughout California, wildfire presents greatest risk to human life and property.

Wildfires have been defined as any free burning vegetation fire that initiates from an unplanned ignition, whether natural or human caused demanding fire suppression actions to contain. These fires are prone to become uncontrolled, spreading through vegetative fuels rapidly exposing people and structures to harm. Wildfires present a significant risk to communities across the state, as evidenced by increasing trends of structural losses from wildland fires. This risk is elevated in areas where development and community growth has intersected, also known as the wildland-urban interface (WUI). In the interface setting, development itself can provide additional fuel for large fires. Recent fires have also demonstrated the ability of fire to consume populated areas in extreme conditions.

California’s Mediterranean climate in combination with its geography and vast population create a combination of factors that promotes an optimal environment for large fire growth and consequences. As there is great diversity of geographic characteristics across the state, the risks and potential consequences of wildfire must be assessed locally. The physical location, weather patterns, local fuel types and volume, extent of the WUI, topography, and additional factors will factor differently from part of the state to another.

The behavior of wildfires in California is significantly influenced by three distinct geographic factors. These factors will help shape the size, direction of spread, rate of combustion, fire intensity, and ability to pre-heat fuels. The physical factors contributing to wildfire behavior include:

- Topography – The rate in which wildfires spread increases with greater slopes in topography. The greater the slope will result in more pre-heating of fuel above the advancing fire. The direction that a slope faces will also influence fire behavior as south facing slopes receive greater solar radiation and thus drier vegetation that is more susceptible to combustion. Ridgetops often denote the end of fire spread as fire has greater difficulty spreading downhill.

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- **Weather** – Weather factors substantially influence the behavior of wildfires. Wind, temperature, humidity, lightning, and lack of precipitation all contribute to a fire’s ability or inability to spread and intensify. California routinely experiences conditions in which these factors are in alignment to contribute to extreme fire behavior during the summer and fall seasons. High winds, low humidity, and high temperatures provide an environment promoting extreme fire activity.

- **Fuels** – Certain types of vegetation are increasingly prone to igniting and promote more intense burning. Areas with greater “fuel loading” (amount of fuel present in terms of weight of fuel per unit of area) increases the amount of fuel to fuel a fire. Greater volumes of dead or dry vegetation compared to live plants is a critical factor. Vegetation during drought conditions will experience decrease in moisture content increasing the conditions for combustion. Fuels close proximity to one another allows for rapid spread through contact or radiant exposures.

A risk assessment for wildfires should be implemented within a geospatial context focusing on the specific location features and incorporates the three components of the wildfire risk triangle – likelihood, intensity, and susceptibility.

### Location of the Hazard

Substantial portions of the State of California are exceptionally vulnerable to wildfire activity or reside in a wildland-urban interface (WUI) area due to the vast open spaces, rangelands, forests and other lands with high susceptibility to fire occurring throughout the state. Chico is located in the central portion of the Sacramento Valley along the eastern edge at the base of the Northern Sierra Nevada Mountains. In general, areas considered to be within Fire Hazard Severity Zones defined by the Fire and Resource Assessment Program (FRAP) within the California Department of Forestry and Fire Protection (CalFire) occur to the east, west, and north of Chico. These areas surrounding the valley are topographically diverse, contain heavier vegetative fuels, and often have residential development interspersed. The land in the Sacramento Valley where the CSU Chico campus is located, is largely urban, developed, or agricultural. The CSU Chico campus is intersected by the Big Chico Creek.

The CSU Chico campus is located in the western portion of the City of Chico. The area immediately surrounding the campus is predominately developed with residential and commercial land uses. The campus is established in downtown Chico surrounded by developed neighborhoods. Fire Hazard Severity Zones are found 3 miles to the north and east towards the foothills. Immediately bordering the City of Chico are Moderate and High Fire Hazard Severity Zones. Very High Fire Hazard Severity Zones are found further up the hillsides. To the west of the city are agricultural areas with extensive crop and orchard production.
Extent of the Hazard

The area immediately surrounding the CSU Chico campus is not in proximity to high fire hazard zones. The Chico campus has experienced multiple days of poor air quality due to fires burning in Butte County and neighboring counties. However, given that the threat to fire directly spreading onto the campus is minimal, the planning committee ranks the extent of the hazard as Low.

The National Fire Danger Rating System (NFDRS) is the current system in use for rating and classifying the potential danger of fire. The NFDRS tracks the effects of previous weather events on both dead and live fuel loads and adjusts accordingly based on future or predicted weather conditions. These complex relationships and equations are computed, and the outputs are expressed in terms that users can quickly and easily understand. The current NFDRS is used by all federal and most state agencies to assess fire danger conditions.

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87 California Department of Forestry and Fire Protection, Fire and Resource Assessment Program, Fire Hazard Severity Zone Viewer. Retrieved 05.05.2021 from: https://egis.fire.ca.gov/FHSZ/
The following table depicts the NFDRS, from the US Forest Service’s Wildland Fire Assessment System.

Table 6-22: National Fire Danger Rating System

<table>
<thead>
<tr>
<th>Rating</th>
<th>Basic Description</th>
<th>Detailed Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>CLASS 1: Low Danger (L)</td>
<td>Fires not easily started</td>
<td>Fuels do not ignite readily from small firebrands. Fires in open or cured grassland may burn freely a few hours after rain, but wood fires spread slowly by creeping or smoldering and burn in irregular fingers. There is little danger of spotting.</td>
</tr>
<tr>
<td>COLOR CODE: Green</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CLASS 2: Moderate Danger (M)</td>
<td>Fires start easily and spread at a moderate rate</td>
<td>Fires can start from most accidental causes. Fires in open cured grassland will burn briskly and spread rapidly on windy days. Woods fires spread slowly to moderately fast. The average fire is of moderate intensity, although heavy concentrations of fuel – especially draped fuel – may burn hot. Short-distance spotting may occur but is not persistent. Fires are not likely to become serious and control is relatively easy.</td>
</tr>
<tr>
<td>COLOR CODE: Blue</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CLASS 3: High Danger (H)</td>
<td>Fires start easily and spread at a rapid rate</td>
<td>All fine dead fuels ignite readily, and fires start easily from most causes. Unattended brush and campfires are likely to escape. Fires spread rapidly and short-distance spotting is common. High intensity burning may develop on slopes or in concentrations of fine fuel. Fires may become serious and their control difficult, unless they are hit hard and fast while small.</td>
</tr>
<tr>
<td>COLOR CODE: Yellow</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CLASS 4: Very High Danger (VH)</td>
<td>Fires start very easily and spread at a very fast rate</td>
<td>Fires start easily from all causes and immediately after ignition, spread rapidly and increase quickly in intensity. Spot fires are a constant danger. Fires burning in light fuels may quickly develop high-intensity characteristics - such as long-distance spotting - and fire whirlwinds when they burn into heavier fuels. Direct attack at the head of such fires is rarely possible after they have been burning more than a few minutes.</td>
</tr>
<tr>
<td>COLOR CODE: Orange</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Fires under extreme conditions start quickly, spread furiously, and burn intensely. All fires are potentially serious. Development into high intensity burning will usually be faster and occur from smaller fires than in the Very High Danger class (4). Direct attack is rarely possible and may be dangerous, except immediately after ignition. Fires that develop headway in heavy slash or in conifer stands may be unmanageable while the extreme burning condition lasts. Under these conditions, the only effective and safe control action is on the flanks, until the weather changes or the fuel supply lessens.

Due to the impacts of wildfires on public health, agencies across the nation have adopted the use of the Air Quality Index (AQI) to communicate and provide a consistent approach to air quality measurements and categorization. The AQI primarily focuses on the health effects caused by pollutants in the air such as smoke. The goal of the AQI is to provide advisories to assist the public in determining when to reduce exposures to inhalation of air pollution as pollution levels rise.

Table 6-23: Air Quality Index for Ozone and Particulate Pollution

<table>
<thead>
<tr>
<th>Daily AQI Color</th>
<th>Levels of Concern</th>
<th>Values of Index</th>
<th>Description of Air Quality</th>
</tr>
</thead>
<tbody>
<tr>
<td>Green</td>
<td>Good</td>
<td>0 to 50</td>
<td>Air quality is satisfactory, and air pollution poses little or no risk.</td>
</tr>
<tr>
<td>Yellow</td>
<td>Moderate</td>
<td>51 to 100</td>
<td>Air quality is acceptable. However, there may be a risk for some people, particularly those who are unusually sensitive to air pollution.</td>
</tr>
<tr>
<td>Orange</td>
<td>Unhealthy for Sensitive Groups</td>
<td>101 to 150</td>
<td>Members of sensitive groups may experience health effects. The general public is less likely to be affected.</td>
</tr>
</tbody>
</table>

Some members of the general public may experience health effects; members of sensitive groups may experience more serious health effects.

Health alert: The risk of health effects is increased for everyone.

Health warning of emergency conditions: everyone is more likely to be affected.

### History of the Hazard

The State of California has a long history of chronic and destructive wildfires throughout the state. On average, 8,300 wildfires have caused burnt 928,245 acres across the state over the 20-year period between 2000 and 2020. Butte County also has a long history of wildfire activity primarily in the foothills and mountains surrounding the Sacramento Valley. Wildfires occurring in Butte County have resulted in hundreds of thousands of acres burned and hundreds of millions of dollars in damages.

The area immediately surrounding the CSU Chico campus is not in proximity to high fire hazard zones. The Chico campus has experienced multiple days of poor air quality due to fires burning in Butte County and neighboring counties. The 2017, 2018, and 2020 fire seasons in particular illustrated the increase in wildfire generated smoke saturating the air of communities throughout the state including Chico. CSU Chico personnel reported the ongoing development of policies and procedures to address the response to poor air quality days.

### Table 6-24: Historic Large-Scale Fires Near Chico

<table>
<thead>
<tr>
<th>Date</th>
<th>Fire</th>
<th>Location</th>
<th>Declaration</th>
<th>Damages</th>
</tr>
</thead>
<tbody>
<tr>
<td>7/21/1943</td>
<td>Pine Creek</td>
<td>Butte County</td>
<td></td>
<td>11,360 acres</td>
</tr>
<tr>
<td>9/11/1951</td>
<td>Milk Ranch</td>
<td>Butte County</td>
<td></td>
<td>21,979 acres</td>
</tr>
<tr>
<td>7/12/1964</td>
<td>Lightning #1</td>
<td>Butte County</td>
<td></td>
<td>9,876 acres</td>
</tr>
<tr>
<td>8/13/1990</td>
<td>Campbell</td>
<td>Butte County</td>
<td></td>
<td>131,504 acres</td>
</tr>
</tbody>
</table>

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90 California Department of Forestry and Fire Protection, Stats and Events, https://www.fire.ca.gov/stats-events/
<table>
<thead>
<tr>
<th>Date</th>
<th>Fire</th>
<th>Location</th>
<th>Declaration</th>
<th>Damages</th>
</tr>
</thead>
<tbody>
<tr>
<td>8/23/1999</td>
<td>Bucks</td>
<td>Butte County</td>
<td>EM-3140-CA</td>
<td>34,236 acres</td>
</tr>
<tr>
<td>8/23/1999</td>
<td>Doe Mill</td>
<td>Butte County</td>
<td>EM-3140-CA</td>
<td>10,857 acres</td>
</tr>
<tr>
<td>8/23/1999</td>
<td>Musty</td>
<td>Butte County</td>
<td>EM-3140-CA</td>
<td>16,757 acres</td>
</tr>
<tr>
<td>6/11/2008</td>
<td>Humboldt</td>
<td>Butte County</td>
<td>FM-2771-CA; EM-3287-CA</td>
<td>23,344 acres, $20.5 million</td>
</tr>
<tr>
<td>7/2/2008</td>
<td>BTU Lightning Complex</td>
<td>Butte County</td>
<td>State</td>
<td>53,699 acres, $85 million</td>
</tr>
<tr>
<td>11/8/2018</td>
<td>Camp</td>
<td>Butte County</td>
<td>FM-5278-CA</td>
<td>153,336 acres 85 fatalities, $19.3 million</td>
</tr>
</tbody>
</table>

Fire has contributed significantly to Butte County’s hazard and disaster history. Some particular fires that have shaped the way fire plays into preparedness, planning, response, recovery, and mitigation efforts are described in the following.

The June 11, 2006 Humboldt Fire in Butte County east of Chico burned a total of 23,344 acres in moderate to heavy fuels. The fire demonstrated extreme fire behavior during red flag fire warning conditions. The arson caused fire forced the evacuations of 9,000 people, destroyed 87 homes, damaged 7 homes, and destroyed 167 other buildings. The fire was contained after five days and ultimately caused $21 million in damages.

The Butte Lightning Complex ignited on June 21, 2008 due to lightning strikes. At one point there were as many as 27 separate lightning fires burning in the higher elevations of Butte County east of Paradise. Multiple communities were threatened. The three-week long fire burned 59,440 acres, destroyed 202 homes and 11 other buildings, and cost over $85 million.

The Camp Fire is the worst suffered fire in Butte County history. The fire ignited on November 8, 2018 in an area that had been identified as being “the greatest risk to the ridge communities is from an East Wind driven fire that originates above the communities and blows downhill through developed areas.” This is what occurred in November of 2018 leading to the eventual destruction of 64% of structures in the Town of Paradise. Conditions were optimal for intense fire speed and spread, minimal humidity, unusually dry fuels, hot gusty winds, and heavy fuel growth. Roadways leading in and out of the area were only a handful of two-lane highways limiting capacity for

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evacuations and entry for fire resources. The fire grew rapidly to a final 153,336 acres destroying entire communities. The smoke generated from this fire spread for hundreds of miles and degraded air quality across Northern California. Cities like Chico received evacuees and supported their needs for months. The CSU Chico campus participated in this effort as a community partner. Ultimately, almost 19,000 structures were destroyed, including almost 14,000 residences, 528 businesses were destroyed, significant infrastructure was destroyed including communications systems, and 85 people were killed.

Potential Impacts of the Hazard

The location of the CSU Chico campus surrounded by residential and commercial development mitigates the direct effect that direct flame exposure from wildfire would pose on the campus. There is potential for fire in the urban forest to develop and grass fires to occur in the surrounding fields composed of light and flashy fuels. The threat of these fields to campus structures is minimal.

Potential impacts to the campus community resulting from wildfires include:

- Injuries or loss of life
- Campus property destruction or damage
- Residential property destruction or damage
- Commercial property destruction or damage
- Loss of property contents
- Infrastructure damage
- Damaged or destroyed lifelines/supply routes
- Damaged or destroyed utilities
- Damaged or destroyed critical facilities supporting campus emergency support needs
- Loss of community economic base
- Employment losses
- Loss to ground supporting vegetation on hillsides resulting in erosion or landslides in future precipitation events
- Agricultural (crops and livestock) damages or destruction
- Environmental damage
- Societal and community impacts
- Damage to organizations and facilities providing support services to vulnerable populations
- Greater evacuation challenges for those most vulnerable
Psychological impacts of impacted populations
Disruptions to education delivery to community

Potential impacts resulting from wildfire generated smoke include:

- Dangerous levels of air pollution
- Human Health Effects
- Air conditioning systems overwhelmed
- Greater demands on air filtration systems
- Greater demands on healthcare systems

Additionally, there remains a number of secondary impacts from wildfires that could affect the campus community. Utilities feeding areas of Butte County including the campus may be damaged resulting in power outages. Fire related damage in the watersheds will likely cause future landslides, degradation to plants supporting hillsides, and impact the hydro-electric power capabilities. Fires may present threats to areas of recreation, scenic value, and wildlife that are a part of the culture of the campus community. Finally, the campus may experience effects of evacuated individuals arriving on campus from other areas as a location of refuge.

Probability of Future Occurrence of the Hazard

The CSU Chico campus is located in an area not considered to have a high wildfire risk. Based on the wildfire threat potential in the area surrounding the CSU Chico campus, including the distance to Fire Hazard Severity Zones and density of residential and commercial development, the probability of wildfire related damage is considered Unlikely.

Based on the wildfire threat potential in the area surrounding the Chico region, including the volume of areas in elevated Fire Hazard Severity Zones surrounding the northern Sacramento Valley, the probability of wildfire generated smoke impacts to air quality is considered Likely.

Vulnerability to the Hazard

The CSU Chico campus is not likely to be subject to direct impact from wildfire due to the campus location in an urban/suburban area of Chico. The vulnerabilities to the effects of wildfire would largely lie within the campus community who may reside or work in locations that are exposed to the Fire Hazard Severity Zones outside of Chico and within the agricultural areas surrounding the city. Wildfires occurring in other areas of the region may result in the displacement of large numbers of people. These effects may spill onto the campus in the form of evacuees or facility support to emergency resources.
Fire directly threatening the campus would likely take the form of localized fires involving single structures or small areas. Smaller vegetation fires are possible surrounding the campus in the urban forest or fields surrounding the city. These incidents would likely have little impact to the campus.

The primary basis of vulnerability is based on the population affected and the built environment exposed. In general, newer construction will be more fire resistant than older buildings as building and fire codes and construction technology have improved. Density of buildings and proximity of fuels to buildings or equipment at risk of combustion would additionally influence the fire’s ability to spread to structures.

The greater concerns regarding vulnerabilities to wildfire are related to the smoke that fires in the area would produce. The past few summer seasons have clearly demonstrated the reality of large wildfires producing enough smoke to fill the Sacramento Valley even from substantial distances away. These recent fires have displayed how the effects of this smoke impact the general population and especially vulnerable populations. CSU Chico students, faculty, and staff both on campus and off campus face these same vulnerabilities related to smoke filled air.

Smoke generated from large wildfires pose a threat in terms of diminished air quality that would be exposed to the population within the area of smoke distribution. Individuals with existing health problems such as respiratory or cardiac illnesses are increasingly vulnerable to wildfire generated smoke. Staff who work in roles requiring outdoor activity will be increasingly exposed during days where the air quality index is considered unhealthy or worse. Student athletes participating in outdoor sports and engaging in aerobic activities are increasingly vulnerable to the effects of wildfire.

The vulnerability to members of the campus community in which wildfire generated smoke on the CSU Chico campus will vary depending on when the air quality was to reach unhealthy levels. The risk to the campus population will be lessened during periods when classes are not in session or during periods of breaks. Conversely, during the days and hours that classes are in session and staff are at their workplaces, the human vulnerability increases. However, in region-wide events this vulnerability may be shared with the homes and workplaces of members of the campus community and their families.

Vulnerable populations will likely face disproportionate health safety issues from smoke filled air, experience increased stresses, may require the need to remain away from the campus enclosed at home, and may find difficulty in accessing equipment or supplies to aid in a specific need.

Estimate of Potential Losses

Estimates of potential losses will be influenced by a variety of factors. The risk to wildfire directly impacting the campus is minimal. Costs would be likely be limited to mitigation or repairs of HVAC systems, sealing of doors and windows, and other methods of keeping smoke from entering buildings. Secondary costs would include lost academic days during campus closures, lost staff on campus productivity, and health and medical interventions for affected members of the campus community.
Based on estimate replacement costs of facilities and structures on campus, the maximum total replacement costs due to wildfire are $344,244,561. However due to the campus being located in an urban environment, it is unlikely for fire to cause destructive losses.

Table 6-25: Wildfire Hazard Potential (WHP) Zone Estimated Losses

<table>
<thead>
<tr>
<th>WHP Zone</th>
<th>No. of Buildings</th>
<th>Maximum Replacement Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Extreme</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Very High</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>High</td>
<td>15</td>
<td>$23,866,687</td>
</tr>
<tr>
<td>Moderate</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Low</td>
<td>1</td>
<td>$1,906,036</td>
</tr>
<tr>
<td>Non-Burnable</td>
<td>51</td>
<td>$318,471,838</td>
</tr>
<tr>
<td>No Building Value Data</td>
<td>28</td>
<td>Unknown</td>
</tr>
</tbody>
</table>

Vulnerability Assessment Conclusions

While the occurrence of wildfires has been more frequent in Butte County, historically there have not been wildfire incidents that have caused damages near the CSU Chico campus. The location of the CSU Chico campus surrounded by residential and commercial developed neighborhoods limits the ability for wildfire to threaten the campus. The foothills and mountains surrounding the northern Sacramento Valley host environments that are ideal for the development of wildfire activity. The consequences of fires in these areas would present primary and secondary consequences to the CSU Chico campus and expose vulnerabilities on the campus and to the campus community.

The topography of the valley surrounded by mountains allows for smoke filled air to linger in the Chico area with the potential for unhealthy air quality. Fires in the watersheds of the Feather River and tributaries may damage vegetation stabilizing hillsides and result in increased sediments to be discharged into the river system and reservoirs reducing their capacity and effectiveness. Communities located within or near the Wildland Urban Interface may be subject to damaging fires. These same communities may be home to members of the campus community. The potential for large-scale wildfires in the region further generates the added potential for a number of cascading effects such as disruptions to the local economy, utility failures, disruptions to providing for the needs of the community, and development of public health hazards. The potential for large-scale wildfires and resulting damage of homes and businesses has exponentially powerful impacts on particular populations among the campus community including those with access or functional needs, international students, the homeless, and students residing in the residence halls.
Identified Data Limitations

Missing campus structural replacement costs and an inventory of building construction types to include status of earthquake retrofitting. HAZUS generated analysis is focused on the broader community level versus finetuning the analysis to the micro-level for facilities such as a university campus.

**Severe Weather (Wind, Tornado, Hail, and Lightning)**

Description of the Hazard

Severe weather can be described as a variety of weather or climate events that are beyond or near the ends of the range of observed weather patterns and behavior. These events can include high or extreme winds, storms, lightning, hail, tornadoes, heat waves, unusually cold temperatures, extreme rainfall, and flooding.\(^\text{93}\) According to the Intergovernmental Panel on Climate Change (IPCC), to be classified as severe (or extreme), the occurrence of each value of a climate or weather variable (e.g., wind, hail, lightning, tornado, etc.) must be “above (or below) a threshold value near the upper (or lower) ends of the range of observed values of the variable.”\(^\text{94}\)

Severe weather in California can be generated by local, regional, and/or global weather and climate influences. From the individual thunderstorm to the Santa Ana wind event to the strong El Niño, damaging weather elements that are produced by and accompany severe weather and climate phenomena (e.g., damaging winds, hail, lightning, and tornadoes) occur throughout California and the California State University (CSU) system.

**Global Scale Influences on Severe Weather in California: El Niño, La Niña, and ENSO**

The El Niño-Southern Oscillation (ENSO) is a recurring climate pattern involving changes in the temperature of waters in the central and eastern tropical Pacific Ocean. On periods ranging from about three (3) to seven (7) years, the surface waters across a large swath of the tropical Pacific Ocean warm or cool by anywhere from 1°C to 3°C, compared to normal. This oscillating warming and cooling pattern, referred to as the ENSO cycle, directly affects rainfall distribution in the tropics and can have a strong influence on weather across the United States and other parts of the world.


El Niño and La Niña are extreme phases of the ENSO cycle, with a third phase occurring between them called the Neutral phase. The El Niño phase is characterized by unusually warm ocean temperatures and weaker-than-normal east winds in the Equatorial Pacific, while the La Niña phase is characterized by unusually cold ocean temperatures and stronger-than-normal east winds in the Equatorial Pacific. Both extreme ENSO phases lead to significant differences from the average ocean temperatures, winds, surface pressure, and rainfall across parts of the tropical Pacific. The Neutral phase indicates that conditions are near their long-term average.

The extreme ENSO phases affect the frequency and intensity of weather events across the world, including in California. On average, areas across California experience exceptionally stormy winters with increased precipitation under El Niño conditions, but experience less stormy and drier winters under La Niña conditions. This variability in storminess and precipitation brought on by El Niño and La Niña events affects the both the frequency and intensity of severe weather conditions experienced by all CSU campuses, including CSU Chico.

Regional Climate Influences on Severe Weather across California

Most of the weather in California is influenced by the wet-winter/ dry-summer Mediterranean climate pattern. In the summer months, Pacific storm tracks are deflected north due to the position of the Pacific High (i.e., a large-scale atmospheric circulation over the Northeast Pacific Ocean), preventing Pacific storms from reaching California. As a result, most summer storms are generated due to the incursion of moist air from the Gulf of Mexico or the Gulf of California, and occur as scattered, locally heavy showers in the desert and mountain regions of the state. In the winter months, the Pacific High decreases in intensity and moves south, permitting powerful Pacific storms to move into and across the state; these storms can produce extreme winds, heavy rains (including “atmospheric river” events), and widespread coastal and inland flooding. (Please see the Flood Hazard profile in this document for information on Floods.) As a result, storm events accompanied by precipitation in California are far more frequent in the winter months than they are in the summer months.

While the Mediterranean climate pattern influences the seasonal frequency, intensity, geographic spread, and type of some severe weather events CSU campuses experience (including CSU Chico), other severe weather phenomena may occur in California at any
time of the year. For example, near the coast and over the Central Valley, there appears to be no defined seasonality to thunderstorms, and these storms are usually light and infrequent. Thunderstorms are more intense and more frequent in the intermediate and higher elevations of the Sierra Nevada, and occur with greater frequency during the summer months.\textsuperscript{101}

**Types of Storms in California**

The 2018 California State Hazard Mitigation Plan (SHMP) defines a storm as a violent atmospheric disturbance occurring over land and/or water that is distinguished by its strength, characteristics, and the scale of the resulting damage.\textsuperscript{102} The SHMP also lists the following types of storms that produce hazardous conditions and potential damage throughout the state of California.\textsuperscript{103} These storms affect (in varying degrees) all CSU campuses, including CSU Chico.

- **Thunderstorm**: A rain-bearing cloud that also produces lightning. Thunderstorms can produce some of nature’s most destructive and deadly weather including tornadoes, hail, strong winds, lightning and flooding.\textsuperscript{104} Thunderstorms are caused by an atmospheric imbalance from warm unstable air rising rapidly into the atmosphere. Lightning, which occurs during all thunderstorms, can strike anywhere.\textsuperscript{105} Thunderstorms can produce some of nature’s most destructive and deadly weather including tornadoes, hail, strong winds, lightning and flooding.\textsuperscript{106} **Severe thunderstorms** are more intense, violent, and dangerous thunderstorms. The National Oceanic and Atmospheric Administration (NOAA) defines a severe thunderstorm as any storm that produces one or more of the following elements: Damaging winds or speeds of 58 mph (50 knots) or greater, hail 1 inch in diameter or larger, and/or a tornado.\textsuperscript{107} \textsuperscript{108}

- **Hailstorm**: a type of storm that precipitates round chunks of ice. Hailstorms usually occur during regular thunderstorms.\textsuperscript{109}

\textsuperscript{101} Retrieved on 07.17.2021 from https://wrcc.dri.edu/Climate/narrative_ca.php
\textsuperscript{104} Retrieved on 07.14.2021 from https://www.weather.gov/phi/ThunderstormDefinition
\textsuperscript{107} Retrieved on 07.15.2021 from https://www.noaa.gov/explainers/severe-storms
\textsuperscript{108} Retrieved on 07.15.2021 from https://www.weather.gov/safety/thunderstorm
- **Wind storm**: marked by high wind with little or no precipitation.\(^{110}\)

- **Winter storm**: A storm that can produce a combination of freezing rain, sleet, heavy snow, and/or strong winds.\(^{111}\)

- **Coastal storm**: large wind-driven waves and/or storm surge that strike the coastal zone.\(^{112}\)

- **Ice storm**: Ice storms are one of the most dangerous forms of winter storms. When surface temperatures are below freezing, but a thick layer of above-freezing air remains aloft, rain can fall into the freezing layer and freeze upon impact into a glaze of ice. In general, 8 millimeters (0.31 inch) of accumulation is all that is required, especially in combination with breezy conditions, to start downing power lines as well as tree limbs. Ice storms also make unheated road surfaces too slick to drive on. Ice storms can vary in time range from hours to days and can cripple small towns and large urban centers alike.\(^{113}\)

- **Snowstorm**: A heavy fall of snow accumulating at a rate of more than 5 centimeters (2 inches) per hour that lasts several hours. Snowstorms, especially ones with a high liquid equivalent and breezy conditions, can down tree limbs, cut off power, and paralyze travel over a large region.\(^{114}\)

**Severe Weather Hazard Elements: Wind Hazards, Hail, and Lightning**

This hazard profile concentrates on the following types of severe weather hazards: **wind hazards** (including tornadoes), **hail**, and **lightning**. These hazards are produced by a variety of weather phenomena, including thunderstorms, coastal storms, winter storms, and topographically-enhanced downslope winds. While storm and downslope wind hazards are responsible for severe weather events across the CSU system, only the wind, tornado, hail, and lightning elements generated by these hazards are covered in this profile. (Storm-related hazards such as flooding and extreme temperatures are covered in other sections of this document.)


Wind Hazards

Wind is the horizontal movement of air past any given point. Wind begins with differences in air pressures; pressure that is higher at one point than another sets up a force, pushing the high towards the low pressure. Wind gusts are defined as “rapid fluctuations in the wind speed with a variation of 10 knots or more between peaks and lulls.”

Wind hazards in California take several forms: High Wind, Strong Winds, Thunderstorm Winds, Mountain-Valley (Downslope) Winds, and Tornadoes. These hazards are encountered across California, and have the potential to cause harm to or loss of life and/or property throughout California and the CSU system (including CSU Chico).

High Winds, Strong Winds, and Thunderstorm Winds

The National Weather Service reports three (3) types of wind events that occur areas over land: High Winds, Strong Winds, and Thunderstorm Winds. Collectively, these reports are used to determine the frequency with which wind hazard events have affected areas across the U.S., including California.

High Winds

High winds are defined as sustained non-convective winds of 35 knots (40 mph) or greater lasting for 1 hour or longer, or gusts of 50 knots (58 mph) or greater for any duration (or otherwise locally/regionally defined). In some mountainous areas, the above numerical values are 43 knots (50 mph) and 65 knots (75 mph), respectively.

Strong Winds

Strong winds are defined as non-convective winds gusting less than 50 knots (58 mph), or sustained winds less than 35 knots (40 mph), resulting in a fatality, injury, or damage.

Thunderstorm Winds

Thunderstorm winds are winds that arise from thunderstorm convection (occurring within 30 minutes of lightning being observed or detected), with speeds of at least 50 knots (58 mph). They can also be winds of any speed (non-severe thunderstorm winds below 50 knots (58 mph)) producing a fatality, injury, or damage.

References:

Please note: **Straight-line wind** is a term used to define any thunderstorm wind that is not associated with rotation. It is used mainly to differentiate from the rotational winds found in tornado-producing storms. However, it is not a term used in the NCEI Storm Events Database, and therefore cannot be used to determine severe weather history of or potential impacts to CSU campuses.

**Tornadoes**

A tornado is an extreme severe weather wind hazard. A tornado is a rapidly rotating column of air extending from a thunderstorm to the surface of the Earth. This column extends between cloud and the Earth’s surface. The damage from tornadoes comes from the strong winds they contain and the flying debris they create. It is generally believed that rotational wind speeds can be as high as 300 mph in the most violent tornadoes. On a local scale, tornadoes are the most violent and most destructive of all atmospheric phenomena.

**Mountain-Valley (Downslope) Wind Systems: Santa Ana, Diablo, and Sundowner Winds.**

**Santa Ana Winds.** A type of wind hazard that is peculiar to Southern California is called a **Santa Ana Wind.** Santa Ana winds are strong, topographically-enhanced, extremely dry downslope winds that originate inland and affect coastal southern California and northern Baja California (Mexico). They occur when air from a region of high pressure over the dry, desert region of the southwestern U.S. flows westward towards low pressure located off the California coast. This creates dry winds that flow east to west through the mountain passages in Southern California. These winds have a strong seasonal component; they are most common during the cooler months of the year, occurring from September through May. Santa Ana winds typically feel warm (or even hot) because as the cool desert air moves down the side of the mountain, it is compressed, which causes the temperature of the air to rise. If strong enough, Santa Ana winds can cause major property damage, and may present difficulties for airborne and seagoing transportation. They also may increase wildfire risk because of the dryness of the winds and the speed at which they can spread a flame across the landscape. (Note: The Wildfire hazard is profiled elsewhere in this document.)

Figure below illustrates the mechanisms involved in the generation of Santa Ana winds across Southern California.

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120 Retrieved on 07.15.2021 from [https://www.nssl.noaa.gov/education/svrwx101/wind/types/](https://www.nssl.noaa.gov/education/svrwx101/wind/types/)
121 Retrieved on 07.15.2021 from [https://www.earthnetworks.com/tornado/](https://www.earthnetworks.com/tornado/)
123 Retrieved on 07.15.2021 from [https://www.weather.gov/bgm/severedefinitions](https://www.weather.gov/bgm/severedefinitions)
**Diablo Winds.** The Diablo wind is another type of topographically-enhanced downslope wind phenomenon that occurs in the North-Central areas of California. Diablo winds are offshore wind events that flow northeasterly over Northern California’s Coast Ranges, often creating high wind speeds downwind of major canyons and over ridges, and extreme fire danger for the San Francisco Bay Area. Diablo winds are driven by a surface pressure gradient that forms in response to an inverted pressure trough that develops over California.127

**Sundowner Winds.** Sundowner winds are significant and potentially damaging downslope wind and warming events that periodically occur along a short segment of the southern California coast in the vicinity of Santa Barbara, CA. The unique topography of this coastal region promotes the development of Sundowner wind events: over a length of about 100 km, the coastline is oriented approximately west–east, with the adjoining narrow coastal plain bounded by a steeply rising (to elevations greater than 1200 m) and

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coast-parallel mountain range. Called Sundowner winds because they often begin in the late afternoon or early evening, their onset is typically associated with a rapid rise in temperature and decrease in relative humidity, and the winds tend to blow from the north from the Santa Ynez Mountains to the coast of Santa Barbara County, California. During the more intense Sundowner wind events, wind speeds can be of gale force 39-54 miles per hour) or higher, and can even reach hurricane force ( ≥ 74 miles per hour) in the most extreme cases. Temperatures over the coastal plain, and even at the coast itself, can rise significantly above 37.8°C (100°F). Seasonally, Sundowner winds peak in March, April, and May, with a minimum during summer and a secondary peak in winter that often corresponds with Santa Ana winds. In addition to causing a dramatic change from the more typical marine-influenced local weather conditions, Sundowner wind episodes have produced significant wind-related property and agricultural damage, as well as conditions of extreme fire danger.128 129 130

**Hail**

Hail is a form of precipitation consisting of solid ice that forms inside thunderstorm updrafts.131 It is roughly round in shape and at least 0.2′ in diameter. Hail develops in the upper atmosphere as ice crystals that are bounced about by high velocity updraft winds; the ice crystals accumulate frozen droplets and fall after developing enough weight. The size of hailstones varies and is a direct consequence of the severity and size of the storm that produces them – the higher the temperatures at the Earth’s surface, the greater the strength of the updrafts and the amount of time hailstones are suspended, and therefore the greater the size of the hailstone.132

**Lightning**

Lightning is an electrical discharge produced by a thunderstorm. Lightning rapidly heats the air in its immediate vicinity to about 50,000°F - about five times the temperature of the surface of the sun. This compresses the surrounding air and creates a supersonic shock wave, which decays to an acoustic wave that is heard as thunder.133

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The discharge may occur within or between clouds, between the cloud and air, between a cloud and the ground, or between the ground and a cloud.\textsuperscript{134} Lightning that is produced from thunderstorms in which precipitation evaporates before reaching the ground is called “dry lightning.”

**Location of the Hazard**

Severe weather is a non-spatial hazard, and can occur anywhere in the CSU system, including on the CSU Chico campus. No one area of the campus – or of the surrounding community – is subject to experiencing severe weather more than any other area.

There is geographic variability among the different types of mountain and valley wind events (as a sub-category of the severe weather hazard). Santa Ana winds occur in Southern California, Diablo winds occur in North-Central California, and Sundowner winds occur almost exclusively in Santa Barbara County, California.

**Extent of the Hazard**

Severe weather hazards are non-spatial hazards that potentially affect all CSU Chico campus areas equally. However, the smallest geographic unit of measurement for almost all official severe weather event data is at the county level. Because the severe weather data used do not exist at the campus level, it is assumed that the same (or similar) severe weather risks to CSU Chico reflect those of the surrounding community and County. As a result, all assets and people at CSU Chico are at risk from the effects of severe weather and can expect to experience at least some (or the complete range of) endemic severe weather hazards. In consideration of the campus’ design, layout, and operations, the severe weather history and degree of severity in the Chico area, and the history and degree of severity of each severe weather sub-type identified by the extent scales (below), the campus planning committee ranks the overall extent of the Severe Weather hazard as **MODERATE**. See each sub-hazard below for the planning committee’s sub-type extent ranking.

**Wind Hazard: Non-Rotational**

The Beaufort Scale is an empirical measure that relates wind speed to observed conditions at sea or on land. Its full name is the Beaufort wind force scale.\textsuperscript{135} First developed in 1805, it is still used today to estimate wind strengths.\textsuperscript{136}

\begin{flushleft}
\textsuperscript{135} Retrieved on 07.15.2021 from \url{https://www.rmets.org/resource/beaufort-scale}
\textsuperscript{136} Retrieved on 07.15.2021 from \url{https://www.weather.gov/mfl/beaufort}
\end{flushleft}
Table 6-26: Beaufort Wind Force Scale\textsuperscript{137}

<table>
<thead>
<tr>
<th>Force</th>
<th>Speed (mph)</th>
<th>Speed (knots)</th>
<th>Description</th>
<th>Specifications for use at sea</th>
<th>Specifications for use on land</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0-1</td>
<td>0-1</td>
<td>Calm</td>
<td>Sea like a mirror.</td>
<td>Calm; smoke rises vertically.</td>
</tr>
<tr>
<td>1</td>
<td>1-3</td>
<td>1-3</td>
<td>Light Air</td>
<td>Ripples with the appearance of scales are formed, but without foam crests.</td>
<td>Direction of wind shown by smoke drift, but not by wind vanes.</td>
</tr>
<tr>
<td>2</td>
<td>4-7</td>
<td>4-6</td>
<td>Light Breeze</td>
<td>Small wavelets, still short, but more pronounced. Crests have a glassy appearance and do not break.</td>
<td>Wind felt on face; leaves rustle; ordinary vanes moved by wind.</td>
</tr>
<tr>
<td>3</td>
<td>8-12</td>
<td>7-10</td>
<td>Gentle Breeze</td>
<td>Large wavelets. Crests begin to break. Foam of glassy appearance. Perhaps scattered white horses.</td>
<td>Leaves and small twigs in constant motion; wind extends light flag.</td>
</tr>
<tr>
<td>4</td>
<td>13-18</td>
<td>11-16</td>
<td>Moderate Breeze</td>
<td>Small waves, becoming larger; fairly frequent white horses.</td>
<td>Raises dust and loose paper; small branches are moved.</td>
</tr>
<tr>
<td>5</td>
<td>19-24</td>
<td>17-21</td>
<td>Fresh Breeze</td>
<td>Moderate waves, taking a more pronounced long form; many white horses are formed.</td>
<td>Small trees in leaf begin to sway; crested wavelets form on inland waters.</td>
</tr>
<tr>
<td>6</td>
<td>25-31</td>
<td>22-27</td>
<td>Strong Breeze</td>
<td>Large waves begin to form; the white foam crests are more extensive everywhere.</td>
<td>Large branches in motion; whistling heard in telegraph wires; umbrellas used with difficulty.</td>
</tr>
<tr>
<td>7</td>
<td>32-38</td>
<td>28-33</td>
<td>Near Gale</td>
<td>Sea heaps up and white foam from breaking waves begins to be blown in streaks along the direction of the wind.</td>
<td></td>
</tr>
<tr>
<td>Extent</td>
<td>Wind Conditions</td>
<td>Rating</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>--------</td>
<td>---------------------------------------------------------------------------------</td>
<td>--------</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Whole trees in motion; inconvenience felt when walking against the wind.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Moderately high waves of greater length; edges of crests begin to break into spindrift. The foam is blown in well-marked streaks along the direction of the wind.</td>
<td>Gale</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Breaks twigs off trees; generally impedes progress.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>High waves. Dense streaks of foam along the direction of the wind. Crests of waves begin to topple, tumble and roll over. Spray may affect visibility</td>
<td>Severe Gale</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Slight structural damage occurs (chimney-pots and slates removed)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>Very high waves with long overhanging crests. The resulting foam, in great patches, is blown in dense white streaks along the direction of the wind. On the whole the surface of the sea takes on a white appearance. The tumbling of the sea becomes heavy and shock-like. Visibility affected.</td>
<td>Storm</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Seldom experienced inland; trees uprooted; considerable structural damage occurs.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>Exceptionally high waves (small and medium-size ships might be for a time lost to view behind the waves). The sea is completely covered with long white patches of foam lying along the direction of the wind. Everywhere the edges of the wave crests are blown into froth. Visibility affected.</td>
<td>Violent Storm</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Very rarely experienced; accompanied by widespread damage.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>The air is filled with foam and spray. Sea completely white with driving spray; visibility very seriously affected.</td>
<td>Hurricane</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Based on those extent ranking factors identified (above), the planning committee ranks the extent of non-rotational wind hazards as **MODERATE**.
**Extent: Tornado**

Tornadoes have their own severity/extent scale. Until 2007, tornadoes were measured and described according to the Fujita Scale.\(^{138}\)

In February 2007, use of the Fujita Scale was discontinued. In its place, the Enhanced Fujita (EF) Scale is used. The Enhanced Fujita scale considers how most structures are designed and is thought to be a much more accurate representation of the surface wind speeds in the most violent tornadoes. Like the original Fujita scale, the Enhanced Fujita scale is a set of wind estimates (not measurements) based on damage.

It is important to note the date that a tornado occurred. Tornadoes that occurred prior to February, 2007 are classified using the original Fujita scale and will not be converted to the Enhanced Fujita Scale.

Table below illustrates the Fujita Scale in use prior to February 2007.

Table 6-27: Fujita Tornado Scale (Pre-February 2007)\(^{139}\)

<table>
<thead>
<tr>
<th>F-Scale Number</th>
<th>Intensity Phrase</th>
<th>Wind Speed</th>
<th>Type of Damage</th>
</tr>
</thead>
<tbody>
<tr>
<td>F0</td>
<td>Gale tornado</td>
<td>40-72 mph</td>
<td>Some damage to chimneys; breaks branches off trees; pushes over shallow-rooted trees; damages sign boards.</td>
</tr>
<tr>
<td>F1</td>
<td>Moderate tornado</td>
<td>73-112 mph</td>
<td>The lower limit is the beginning of hurricane wind speed; peels surface off roofs; mobile homes pushed off foundations or overturned; moving autos pushed off the roads; attached garages may be destroyed.</td>
</tr>
<tr>
<td>F2</td>
<td>Significant tornado</td>
<td>113-157 mph</td>
<td>Considerable damage. Roofs torn off frame houses; mobile homes demolished; boxcars pushed over; large trees snapped or uprooted; light object missiles generated.</td>
</tr>
<tr>
<td>F3</td>
<td>Severe tornado</td>
<td>158-206 mph</td>
<td>Roof and some walls torn off well-constructed houses; trains overturned; most trees in forest uprooted.</td>
</tr>
</tbody>
</table>


<table>
<thead>
<tr>
<th>Scale</th>
<th>Description</th>
<th>Wind Speed</th>
</tr>
</thead>
<tbody>
<tr>
<td>F4</td>
<td>Devastating tornado</td>
<td>207-260 mph</td>
</tr>
<tr>
<td></td>
<td>261-318 mph</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Strong frame houses lifted off foundations and carried considerable distances to disintegrate; automobile sized missiles fly through the air in excess of 100 meters; trees debarked; steel reinforced concrete structures badly damaged.</td>
<td></td>
</tr>
<tr>
<td>F6</td>
<td>Inconceivable tornado</td>
<td>319-379 mph</td>
</tr>
<tr>
<td></td>
<td>These winds are very unlikely. The small area of damage they might produce would probably not be recognizable along with the mess produced by F4 and F5 wind that would surround the F6 winds. Missiles, such as cars and refrigerators would do serious secondary damage that could not be directly identified as F6 damage. If this level is ever achieved, evidence for it might only be found in some manner of ground swirl pattern, for it may never be identifiable through engineering studies.</td>
<td></td>
</tr>
</tbody>
</table>

Table below illustrates the Enhanced Fujita (EF) Scale, currently in use. Tornadoes that have occurred since February, 2007 are classified using the Enhanced Fujita Scale.
Table 6-28: Enhanced Fujita Scale (February 2007 and Later) 140

<table>
<thead>
<tr>
<th>Enhanced Fujita Category</th>
<th>Wind Speed</th>
<th>Potential Damage</th>
</tr>
</thead>
<tbody>
<tr>
<td>EF0 65-85 mph</td>
<td>Light damage. Peels surface off some roofs; some damage to gutters or siding; branches broken off trees; shallow-rooted trees pushed over.</td>
<td></td>
</tr>
<tr>
<td>EF1 86-110 mph</td>
<td>Moderate damage. Roofs severely stripped; mobile homes overturned or badly damaged; loss of exterior doors; windows and other glass broken.</td>
<td></td>
</tr>
<tr>
<td>EF2 111-135 mph</td>
<td>Considerable damage. Roofs torn off well-constructed houses; foundations of frame homes shifted; mobile homes completely destroyed; large trees snapped or uprooted; light-object missiles generated; cars lifted off ground.</td>
<td></td>
</tr>
<tr>
<td>EF3 136-165 mph</td>
<td>Severe damage. Entire stories of well-constructed houses destroyed; severe damage to large buildings such as shopping malls; trains overturned; trees debarked; heavy cars lifted off the ground and thrown; structures with weak foundations blown away some distance.</td>
<td></td>
</tr>
<tr>
<td>EF4 166-200 mph</td>
<td>Devastating damage. Well-constructed houses and whole frame houses completely leveled; cars thrown and small missiles generated.</td>
<td></td>
</tr>
<tr>
<td>EF5 &gt;200 mph</td>
<td>Incredible damage. Strong frame houses leveled off foundations and swept away; automobile-sized missiles fly through the air in excess of 100 m (107 yd); high-rise buildings have significant structural deformation; incredible phenomena will occur.</td>
<td></td>
</tr>
</tbody>
</table>

Based on the extent ranking factors identified (above), the planning committee ranks the extent of tornados as **LOW**.

**Extent: Hail**

The National Oceanic and Atmospheric Administration and the Tornado and Storm Research Organization (TORRO) have combined efforts to create the Hailstorm Intensity Scale. Table below provides details of this scale.

Table 6-29: Combined NOAA/TORRO Hailstorm Intensity Scale\(^{141}\)

<table>
<thead>
<tr>
<th>Size Code</th>
<th>Intensity Category</th>
<th>Typical Hail Diameter</th>
<th>Approximate Size</th>
<th>Typical Damage Impacts</th>
</tr>
</thead>
<tbody>
<tr>
<td>H0</td>
<td>Hard Hail</td>
<td>Up to 0.33”</td>
<td>Pea</td>
<td>No damage</td>
</tr>
<tr>
<td>H1</td>
<td>Potentially Damaging</td>
<td>0.33” – 0.60”</td>
<td>Marble or Mothball</td>
<td>Slight damage to plants and crops</td>
</tr>
<tr>
<td>H2</td>
<td>Potentially Damaging</td>
<td>0.60” – 0.80”</td>
<td>Dime or grape</td>
<td>Significant damage to fruit, crops, and vegetation</td>
</tr>
<tr>
<td>H3</td>
<td>Severe</td>
<td>0.80” – 1.20”</td>
<td>Nickel to Quarter</td>
<td>Severe damage to fruit and crops, damage to glass and plastic structures, paint and wood scored</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>H4</th>
<th>Destructive</th>
<th>1.20” – 1.60”</th>
<th>Half Dollar to Ping Pong Ball</th>
<th>Widespread glass damage, vehicle body damage</th>
</tr>
</thead>
<tbody>
<tr>
<td>H5</td>
<td>Destructive</td>
<td>1.60” – 2.0”</td>
<td>Silver Dollar to Golf Ball</td>
<td>Wholesale destruction of glass, damage to tiled roofs, significant risk of injuries</td>
</tr>
<tr>
<td>H6</td>
<td>Destructive</td>
<td>2.0” – 2.4”</td>
<td>Lime or Egg</td>
<td>Aircraft body dented; brick walls pitted</td>
</tr>
<tr>
<td>H7</td>
<td>Very Destructive</td>
<td>2.4” – 3.0”</td>
<td>Tennis Ball</td>
<td>Severe roof damage, risk of serious injuries</td>
</tr>
<tr>
<td>H8</td>
<td>Very Destructive</td>
<td>3.0” – 3.5”</td>
<td>Baseball to Orange</td>
<td>Severe damage to aircraft body</td>
</tr>
<tr>
<td>H9</td>
<td>Super Hailstorms</td>
<td>3.5” – 4.0”</td>
<td>Grapefruit</td>
<td>Extensive structural damage, risk of severe or fatal injuries to persons caught in the open</td>
</tr>
</tbody>
</table>

Based on those extent ranking factors identified (above), the planning committee ranks the extent of the hail hazard as LOW.
**Extent: Lightning**

The National Weather Service (NWS) uses a Lightning Activity Level (LAL) scale to indicate the frequency and character of cloud-to-ground (C/G) lightning. The scale uses a range of 1 – 6, with 6 being the high end of the scale. Table below provides details of the LAL scale.

Table 6-30: Lightning Activity Level (LAL) Scale

<table>
<thead>
<tr>
<th>Rank</th>
<th>Cloud and Storm Development</th>
<th>Areal Coverage</th>
<th>Counts C/G per 5 Minutes</th>
<th>Counts C/G per 15 Minutes</th>
<th>Average C/G per Minute</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>No Thunderstorms</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>2</td>
<td>Cumulus clouds are common but only a few reaches the towering stage. A single thunderstorm must be confirmed in the rating area. The clouds mostly produce virga, but light rain will occasionally reach ground. Lightning is very infrequent.</td>
<td>&lt;15%</td>
<td>1-5</td>
<td>1-8</td>
<td>&lt;1</td>
</tr>
<tr>
<td>3</td>
<td>Cumulus clouds are common. Swelling and towering cumulus cover less than 2/10 of the sky. Thunderstorms are few, but 2 to 3 occur within the observation area. Light to moderate rain will reach the ground, and lightning is infrequent.</td>
<td>15% to 24%</td>
<td>6-10</td>
<td>9-15</td>
<td>1-2</td>
</tr>
</tbody>
</table>

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142 Retrieved on 07.19.2021 from [https://graphical.weather.gov/definitions/defineLAL.html](https://graphical.weather.gov/definitions/defineLAL.html)
## Lightning Activity Level Scale

<table>
<thead>
<tr>
<th>Rank</th>
<th>Cloud and Storm Development</th>
<th>Areal Coverage</th>
<th>Counts C/G per 5 Minutes</th>
<th>Counts C/G per 15 Minutes</th>
<th>Average C/G per Minute</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>Swelling cumulus and towering cumulus cover 2-3/10 of the sky. Thunderstorms are scattered but more than three must occur within the observation area. Moderate rain is commonly produced, and lightning is frequent.</td>
<td>25% to 50%</td>
<td>11-15</td>
<td>16-25</td>
<td>2-3</td>
</tr>
<tr>
<td>5</td>
<td>Towering cumulus and thunderstorms are numerous. They cover more than 3/10 and occasionally obscure the sky. Rain is moderate to heavy, and lightning is frequent and intense.</td>
<td>&gt;50%</td>
<td>&gt;15</td>
<td>&gt;25</td>
<td>&gt;3</td>
</tr>
<tr>
<td>6</td>
<td>Dry lightning outbreak. (LAL of 3 or greater with majority of storms producing little or no rainfall.)</td>
<td>&gt;15%</td>
<td>None</td>
<td>None</td>
<td>None</td>
</tr>
</tbody>
</table>

Based on those extent ranking factors identified (above), the planning committee ranks the extent of the lightning hazard as **LOW**.

### Extent: Thunderstorms that Generate Wind, Tornado, Hail, and Lightning Hazard Events

Thunderstorms are not explicitly identified as a severe weather category for this hazard profile. However, they are responsible for most tornado, lightning, and hail hazard events – as well as a significant number of wind hazard events – across California and the CSU system. While individual thunderstorms affect relatively small areas, there are many instances in which thunderstorms can cluster together and/or travel in a line over long distances, producing significant damage over large geographic areas.

A thunderstorm is classified as “severe” when certain meteorological parameters within the thunderstorm are reached (i.e., damaging winds or speeds of 58 mph (50 knots) or greater, hail 1 inch in diameter or larger, and/or a tornado). However, there is currently no
established, objective severity scale for thunderstorms.\textsuperscript{143} \textsuperscript{144} That said, according to the \textit{Glossary of Meteorology} published by the American Meteorological Society (AMS), a thunderstorm is reported as \textit{light, medium, or heavy} according to following five (5) characteristics:

- the nature of the lightning and thunder;
- the type and intensity of the precipitation, if any;
- the speed and gustiness of the wind;
- the appearance of the clouds; and
- the effect upon surface temperature.\textsuperscript{146}

A thunderstorm may also be classified by the nature of the overall weather situation in which the thunderstorm is produced, including:

- \textbf{Airmass Thunderstorm}: A thunderstorm produced by local convection within an unstable air mass;\textsuperscript{146}
- \textbf{Frontal Thunderstorm}: An individual thunderstorm the initiation of which results from rising motion associated with a front, or a thunderstorm within a convective system generated and organized by frontal rising motion;\textsuperscript{147} or
- \textbf{Squall-line Thunderstorm}: An individual thunderstorm included within a squall line (i.e., a continuous or broken line of active deep moist convection frequently associated with thunder).\textsuperscript{148} \textsuperscript{149}

Based on the extent ranking factors identified (above) in relation to campus layout and operations, and past event low degree of severity, the planning committee ranks the extent of the thunderstorm hazard as \textbf{LOW}.

\textit{History of the Hazard}

\footnotesize

\textsuperscript{143} Retrieved on 07.15.2021 from \url{https://www.noaa.gov/explainers/severe-storms}
\textsuperscript{144} Retrieved on 07.15.2021 from \url{https://www.weather.gov/safety/thunderstorm}
Severe weather hazards have been an annual occurrence in Butte County and on the CSU Chico campus. Historical data for these hazards are presented below.

**Historical Storm Data Collection: NCEI Storm Events Database**

Historical information regarding severe weather hazards can be found using The National Centers for Environmental Information (NCEI) Storm Events Database. The Storm Events Database contains searchable, archived National Weather Service (NWS) storm data from January 1950 to April 2021, as entered by NOAA’s National Weather Service (NWS). Due to changes in the data collection and processing procedures over time, there are unique periods of record available depending on the event type. For example, from 1950 through 1954, only tornado events were recorded; from 1955 through 1995, only tornado, thunderstorm wind, and hail events were introduced into the database; from 1996 to present, 45 additional event types are recorded, including high wind, strong wind, and lightning events. To obtain the most accurate portrayal of severe weather event frequency, searches of the Storm Events Database are conducted using data collected since 01/01/1996. As a reminder, all official severe weather event data is at the county level. Severe weather data do not exist at the campus level. That said, it may be the case that the campus to some degree experiences the severe weather events reported for the surrounding community and County.

**Wind Hazards (excluding Tornadoes)**

Information obtained from the NCEI Storm Event Database website shows the number of events (or occurrences) of wind hazard events in Butte County since 1996. Here, wind hazard events include all “High Wind,” “Strong Wind,” and “Thunderstorm Wind” storm reports.

- **High Wind:** at least 41 events, or approximately 1.62 events per year
- **Strong Wind:** at least 9 events, or approximately 0.36 events per year

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154 National Climatic Data Center. Storm Events Database. Retrieved 07.29.2021 from [https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28Z%29+High+Wind&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=BUTTE%3A7&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCAFLORINA](https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28Z%29+High+Wind&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=BUTTE%3A7&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCAFLORINA)

155 National Climatic Data Center. Storm Events Database. Retrieved 07.29.2021 from [https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28Z%29+Strong+Wind&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=BUTTE%3A7&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCAFLORINA](https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28Z%29+Strong+Wind&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=BUTTE%3A7&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCAFLORINA)
- **Thunderstorm Wind**: at least 12 events, or approximately 0.47 events per year.\\(^{156}\)

- **All Wind Hazard events** (excluding Tornadoes): at least 56 events, or approximately 2.21 events per year.\\(^{157}\) (Note: This was determined by conducting a simultaneous search of the component wind hazards of high wind, strong wind and thunderstorm wind.)

Overall, in Butte County, there have been at least **56** wind hazard events since 1996, excluding tornadoes.\\(^{158}\) That translates to an approximate average historical frequency of occurrence of **2.21** wind hazard events per year.

Please note: Differences between the sums of individual component severe weather hazard event Database searches (i.e., 62 events) and simultaneous Database searches of all severe weather hazard events (i.e., 56 events) may be due to the following factors: (1) multiple event types are in the same record (e.g., "Thunderstorm Wind/Hail" or "Hail/Tornado;" and/or (2) severe weather hazard events such as “Thunderstorm Wind” or “Hail” that are reported for Butte County have actually taken place hundreds of miles away, but are erroneously recorded as events that have occurred in the County.\\(^{159}\) When such a discrepancy arises, the more conservative aggregate hazard wind event value (i.e., 56 events) is used to determine the historical frequency of occurrence for the severe weather hazard. The origin of this discrepancy is unknown at this time.

### Historical Wind Hazard Losses for Butte County since 1996

According to the NCEI Storm Events Database, the wind hazard events that Butte County has experienced since 1996 have been costly. There have been 3 deaths and 4 injuries,

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\\(^{156}\) National Climatic Data Center. Storm Events Database. Retrieved 07.29.2021 from [https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Thunderstorm+Wind&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=BUTTE%3A7&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA](https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Thunderstorm+Wind&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=BUTTE%3A7&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA)

\\(^{157}\) National Climatic Data Center. Storm Events Database. Retrieved 07.29.2021 from [https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28Z%29+High+Wind&eventType=%28Z%29+Strong+Wind&eventType=%28C%29+Thunderstorm+Wind&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=BUTTE%3A7&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA](https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28Z%29+High+Wind&eventType=%28Z%29+Strong+Wind&eventType=%28C%29+Thunderstorm+Wind&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=BUTTE%3A7&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA)

\\(^{158}\) National Climatic Data Center. Storm Events Database. Retrieved 07.29.2021 from [https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28Z%29+High+Wind&eventType=%28Z%29+Strong+Wind&eventType=%28C%29+Thunderstorm+Wind&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=BUTTE%3A7&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA](https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28Z%29+High+Wind&eventType=%28Z%29+Strong+Wind&eventType=%28C%29+Thunderstorm+Wind&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=BUTTE%3A7&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA)

and property and crop damage estimates have totaled approximately $17,223,000 and $30,000,000, respectively.¹⁶⁰

**Tornado Wind Hazards**

Information from the NCEI Storm Events Database indicates that since 1996, there have been 7 reported events of tornadoes in Butte County, which translates to approximately 0.28 tornado events per year.¹⁶¹ Five (5) tornado reports in Butte County since 1996 have been of tornadoes with a severity rating of F0/EF0, with 1 F1 tornado and 1 EF2 tornado also reported.¹⁶²

**Historical Tornado Hazard Losses for Butte County since 1996**

According to the NCEI Storm Events Database, the tornado hazard events that Butte County has experienced since 1996 have been costly. While there have been no deaths or injuries reported, property damage estimates have totaled approximately $150,000; no crop damage estimates have been reported.¹⁶³

**Hail**

Information from the NCEI Storm Events Database indicates that since 1996, there have been eight (8) reported events of hail in Butte County, which translates to approximately 0.32 events per year.¹⁶⁴ (Note: The NCEI Storm Event Database search results for hail indicate that there has been a total of nine (9) reports of hail since 1996. However, one (1)

¹⁶⁰ National Climatic Data Center. Storm Events Database. Retrieved 07.29.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28Z%29+High+Wind&eventType=%28Z%29+Strong+Wind&eventType=%28Z%29+Thunderstorm+Wind&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=BUTTE%3A7&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA

¹⁶¹ National Climatic Data Center. Storm Events Database. Retrieved 07.29.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Tornado&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=BUTTE%3A7&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA

¹⁶² National Climatic Data Center. Storm Events Database. Retrieved 07.29.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Tornado&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=BUTTE%3A7&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA

¹⁶³ National Climatic Data Center. Storm Events Database. Retrieved 07.29.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Tornado&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=BUTTE%3A7&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA

¹⁶⁴ National Climatic Data Center. Storm Events Database. Retrieved 07.29.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Hail&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=BUTTE%3A7&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA
entry is for a hail event in San Diego County, hundreds of miles away from Butte County. The origin of this discrepancy is unknown at this time.)

**Historical Hail Hazard Losses for Butte County since 1996**

According to the NCEI Storm Events Database, the hail hazard events that Butte County has experienced since 1996 have generated minimal losses. There have been no deaths or injuries, and property damage estimates have totaled approximately $1,000; no crop damage estimates have been reported.165 (Note: The San Diego County hail event that was included erroneously in the search results for hail events in Butte County accounted for all injuries (i.e., 5) and crop damage estimates (i.e., $300,000) presented in the search results.)

**Lightning**

Information from the NCEI Storm Events Database indicates that since 1996, there have been four (4) reported event(s) of lightning in Butte County, which translates to approximately 0.16 lightning events per year.166

**Historical Lightning Hazard Losses for Butte County since 1996**

According to the NCEI Storm Events Database, the lightning hazard events that Butte County has experienced since 1996 have been costly. While there have been no deaths or injuries, property damage estimates have totaled approximately $136,000; no crop damage estimates have been reported.167

**All Severe Weather Hazard Events Recorded by the NCEI Storm Events Database**

165 National Climatic Data Center. Storm Events Database. Retrieved 07.29.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Hail&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=BUTTE%3A7&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA

166 National Climatic Data Center. Storm Events Database. Retrieved 07.29.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Lightning&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=BUTTE%3A7&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA

167 National Climatic Data Center. Storm Events Database. Retrieved 07.29.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Lightning&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=BUTTE%3A7&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA
Information obtained from the NCEI Storm Events Database indicates that there have been 75 occurrences of the severe weather hazard in Butte County. This translates to 2.96 severe weather hazard occurrences per year.\(^{168}\)

Please note: Differences between the sums of individual component severe weather hazard event Database searches (i.e., 82 events) and simultaneous Database searches of all severe weather hazard events (i.e., 75 events) may be due to the following factors: (1) multiple event types are in the same record (e.g., “Thunderstorm Wind/Hail” or “Hail/Tornado,” and/or (2) severe weather hazard events such as “Thunderstorm Wind” or “Hail” that are reported for Butte County have actually taken place hundreds of miles away, but are erroneously recorded as events that have occurred in the County.\(^{169}\) When such a discrepancy arises, the more conservative aggregate hazard wind event value (i.e., 75 events) is used to determine the historical frequency of occurrence for the severe weather hazard. The origin of this discrepancy is unknown at this time.

**Historical, Aggregated Severe Hazard Losses for Butte County since 1996**

According to the NCEI Storm Events Database, the severe weather events that Butte County has experienced since 1996 have been costly. There have been 3 deaths and 4 injuries, and property and crop damage estimates have totaled approximately $17,510,000 and $30,000,000, respectively.\(^{170}\) However, it is important to note that for all Butte County severe weather hazard events recorded on the Storm Events Database, all deaths, injuries, and crop losses, and approximately 98.4% of all property losses, have been caused by wind hazard events alone.

**Wind Hazards Not Included in the NCEI Storm Events Database**

*Santa Ana Winds*

Santa Ana wind events occur at least twice per month from October through April.\(^{171}\) From 1948 to 2012, total of 2056 events on the 65-year record were recorded in the Southern California region, yielding an average of 32 occurrences per year. Typical Santa Ana wind events last 1–2 days and represent 27% of the occurrences, with events lasting

\(^{168}\) National Climatic Data Center. Storm Events Database. Retrieved 07.29.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Hail&eventType=%28Z%29+High+Wind&eventType=%28C%29+Lightning&eventType=%28Z%29+Strong+Wind&eventType=%28C%29+Thunderstorm+Wind&eventType=%28C%29+Tornado&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=BUTTE%3A7&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA


\(^{170}\) National Climatic Data Center. Storm Events Database. Retrieved 07.29.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Hail&eventType=%28Z%29+High+Wind&eventType=%28C%29+Lightning&eventType=%28Z%29+Strong+Wind&eventType=%28C%29+Thunderstorm+Wind&eventType=%28C%29+Tornado&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=BUTTE%3A7&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA

up to 6 days accounting for 90% of all occurrences. The remaining 10% are made up almost entirely of events lasting between 7 and 12 days.\textsuperscript{172} \textsuperscript{173}

Figure below shows the mean monthly frequency per season of Santa Ana Wind events detected from 1948 to 2012. Extreme Santa Ana wind events are shown in dark red, and are defined as those events that are above the 90th percentile of all events on record.

Figure 6-20: Mean Annual Frequency of Santa Ana Wind events (1948-2012)\textsuperscript{174} \textsuperscript{175}

\begin{figure}
\centering
\includegraphics[width=\textwidth]{figure620.png}
\caption{Mean Annual Frequency of Santa Ana Wind events (1948-2012)}
\end{figure}

**Diablo Winds**

Diablo wind events occur approximately **2.5 events per year.** These events are most frequent during the fall and early winter seasons, with the highest frequency of events occurring in October. As a result, the highest risk of Diablo-wind-related damage is in the fall and early winter.\(^{176}\)

Figure below shows the monthly frequency of Diablo winds (along with average live fuel moisture content). The Diablo Wind data are derived from a 17-year climatology of San Francisco Bay Area regional surface weather stations.\(^ {177}\)

Figure 6-21: Monthly Frequency of Diablo Winds and Average Live Fuel Moisture Content (Dashed Line)\(^ {178}\)

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**Sundowner Winds**

Strong sundowner wind events occur approximately **2-3 times per year.** These events can create sharp temperature rises, local gale force winds, and significant weather-related problems. Rare, “explosive” types of sundowner wind events occur about 6 times per century that present dangerous weather situations, generating extremely strong and hot winds that can reach gale force or higher speeds.\(^ {179}\)

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\(^{177}\) Retrieved on 07.15.2021 from https://www.fireweather.org/diablo-winds

\(^{178}\) Retrieved on 07.13.2021 from https://www.fireweather.org/diablo-winds

Historical Frequency of All Severe Weather Hazards

Table below shows the average historical frequency of severe weather hazard events for Butte County since 1996.)

Table 6-31: Severe Weather Hazard Event

Frequencies for Butte County since 1996.

<table>
<thead>
<tr>
<th>Severe Weather Hazard Category</th>
<th>Average Number of Hazard Events Per Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wind (Includes High, Strong and Thunderstorm Winds ONLY)</td>
<td>2.21</td>
</tr>
<tr>
<td>Tornado</td>
<td>0.28</td>
</tr>
<tr>
<td>Hail</td>
<td>0.32</td>
</tr>
<tr>
<td>Lightning</td>
<td>0.16</td>
</tr>
<tr>
<td>Diablo Wind</td>
<td>2.5</td>
</tr>
<tr>
<td>Santa Ana Wind *</td>
<td>32</td>
</tr>
<tr>
<td>Sundowner Wind*</td>
<td>2 to 3</td>
</tr>
</tbody>
</table>

* Note: The Santa Ana and Sundowner wind hazards are not present in Butte County. They are included here for information purposes only.

Potential Impacts of the Hazard

The significance (or priority) of a hazard’s potential impacts is based primarily on the frequency and resulting damage caused by the hazard, including deaths/injuries and property, crop, and economic damage. All assets and people within CSU Chico campus areas are at risk from the effects of the severe weather hazard.

Wind Hazards (Including Tornadoes)

Wind hazard events have the potential to impact people, property, and operations on campuses across the CSU system. People caught in the open during a hazardous wind event are exposed to high winds and debris, and could be injured or killed.

The habitability of buildings can be compromised (by damaging roofs, windows, or other weak points in the building envelope), leading to long-term operational issues for the campus. As with most university campuses, space is always at a premium at the CSU
Chico campus, and the loss of any currently utilized space due to building or structural damage would likely disrupt operations and the University’s mission.

Extreme wind events can result in power failure, which would impact the operation of the campus. Fallen tree limbs and other potential transportation hazards may also cause disruption to the surrounding community and limit ingress/egress to the campus.

According to the 2019 Butte County Local Hazard Mitigation Plan (LHMP), wind hazards (including tornadoes) are considered to be medium significance, and therefore to have a moderate potential impact on both the County and (by extension) CSU Chico.\textsuperscript{180}

\textit{Hail}

Hail typically impacts property by damaging structures, cars, and utilities as it falls. Dents in cars, broken glass, and holes in roofs are common impacts of hail. Injuries to people from hail are less common, though they can happen, as hail is a hard object falling in an unpredictable manner at a fairly high rate of speed.

According to the 2019 Butte County Local Hazard Mitigation Plan (LHMP), hail hazards are considered to be medium significance, and therefore to have a moderate potential impact on both the County and (by extension) CSU Chico.\textsuperscript{181}

\textit{Lightning}

Lightning strikes the United States about 20-25 million times a year.\textsuperscript{182} Although most lightning occurs in the summer months, people can be struck at any time of year. Since 1990, lightning has killed an average of 39 people each year in the United States, and hundreds more have been injured.\textsuperscript{183} Property losses due to lightning have been very costly across the U.S. For example, from 2005 through 2020, U.S. homeowner’s insurance claim payouts for lightning losses totaled approximately $15,334,600,000, or $958,412,500 worth of payouts per year.\textsuperscript{184} (Commercial claim payouts for lightning losses for the U.S. were not available.)

\begin{itemize}
  \item \textsuperscript{180} Butte County Office of Emergency Management. 2019. \textit{Butte County Local Hazard Mitigation Plan Update}. Prepared October, 2019. Retrieved on 08.06.2021 from \url{https://www.buttecounty.net/oem/mitigationplans}
  \item \textsuperscript{181} Butte County Office of Emergency Management. 2019. \textit{Butte County Local Hazard Mitigation Plan Update}. Prepared October, 2019. Retrieved on 08.06.2021 from \url{https://www.buttecounty.net/oem/mitigationplans}
  \item \textsuperscript{182} Retrieved on 07.21.2021 from \url{https://www.elcosh.org/document/4154/d001459/OSHA+NOAA+Fact+Sheet%253A+Lightning+Safety+When+Working+Outdoors.html}
  \item \textsuperscript{183} Retrieved on 07.21.2021 from \url{https://www.weather.gov/media/hazstat/80years_2020.pdf}
  \item \textsuperscript{184} Retrieved on 07.21.2021 from \url{https://www.iii.org/table-archive/20504}
\end{itemize}
According to the 2019 Butte County Local Hazard Mitigation Plan (LHMP), lightning hazards are considered to be of medium significance, and therefore to have a moderate potential impact on both the County and (by extension) CSU Chico.\textsuperscript{185}

**Probability of Future Occurrence of the Hazard**

Areas throughout California, including all California State University (CSU) campuses, experience severe weather events every year, and future occurrences of such events are projected to increase in both their frequency and intensity. The 2019 Butte County Local Hazard Mitigation Plan (LHMP) states that there is a near 100\% chance that three (3) of the severe weather hazards profiled above for Butte County (i.e., wind, hail and lightning) will occur in the future, while there is between a 10\% and 100\% chance that the tornado hazard will occur in the future.\textsuperscript{186} Also, according to the NCEI Storm Events Database, some of these same severe weather hazards have occurred in Butte County at least once per year. Furthermore, while the severe weather hazard is a non-spatial hazard that affects all areas of the CSU Chico campus equally, the smallest geographic unit of measurement for almost all official severe weather event data is at the county level. Because the severe weather data used in this assessment do not exist at the campus level, it is assumed that the severe weather probabilities for the CSU Chico campus reflect those of the surrounding community and County identified in the Tables below.

Based on the data available from both the 2019 Butte County Local Hazard Mitigation Plan (LHMP) and the NCEI Storm Events Database, the severe weather hazard is expected to occur on (or otherwise impact) the CSU Chico campus at least once on an annual basis. Therefore, the probability of future occurrence of the severe weather hazard for CSU Chico is HIGHLY LIKELY. See Table 6-XX for probabilities of future occurrence for component severe weather hazards for Butte County and the CSU Chico campus.

Table 6-32: Severe Weather Hazard Probabilities of Future Occurrence for Butte County and CSU Chico

<table>
<thead>
<tr>
<th>Severe Weather Hazard Category</th>
<th>Average Number of Hazard Events Per Year</th>
<th>Probability of Future Occurrence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wind (Includes High, Strong and Thunderstorm Winds ONLY)</td>
<td>2.21</td>
<td>Highly Likely</td>
</tr>
<tr>
<td>Tornado</td>
<td>0.28</td>
<td>Possible</td>
</tr>
<tr>
<td>Hail</td>
<td>0.32</td>
<td>Possible</td>
</tr>
</tbody>
</table>


Vulnerability to the Hazard

People, structures, and assets on the CSU Chico campus are all vulnerable to the impacts associated with severe weather. Infrastructure can be damaged or destroyed by hail, wind, tornadoes, thunderstorms, and lightning, which can result in service interruptions and outages. Structures can be damaged or destroyed by hail, wind, tornadoes, thunderstorms, and lightning. People can be injured or killed by lightning, flying debris, hail, or extreme wind events. The CSU Chico campus also has vehicles, as well as off-campus conference and recreational facilities, that are all vulnerable to a severe weather event.

Estimate of Potential Losses

Severe weather is a non-spatial hazard that affects the entire CSU Chico campus. Each of the hazards associated with severe weather can result in losses throughout the planning area.

All structures within the CSU Chico campus are at risk from severe weather. There are approximately 94 buildings on the campus that could be damaged by wind, hail, and/or lightning. If even a fraction of these assets were to be damaged, the resulting estimated losses would still be in the millions of dollars. The total replacement costs due to severe weather hazards are $344,244,561 for 66 buildings, and are unknown for the remaining 28 buildings. An analysis of projected dollar losses to campus buildings from severe weather as a percentage of building replacement costs is not currently available, though CSU leadership may pursue such data in the future.
The population at the CSU Chico campus varies throughout the day. As of Fall, 2019, CSU Chico had 11,199 students and 1,277 faculty and staff; all are at risk from severe weather events, with 12,476 being directly vulnerable in this scenario.187 188

Vulnerability Assessment Conclusions

Severe weather presents a variety of hazards to the CSU Chico campus. People, assets, infrastructure, and vehicles can all be damaged by this hazard, and losses can quickly begin to rise. In the aggregate, severe weather is a frequently occurring hazard (mostly in the form of wind hazard events) that presents a variety of risks to CSU Chico.

It is evident that the CSU Chico campus has vulnerabilities to and risks from severe weather hazard incidents, and that pre-event planning, communication, and mitigation efforts should be implemented. Public education and outreach regarding areas of shelter that could be used by campus populations during severe weather events is considered by campus leadership to be one viable mitigation option. The campus planning committee will continue to look for feasible and cost-effective options for the mitigation of severe weather risks going forward.

Identified Data Limitations

Numerous federal agencies maintain a variety of records regarding losses associated with hazards. Unfortunately, no single source is considered to offer a definitive accounting of all losses. The Federal Emergency Management Agency (FEMA) maintains records on federal expenditures associated with declared major disasters. The US Army Corps of Engineers (USACE) and the Natural Resources Conservation Service (NRCS) collect data on losses during the course of some of their ongoing projects and studies. Additionally, the National Oceanic and Atmospheric Administration’s (NOAA) National Centers for Environmental Information (NCEI) collects and maintains data about natural hazards in summary format, as well as occurrences, dates, injuries, deaths, and estimated costs for individual storm events. Many of these databases and other data collection services, including the NCEI, have inherent data limitations when searching for information at a scale as small as a single campus.

The best available data and records have been used throughout this section. Where no data or records exist or could be located, that deficiency is noted.


6.4 Social Resilience Assessment

Overview

While every person is vulnerable to risk, individuals from diverse populations such as those with access and functional needs are disproportionately more vulnerable and may be at a higher risk to harm in a disaster event. In addition to physical vulnerabilities, the intersectionality between physical hazard risks and population social vulnerabilities must be considered to holistically address overall campus risk.

As inclusivity is a high priority for CSU, addressing campus risk and resilience must be done through the lens of inclusion and equity. Addressing social vulnerability is an increasingly critical requirement of state and national doctrines and described in Section 4.4 of the HVRA Base Plan. Every individual of the campus’s richly diverse population groups needs to have the capacity, skills, and knowledge in order to understand, access, and participate in risk reduction and disaster response in ways that are meaningful to their own unique situation. In a campus community, having strong social support networks and active involvement in community disaster responses may negatively or positively impact these opportunities and reduce the resilience-building process. This section offers a glimpse into the CSU Chico campus’s unique social construct, population demographics, strengths and concerns and presents a high-level assessment of the resilience, coping capacities and potential social vulnerabilities of students, staff and faculty. The research variables that were asked are often considered sensitive subjects, and few are traditionally included in emergency management/hazard mitigation planning.

This social resilience assessment of college campuses is the first of its kind in the nation. The research methodology unfolded as the interviews with campuses progressed. The assessment data presented are not definitive or authoritative. The answers, analysis, and suggested trends are strictly indicators for potential social risk. They do not represent an accurate data capture as limitations on the data gathering process influenced an ability to provide accuracy. This assessment provides indications of increased risk, not accuracy of response or a true reflection of the situation of the campus. The information presented is to be considered in the context of the more detailed system-wide CSU social vulnerability assessment that is included in the baseline HVRA.

Campus-Identified Populations of Concern

During the campus interview, the following responses were provided when asked, “In considering the diverse population group(s) amongst student body, faculty and staff, which are of the most concern in your emergency management planning?”
Table 6-33: High level summary of campus populations of concern

<table>
<thead>
<tr>
<th>Question</th>
<th>Campus Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>Which population groups amongst the student body, faculty, and staff, are of the most concern for physical and social vulnerabilities in emergency management planning?</td>
<td>N/A</td>
</tr>
<tr>
<td>Which population groups are most difficult to reach in an event?</td>
<td>N/A</td>
</tr>
<tr>
<td>Which population groups have little/limited support networks if impacted by an event?</td>
<td>First generation students from socially and economically disadvantaged households</td>
</tr>
</tbody>
</table>

Resilience Variables Related to Campus Emergency Management

The interviewees were asked to reflect on a set of 12 variables for the campus populations of student, faculty and staff: homelessness (*housing insecurity*), food security, health and wellness, disability/access and functional needs (AFN), racial equity, digital equity, communications, international students, immigrants/immigration status issues (*undocumented, DACA, etc.*), LGBTQI (Lesbian Gay Bisexual Transgender Questioning (or queer) Intersex), and transportation dependency. They were also offered an opportunity to add any other factor they wanted to include. The following two questions were asked:

- Is this factor a particular issue of concern for emergency management on your campus? Responses were summarized as *Very High, High, Medium, Low*
- Is this factor reflected in the emergency plans and processes for your campus? Responses were summarized as *Yes, No, In Progress, NA*

In order to provide a high-level qualitative response for the answers, the approach of averaging response was taken. If conflicting answers were expressed by the interviewees,
the answer (code) was averaged out. A detailed explanation of the response averaging approach is included in the base HVRA.

Table 6-34: Graph of campus-specific emergency management issues of concern and inclusion in emergency management plans and processes.

<table>
<thead>
<tr>
<th>Issue of Concern</th>
<th>Plans &amp; Processes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Homelessness (Housing Insecurity)</td>
<td>Medium</td>
</tr>
<tr>
<td>Food Security</td>
<td>Low</td>
</tr>
<tr>
<td>Health &amp; Wellness</td>
<td>Medium</td>
</tr>
<tr>
<td>AFN</td>
<td>Low</td>
</tr>
<tr>
<td>Digital Equity</td>
<td>High</td>
</tr>
<tr>
<td>Comms.</td>
<td>Medium</td>
</tr>
<tr>
<td>International Students / Immigrants / Immigration Status</td>
<td>Low</td>
</tr>
<tr>
<td>LGBTQI</td>
<td>Low</td>
</tr>
<tr>
<td>Transportation Dependency</td>
<td>Very High</td>
</tr>
</tbody>
</table>

Qualitative Narrative: Campus Overview of Potential Resilience Vulnerabilities

The following are interview notes of interest:

- Surveys go out to monitor hunger issues.
- Recruiting Hispanic populations, African American populations in the urban areas, and first-generation students from low socio eco backgrounds; having lot of conversations on programs specifically to help support these students, especially those that don’t have cars and are a long way from home; how to support and give community for them to stay local.
- Student health director is pandemic manager in EOC.
- Need for more WIFI / access to high-speed internet. Plans to work on that.
• Communications is in English only. This is a concern for the Hmong are a growing population on the staff and this may be an issue to do outreach in an event, particularly a wildfire.

• For the international students/immigrants/immigration status, they integrate the office that supports them into the emergency, using State Dept. protocols.

• CHICO students come from a long way away—if they close the university and needed to evacuate, there is a concern regarding asking students to go home and then being able to provide a support network to get them and when to tell them to come back. Have MOUs with bus contractors; have three 40 passenger buses, now working with school districts such as Tahama County to move them to an evacuation site close by.

• Have a planning problem with residence halls HVAC – not as safe as a sanctuary as want it to be for the air quality to be good enough to keep the residents there.

• Huge impact on campus with the more extreme weather with dry spells, rainstorms, and megafires.

Campus High Hazards and Potentially Vulnerable Populations

This section provides a brief introduction to the link between socially vulnerable populations and a particular hazard type. While extensive research has been conducted on the impacts of hazards, not all linkages have been documented or published, and detail for finding them are beyond the scope of this assessment. It’s important to note, the intersectional nature of what makes an individual’s personal experience and resilience to an event is played out by unique factors for that individual or population. The nuanced social vulnerabilities often come from the social and physical environment in which a person is embedded.

In order to aid in further assessing campus resilience, below is a general description of the known impacts. From some hazards, the descriptions are robust, while others are only brief introductions.
Table 6-35: CSU Chico *Highly Likely, Likely and Possible* Hazards

<table>
<thead>
<tr>
<th>Hazard</th>
<th>Future Occurrence Probability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Communicable Disease</td>
<td>Highly Likely</td>
</tr>
<tr>
<td>Drought</td>
<td>Highly Likely</td>
</tr>
<tr>
<td>Earthquake</td>
<td>Possible</td>
</tr>
<tr>
<td>Erosion</td>
<td>Highly Likely</td>
</tr>
<tr>
<td>Extreme Temperature</td>
<td>Likely (Heat); Unlikely (Cold)</td>
</tr>
<tr>
<td>Flood</td>
<td>Possible</td>
</tr>
<tr>
<td>Hazardous Materials</td>
<td>Likely</td>
</tr>
<tr>
<td>Power Outage</td>
<td>Likely</td>
</tr>
<tr>
<td>Wildfire</td>
<td>Unlikely (Fire); Possible (Smoke)</td>
</tr>
</tbody>
</table>

**Communicable Diseases**

*TBD*

**Drought**

The 2012-2016 drought had severe effects on two vulnerable sectors of our population: those in low-income brackets, and those, especially Native Americans, who rely on subsistence fishing for their livelihoods.\(^{189}\) Water bills increased throughout the state. Due to rising water prices, for the working poor, many have paid four to five percent of their income for water. Since many CSU students are commuters, and many living with families, future drought impacts may potentially affect a percentage of non-resident students. NASA’s modeling shows that future droughts are likely to last longer and be more intense, even leading to “megadroughts” in the western states.\(^{190}\) Fresh water supplies are predicted to be full of extremes, with both droughts and extreme precipitation events being more severe. The interrelationship between drought and other hazard conditions may lead to a set of secondary impacts. Drought conditions lead to water quality issues due to loss of drinking water, increased fire danger that leads to


drought-induced fires and elevated AQI levels, as well as extreme heat or prolonged heat events.

**Earthquake**

Impacts on populations from earthquakes are complex, with long-term implications on social stability for all populations. In addition to the physical impact exposure during a no-notice earthquake event and the social and logistical challenges of a recovering community, an earthquake can have lasting impacts long afterwards due to post traumatic stress disorder (PTSD).

Socioeconomic vulnerabilities of populations at risk were analyzed in the hypothetical yet scientifically realistic earthquake sequence that is being used to better understand hazards for the San Francisco Bay region during and after a magnitude-7 earthquake (mainshock) on the Hayward Fault and its aftershocks. In this study, the at-risk populations located in areas of concentrated damage are anticipated to experience longer recovery trajectories, increased long term housing displacement, and transportation impacts due to dependencies on transit dependencies. When neighborhood schools close, families with school age children may move to other areas to keep their children in schools. Persons with access and functions needs are likely to be more dependent on access to functioning medical, social and personal health care services that would be overwhelmed by the event and therefore increasing their vulnerabilities. For the homeless populations, the loss of social community services and damages to shelters could add to protracted relocations. For the young and mobile populations who rent, the major disruption to housing, jobs and transit will also drive relocation. Widespread housing damage and preexisting housing market constraints will make it “extremely challenging” for the socially and economically vulnerable populations to find alternative housing near their home communities. Those who utilize interim and irregular housing for months and years after a disaster are more vulnerable to physical, social, and mental disorders, including suicide, substance abuse, and physical and verbal abuse. Aftershocks and post disaster conditions delay population return and increase outmigration.¹⁹¹

**Erosion**

Risk from erosion relates to earthen and infrastructural losses. The degree of vulnerability to these events and their impacts depends on human behavior and the traditional social factors such as situational awareness, prior knowledge of hazards, social capital and

decision-making capabilities, as well as increased vulnerability due to social factors, such as racial and economic disparities.

**Extreme Temps**

People susceptible to respiratory ailments (asthma, lower and upper respiratory disease) disproportionately suffer from the effects of fire, smoke, air pollutions, allergens, heat and PSPS. Those with limited income or without resources are affected disproportionately due to the inability to provide safe shelter, air conditioning, cooling, air purification, medical care, and quality foods, and are also least able to obtain information related to climate risks and adaptation strategies.

**Heat**

Heatstroke, cardiovascular disease, respiratory disease and cerebrovascular disease are related to extreme heat events. Increased number of heat waves creates heat-related physical stress on populations and is exacerbated in the metropolitan areas where greater amounts of heat-absorbing surfaces (e.g., asphalt and concrete) trap heat and emit higher temperatures throughout the night.

The heat also extends the geographic range and the distribution of disease-carrying insects and pests. Health professionals are concerned that California’s warming climate will allow species to acclimate. Such vectors include such pests as ticks that carry Lyme disease, and mosquitos that transmit Zika, dengue fever, West Nile, plague and tularemia. Some others, such as chikungunya, Chagas disease, and Rift Valley fever virus, are threats as well.

Some communities of color and some low-income, homeless, and immigrant populations are more exposed to heat waves, as these groups often reside in urban areas affected by heat island effects. In addition, these populations are likely to have limited adaptive capacity due to a lack of adequately insulated housing, inability to afford or to use air conditioning, inadequate access to public shelters such as cooling centers, and inadequate access to both routine and emergency health care. These social, economic, and health risk factors give rise to the observed increase in deaths and disease from extreme heat in some immigrant and impoverished communities.

Heat stroke, the most serious heat-related illness, occurs when the body is unable to control its temperature. Body temperature rises rapidly, the sweating mechanism fails, and the body cannot cool down. In extreme causes, heat stroke can cause confusion and unconsciousness, so the victim is unable to seek treatment without assistance.

There are several groups of people who are uniquely vulnerable to the effects of extreme heat, such as infants and children, older adults aged 65 and up, athletes and outdoor workers, low-income households, and individuals with certain chronic medical conditions.

When dealing with an extreme heat event, the most common impacts are those generally felt by the people living in the targeted area. For people in particular, heat can kill when the body is pushed beyond its limits. Most heat disorders occur because the victim has
been overexposed to heat. As discussed, the major human risks associated with extreme heat include dehydration, sunburn, fatigue, heat exhaustion, heat stroke, and in severe cases, death.

Some portions of the population are more at risk to the effects of extreme heat. The very young, the elderly, and certain groups with chronic medical conditions (such as asthma or other pulmonary illnesses, heart disease, poor blood circulation, neurological illnesses, and obesity) are generally more vulnerable to the effects of extreme heat, and are more likely to suffer illness or death as a result.

This is especially true if exposure is extended for a period of time and preventative measures are not taken immediately. Distributional implications of impacts, and even less on distributional implications of adaptation actions.” 192

**Flood**

Risk from floods relates to community risk, exposure and infrastructural losses. The degree of vulnerability to these events and their impacts depends on human behavior and the traditional social factors such as situational awareness, prior knowledge of hazards, social capital and decision-making capabilities. The exposure of humans to floods continues to increase, driven by changes in hydrology and land use. The adverse impacts on socially vulnerable populations are amplified because a disproportionately high number live in flood-prone areas. Research has shown that places of social vulnerabilities are places characterized by housing and racial disparities, such as mobile home parks, structural fragility and poverty, and higher percentages of populations such as Black and Native Americans, and others with shared histories of discrimination, marginalization and exclusion. 193

Health impacts from flooding are well recognized due to the extensive history of flooding in California and around the nation. The impacts range from waterborne illnesses from contaminated waters, respiratory illnesses that impact the lungs, throat, and airways from airborne particles, mold on flooded buildings that can trigger asthma, allergies and other illnesses—all which are particularly impactful to older, younger and individuals with pre-existing health condition. Foodborne illnesses can increase if there are issues with power outages or sewer overflows. Individuals with increased mental health concerns can be impacted by the stress or anxiety from the impacts of the flood. Poor quality housing can

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increase vulnerability to many flood risks, including flood inundation, power outages, mold growth, rodent vectors, and serious health impacts. For those with limited finances, flood inundation and impacts to infrastructure or farmlands may lead to extensive income losses.

The poorest residents suffer disproportionately to flood situations, especially those who have been less able to fund homeowner’s insurance to protect against flood losses. Loss of life is not unusual in flooding situations, as is loss of property, livestock, pets, workplaces, and tourist industries. There is a strong interrelationship between water events and other hazards. Flooding, storms and water quality are related to each other. Drought conditions can exacerbate floods as the surface soils are hardened and not as ready to allow surface water absorption. Extreme heat events can cause snowmelt, inundating waterways and causing flood and water quality issues. Flooding and storm events can have impacts on public health, environmental health, agricultural heath and economic system health. Mental health issues are reported for all people who have experience flood losses, including anxiety, fear, anger, anger, sadness and grief. 194 Additionally, waterborne disease outbreaks are reported weeks after the flood events. Mold contamination leads to indoor air issues. Damp indoor environments lead to increased prevalence of asthma, and also upper and lower respiratory symptoms.

These issues may influence the diverse CSU populations, both on and off campus, in a number of ways long after a flood event, or the related hazards impacts, has concluded.

**Hazardous Materials**

The severity of a hazardous materials release depends upon the type of material released, the amount of the release, and the proximity to populations or environmentally sensitive areas such as wetlands or waterways. The release of materials can lead to injuries or evacuation of nearby residents. Wind direction at the time of the release can also have a bearing on the severity (as well as the location and extent) of a hazardous materials release.

The primary threat from the hazardous materials incident hazard is to the structures located along transmission lines and transportation routes or near facilities that use or store hazardous materials. Minor incidents would likely cause no damage and little disruption, assuming they could be contained quickly. Major incidents could have fatal and disastrous consequences. The severity of a hazardous material release relates primarily to its impact on human safety and welfare and on the threat to the environment. Threats to human safety and welfare include:

- Poisoning of water or food sources and/or supply

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- Presence of toxic fumes or explosive conditions
- Damage to personal property
- Need for the evacuation of people
- Interference with public or commercial transportation

Environmental risks are not uniformly distributed across groups of people. Age, poverty, and minority status place some groups at a disproportionately high risk for environmental disease. Poor access to health information and health care means less health promotion, less risk avoidance, a less healthy diet, and more adverse conditions that increase susceptibility to exposure. Delayed recognition of exposure, diagnosis, and treatment allows effects to accumulate.

**Wildfire**

Increased wildfire threat occurs especially in the end of fall, when conditions are driest, but before the winter rains have come; an east-to-west wind gusts exacerbate fire risk. Wildfire threats have the concomitant threat of Public Safety Power Shutoffs (PSPS). And, in the case of an actual wildfire, danger exists both from fire and from the smoke. Recent wildfires have demonstrated that some demographics are disproportionately affected. Native Americans are six times more likely to be affected than white people. Blacks and Hispanic people are 50 percent more vulnerable. These values take into account the likelihood of a community being affected and the greater difficulty of that community to recover. These statistics reflect the lack of access to resources to pay for insurance, to rebuild and recover, to implement fire safety measures, and to access other resources. Price gouging after a fire (such as documented in Sonoma County after the 2017 Tubbs Fire) further exacerbates the disparity. Furthermore, the disabled and the elderly are at particular risk from extreme wildfire conditions, as they are often not as able to effectively evacuate. Of the 85 people who died in the Camp Fire in Butte in 2018, 62 of them were at least 65 years old.

Smoke from wildfires creates a significant public health threat. Especially vulnerable are individuals who have heart or lung issues, such heart disease, lung disease or asthma. Those most vulnerable include the medically fragile, elderly and children.

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195 [https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3222496/](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3222496/)


Indexes track the level of the following: particulate matter, surface levels of ozone, carbon monoxide, sulfur dioxide, and nitrogen dioxide. All of these can cause respiratory distress and harm lungs.\textsuperscript{199}

The California Department of Public Health reports the increased public health risks, and risk indicators that include: heat-related ED visits, populations living in wildfire areas, adults with multiple chronic conditions, populations living in poverty, race/ethnicity, outdoor workers, public transit access, air conditioner ownership and tree canopy.\textsuperscript{200}

**Hazard Mitigation and Emergency Management Planning**

The goal of this high-level assessment is to provide a starting point to encourage further exploring campus social risks and vulnerabilities, as well as to inform and to enhance holistic emergency management and hazard mitigation decision making, planning processes and future adaptive risk management strategies. By including the social resilience factors, mitigation investments may move beyond standardized planning and regulations, structure and infrastructure projects, and natural systems protections to embrace a more expanded, customized emergency operations plan and an education and outreach program unique to the campus.

A more robust social resilience inquiry is strongly encouraged to develop an accurate picture, based on methodical and scientific research-based data. Such an effort would be envisioned through both nuanced discussions with a variety of campus stakeholders and the invitation of nontraditional stakeholders to join in a collaborative resilience partnership. Such a forward-leaning effort would be directly in keeping with CSU’s commitment to inclusion and equity in risk reduction.


7.1 University Profile

University History

California State University, Dominguez Hills (CSU Dominguez Hills) was founded in 1960. The need for a campus in the South Bay region of Los Angeles County became apparent in response to a rising population in the 1950s, influenced by the growth of families of World War II veterans, and by emerging aerospace and defense industries. The California State Legislature authorized the establishment of the “South Bay State College” and Governor Edmund G. (Pat) Brown signed it into law on April 29, 1960. The originally designated location of the campus was to be in Palos Verdes, CA. However, the campus site was moved to the Dominguez Hills section of unincorporated (now Carson, CA) within Los Angeles County due to both the rapidly rising land costs in Palos Verdes and the recognized need by State legislators to provide higher education opportunities for the underserved minority populations of South Los Angeles. Today, CSU Dominguex Hills is a federally recognized Hispanic-Serving Institution (HSI).

University Governance

The campus president is the chief executive officer who oversees the administration of the entire university. The president manages campus operations and fundraising, sets campus priorities, and oversees the hiring and support of staff and faculty. The president also maintains a close working relationship with the CSU’s systemwide office, reporting to the chancellor and participating in the systemwide Executive Council.

The provost is the chief academic officer of the university, overseeing all academic affairs and programs of the university. The provost reports directly to the president.

The University Planning Council (UPC) is comprised of provosts/vice-presidents and high-level campus executives on campus who serve in an advisory capacity to the president. The UPC oversees and reviews the implementation of the university’s strategic plan and provides status reports to the president on a bi-annual basis.

University Mission

“We provide education, scholarship and service that are, by design, accessible and transformative. We welcome students who seek academic achievement, personal fulfillment, and preparation for the work of today and tomorrow.”

CSU Dominguez Hills highlight seven core values fundamental to their success; Accountability, Collaboration, Continuous Learning, Rigorous Standards, Proactive Partnerships, Respect and Responsiveness. Additionally, CSU Dominguex Hills embraces the notion of being a campus community and gathering place for the community as a whole.
University Location
The 346-acre CSU Dominguez Hills campus is located in the South Bay region of Los Angeles County, in the City of Carson, CA (population 95,324). The campus is approximately 15 miles south of Downtown Los Angeles.

University Population
Typically, enrollment as CSU Dominguez Hills exceeds 17,000 students. CSU Dominguez Hills prides itself in its diverse campus community. CSU Dominguez Hills is ranked among the nation’s top universities for diversity, accessibility, and affordability. CSU Dominguez Hills’ inclusivity and commitment to diversity has resulted in impressive diverse populations. Nearly 63% of the campus undergraduate population is female, as is 73% of the graduate population. Latino students make up 60.3% of CSU Dominguez Hills students, with African-American students making up the second most population with 14.5%. The majority of students at CSU Dominguez Hills are first generation college students (43%).

7.2 Interim Final Rule for Hazard Vulnerability and Risk Assessment

Requirement §201.6(c)(2): The plan shall include a risk assessment that provides the factual basis for activities proposed in the strategy to reduce losses from identified hazards. Local risk assessments must provide sufficient information to enable the jurisdiction to identify and priorities appropriate mitigation actions to reduce losses from identified hazards.

Requirement §201.6(c)(2)(i): [The risk assessment shall include a] description of the type...location and extent of all natural hazards that can affect the jurisdiction. The plan shall include information on previous occurrences of hazard events and on the probability of future hazard events.

Requirement §201.6(c)(2)(ii): [The risk assessment shall include a] description of the jurisdiction’s vulnerability to the hazards described in paragraph (c)(2)(i) of this section. This description shall include an overall summary of each hazard and its impact on the community.

Requirement §201.6(c)(2)(ii): [The risk assessment] must also address National Flood Insurance Program (NFIP) insured structures that have been repetitively damaged floods.

Requirement §201.6(c)(2)(ii)(A): The plan should describe vulnerability in terms of the types and numbers of existing and future buildings, infrastructure, and critical facilities located in the identified hazard area.

Requirement §201.6(c)(2)(ii)(B): [The plan should describe vulnerability in terms of an] estimate of the potential dollar losses to vulnerable structures identified in paragraph (c)(2)(ii)(A) of this section and a description of the methodology used to prepare the estimate.
**Requirement §201.6(c)(2)(ii)(C):** [The plan should describe vulnerability in terms of] providing a general description of land uses and development trends within the community so that mitigation options can be considered in future land use decisions.

**Requirement §201.6(c)(2)(iii):** For multi-jurisdictional plans, the risk assessment must assess each jurisdiction’s risks where they vary from the risks facing the entire planning area.

### 7.3 Hazard Identification and Risk Assessment

**Overview of California State University, Dominguez Hills History of Hazards**

Numerous federal agencies maintain a variety of records regarding losses associated with hazards. Unfortunately, no single source is considered to offer a definitive accounting of all losses. The Federal Emergency Management Agency (FEMA) maintains records on federal expenditures associated with declared major disasters. The US Army Corps of Engineers (USACE) and the Natural Resources Conservation Service (NRCS) collect data on losses during the course of some of their ongoing projects and studies. Additionally, the National Oceanic and Atmospheric Administration’s (NOAA) National Centers for Environmental Information (NCEI) database collects and maintains data about natural hazards in summary format. The data includes occurrences, dates, injuries, deaths, and estimated costs. Many of these databases and other data collection services, including the NCEI, have inherent data limitations when searching for information at a university scale.

The best available data and records were used throughout this assessment.

**Hazard Identification**

As part of the initial hazard identification process, the Campus Assessment Team considered potential hazards with the most chance to significantly affect the planning area. The hazards include those that have occurred in the past and may occur in the future. A variety of sources were used to develop the list of hazards considered including national, regional, and local sources such as emergency operations plans, FEMA’s *How-To Series*, websites, published documents, databases, and maps, as well as discussion among the Campus Assessment Team members.

In the initial phase of the planning process, the Campus Assessment Team considered XX hazards and the risks they create for the University and its material assets, population, and operations. The hazards initially considered, and the determinations as to the treatment of those hazards, are shown in the table below.

<table>
<thead>
<tr>
<th>Hazard</th>
<th>Determination (Yes/No)</th>
<th>Reason for Determination</th>
<th>Future Occurrence Probability</th>
</tr>
</thead>
</table>

Table 7-1: Hazard Identification Determinations
<table>
<thead>
<tr>
<th>Hazard</th>
<th>In Campus</th>
<th>Hazard of Concern for Campus</th>
<th>Future Occurrence Probability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Communicable Disease</td>
<td>Yes</td>
<td>Hazard of concern for campus</td>
<td>Highly Likely</td>
</tr>
<tr>
<td>Dam and Levee Failure</td>
<td>Yes</td>
<td>Hazard of concern for campus</td>
<td>Unlikely</td>
</tr>
<tr>
<td>Drought</td>
<td>Yes</td>
<td>Hazard of concern for campus</td>
<td>Highly Likely</td>
</tr>
<tr>
<td>Earthquake</td>
<td>Yes</td>
<td>Hazard of concern for campus</td>
<td>Possible</td>
</tr>
<tr>
<td>Erosion</td>
<td>Yes</td>
<td>Hazard of concern for campus</td>
<td>Highly Likely</td>
</tr>
<tr>
<td>Extreme Temperature</td>
<td>Yes</td>
<td>Hazard of concern for campus</td>
<td>Unlikely (Heat); Unlikely (Cold)</td>
</tr>
<tr>
<td>Flood</td>
<td>Yes</td>
<td>Hazard of concern for campus</td>
<td>Unlikely</td>
</tr>
<tr>
<td>Hazardous Materials</td>
<td>Yes</td>
<td>Hazard of concern for campus</td>
<td>Unlikely</td>
</tr>
<tr>
<td>Landslide</td>
<td>Yes</td>
<td>Hazard of concern for campus</td>
<td>Possible</td>
</tr>
<tr>
<td>Power Outage</td>
<td>Yes</td>
<td>Hazard of concern for campus</td>
<td>Likely</td>
</tr>
<tr>
<td>Sea Level Rise</td>
<td>No</td>
<td>Not a hazard of concern for campus</td>
<td>N/A</td>
</tr>
<tr>
<td>Tsunami</td>
<td>No</td>
<td>Not a hazard of concern for campus</td>
<td>N/A</td>
</tr>
<tr>
<td>Volcano</td>
<td>Yes</td>
<td>Hazard of concern for campus</td>
<td>Unlikely</td>
</tr>
<tr>
<td>Wildfire</td>
<td>Yes</td>
<td>Hazard of concern for campus</td>
<td>Unlikely (Fire); Likely (Smoke)</td>
</tr>
</tbody>
</table>

**Future Occurrence Probability**

In order to determine the probability of future occurrences of each hazard profiled, the following scale was developed:

- **Highly Likely** - 76%-100% that the hazard would occur annually.
- **Likely** - 50%-75% that the hazard would occur annually.
- **Possible** - 11%-49% that the hazard would occur annually.
- **Unlikely** - 0%-10% that the hazard would occur each annually.

**Communicable Disease**

Description of the Hazard
Communicable diseases are illnesses that occur due to infectious agents or their toxic products, and are infectious due to their potential of transmission from one person or species to another by a replicating agent. They may be transmitted from a reservoir to a susceptible host either directly as from an infected person or animal or indirectly through the agency of an intermediate plant or animal host, vector, or the inanimate environment. Communicable diseases are clinically evident illness resulting from the presence of pathogenic microbial agents, including pathogenic viruses, pathogenic bacteria, fungi, protozoa, multi-cellular parasites, and aberrant proteins known as prions. The degree of spread of a communicable disease depends on both the ability of an organism to enter, survive and multiply in the host and the comparative ease with which the disease is transmitted to other hosts.

Some ways in which communicable diseases spread are by:

- Travel through the air, such as tuberculosis, measles, or COVID-19;
- Physical contact with an infected person, such as through touch (staphylococcus), sexual intercourse (gonorrhea, HIV), fecal/oral transmission (hepatitis A), or droplets (influenza, TB, COVID-19);
- Contact with a contaminated surface or object (Norwalk virus), food (salmonella, E. coli), blood (HIV, hepatitis B), or water (cholera); and,
- Bites from insects or animals capable of transmitting the disease (mosquito: malaria and yellow fever; flea: plague).

Collectively, the twenty-three (23) campuses and Chancellor’s Office of the California State University (CSU) system have identified nine (9) communicable disease hazards that have had significant impacts on their respective student, faculty, and staff populations. Of these communicable diseases, COVID-19 is considered to be the most prominent and widespread agent across all CSU campuses. (See Table 7-2 below.)

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Table 7-2: Communicable Diseases at Identified CSU Campuses

<table>
<thead>
<tr>
<th>Collective List of Communicable Diseases Identified by All CSU Campuses</th>
<th>Number of CSU Campuses (Including Chancellor’s Office) Identifying Communicable Disease Having Significant Impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>COVID-19 (SARS-CoV-2)</td>
<td>24</td>
</tr>
<tr>
<td>Meningitis</td>
<td>7</td>
</tr>
<tr>
<td>Measles</td>
<td>6</td>
</tr>
<tr>
<td>Influenza (Including H1N1/Swine Flu)</td>
<td>6</td>
</tr>
<tr>
<td>Tuberculosis</td>
<td>5</td>
</tr>
<tr>
<td>Norovirus</td>
<td>4</td>
</tr>
<tr>
<td>Mumps</td>
<td>2</td>
</tr>
<tr>
<td>E. Coli</td>
<td>2</td>
</tr>
<tr>
<td>Sexually Transmitted Diseases (STDs)</td>
<td>2</td>
</tr>
</tbody>
</table>

(Source: Interviews with CSU campus staff at CSU campuses and at CSU Chancellor’s Office.)

With the exception of COVID-19, there is variability among CSU campuses regarding which communicable diseases have had the greatest impact on individual campus communities. Table 7-3 shows the communicable disease hazards that have had the greatest impact on each CSU campus.

Table 7-3: Communicable Disease Hazards at CSU Campuses with Greatest Impact

<table>
<thead>
<tr>
<th>CSU Campus</th>
<th>Identified Communicable Disease Hazards with the Greatest Impact on CSU Campus</th>
</tr>
</thead>
<tbody>
<tr>
<td>CSU Bakersfield</td>
<td>COVID-19, Meningitis</td>
</tr>
<tr>
<td>CSU Channel Islands</td>
<td>COVID-19, Measles</td>
</tr>
<tr>
<td>Chico State</td>
<td>COVID-19, Tuberculosis</td>
</tr>
<tr>
<td><strong>CSU Dominguez Hills</strong></td>
<td><strong>COVID-19</strong></td>
</tr>
<tr>
<td>Cal State East Bay</td>
<td>COVID-19, Meningitis</td>
</tr>
<tr>
<td>Fresno State</td>
<td>COVID-19, Meningitis, Tuberculosis</td>
</tr>
<tr>
<td>Cal State Fullerton</td>
<td>COVID-19, Influenza</td>
</tr>
<tr>
<td>Humboldt State</td>
<td>COVID-19, Measles, Norovirus, Influenza, STDs</td>
</tr>
<tr>
<td>Cal State Long Beach</td>
<td>COVID-19</td>
</tr>
<tr>
<td>Cal State LA</td>
<td>COVID-19, E. coli, Measles</td>
</tr>
<tr>
<td>Cal Maritime</td>
<td>COVID-19</td>
</tr>
<tr>
<td>CSU Monterey Bay</td>
<td>COVID-19</td>
</tr>
<tr>
<td>-----------------------</td>
<td>----------</td>
</tr>
<tr>
<td>CSUN (Northridge)</td>
<td>COVID-19, Measles</td>
</tr>
<tr>
<td>Cal Poly Pomona</td>
<td>COVID-19, Influenza (Swine Flu - H1N1)</td>
</tr>
<tr>
<td>Sacramento State</td>
<td>COVID-19</td>
</tr>
<tr>
<td>Cal State San Bernardino</td>
<td>COVID-19, Tuberculosis</td>
</tr>
<tr>
<td>San Diego State</td>
<td>COVID-19, Meningitis, Mumps</td>
</tr>
<tr>
<td>San Francisco State</td>
<td>COVID-19</td>
</tr>
<tr>
<td>San José State</td>
<td>COVID-19, H1N1</td>
</tr>
<tr>
<td>Cal Poly San Luis Obispo</td>
<td>COVID-19, Meningitis, Norovirus</td>
</tr>
<tr>
<td>CSU San Marcos</td>
<td>COVID-19</td>
</tr>
<tr>
<td>Sonoma State</td>
<td>COVID-19, H1N1, Norovirus</td>
</tr>
<tr>
<td>Stanislaus State</td>
<td>COVID-19, Tuberculosis</td>
</tr>
<tr>
<td>Office of the Chancellor</td>
<td>COVID-19</td>
</tr>
<tr>
<td>CSU System-Wide</td>
<td>COVID-19, Meningitis, Measles, Tuberculosis, Influenza-Swine Flu-H1N1, Mumps, Norovirus, E. coli, STDs</td>
</tr>
</tbody>
</table>

(Source: Interviews with CSU campus staff at CSU campuses and at CSU Chancellor’s Office.)

**Descriptions of Identified Communicable Disease Hazard at CSU Dominguez Hills**

CSU Dominguez Hills (CSUDH) has identified one (1) communicable disease hazard that has had the greatest impact on campus – COVID-19. The following is a brief description of the communicable disease hazard at CSUDH.

**COVID-19 (SARS-CoV-2)**

Coronaviruses are a family of viruses that can cause illnesses such as the common cold, severe acute respiratory syndrome (SARS) and Middle East respiratory syndrome (MERS). In 2019, a new coronavirus was identified as the cause of a disease outbreak that originated in China. This virus is now known as the **severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2)**. The disease it causes is called Coronavirus Disease 2019 (COVID-19). In March 2020, the World Health Organization (WHO) declared the COVID-19 outbreak a pandemic.

Signs and symptoms of coronavirus disease 2019 (i.e., COVID-19) may appear two to 14 days after exposure. Common signs and symptoms can include fever, cough, and tiredness. Early symptoms of COVID-19 may also include a loss of taste or smell.

The virus that causes COVID-19 spreads easily among people, and more continues to be discovered over time about how it spreads. Data has shown that the COVID-19 virus spreads mainly from person to person among those in close contact (within about 6 feet,
The virus is transmitted by respiratory droplets being released when someone with the virus coughs, sneezes, breathes, sings or talks. These droplets can be inhaled or land in the mouth, nose or eyes of a person nearby. In some situations, the COVID-19 virus can spread by a person being exposed to small droplets or aerosols that stay in the air for several minutes or hours (i.e., airborne transmission). It's not yet known how common it is for the virus to spread this way. The COVID-19 virus can also spread if a person touches a surface or object with the virus on it and then touches his or her mouth, nose or eyes; however, this is not considered to be a main way it spreads.

The severity of COVID-19 symptoms can range from very mild to severe. Some people may have only a few symptoms, and some people may have no symptoms at all. However, some people may experience worsened symptoms, such as worsened shortness of breath and pneumonia. People who are older have a higher risk of serious illness from COVID-19, and the risk increases with age. People who have existing medical conditions also may have a higher risk of serious illness from COVID-19. In some cases, the disease can cause severe medical complications and may even lead to death.\(^5\)

Location of the Hazard

Communicable diseases have the potential to affect the entire CSU Dominguez Hills planning area equally. As a result, the communicable disease hazard can be found at the CSU Dominguez Hills campus located in Carson, CA (Los Angeles County). Because of the ubiquitous nature of many communicable diseases, students, faculty, staff at (and visitors to) CSU Dominguez Hills are at risk of exposure to the communicable disease hazard.\(^6\)

CSU Student Housing Locations and Populations

Although CSU-campus-owned student housing opportunities have been severely limited due to the COVID-19 pandemic, this situation is temporary. Eventually, students will be allowed back on campus at full capacity, and many of these students will be living in campus-owned housing. When this occurs, over 53,000 students (i.e., just over 11% of the CSU total enrollment) will be at increased risk of exposure to communicable disease hazards, owing to the “close-quarters” living arrangements in student housing. For CSU – Dominguez Hills, approximately 5% of its 17,027 enrolled students or 851 students reside in student housing.


Table 7-4: CSU Campus Student Housing Populations

<table>
<thead>
<tr>
<th>CSU Campus</th>
<th>Approximate Enrollment Population (Fall 2019)</th>
<th>Approximate Proportion of Students Living in School Housing</th>
<th>Approximate School Housing Population (Fall 2019)</th>
</tr>
</thead>
<tbody>
<tr>
<td>CSU Bakersfield</td>
<td>11,199</td>
<td>5%</td>
<td>560</td>
</tr>
<tr>
<td>CSU Channel Islands</td>
<td>7,093</td>
<td>6%</td>
<td>432</td>
</tr>
<tr>
<td>Chico State</td>
<td>17,019</td>
<td>2%</td>
<td>340</td>
</tr>
<tr>
<td><strong>CSU Dominguez Hills</strong></td>
<td>17,027</td>
<td>5%</td>
<td>851</td>
</tr>
<tr>
<td>Cal State East Bay</td>
<td>14,705</td>
<td>15%</td>
<td>2,206</td>
</tr>
<tr>
<td>Fresno State</td>
<td>24,139</td>
<td>5%</td>
<td>1,207</td>
</tr>
<tr>
<td>Cal State Fullerton</td>
<td>39,868</td>
<td>6%</td>
<td>2,392</td>
</tr>
<tr>
<td>Humboldt State</td>
<td>6,983</td>
<td>9%</td>
<td>628</td>
</tr>
<tr>
<td>Cal State Long Beach</td>
<td>38,074</td>
<td>9%</td>
<td>3,427</td>
</tr>
<tr>
<td>Cal State LA</td>
<td>26,361</td>
<td>4%</td>
<td>1,054</td>
</tr>
<tr>
<td>Cal Maritime</td>
<td>911</td>
<td>85%</td>
<td>774</td>
</tr>
<tr>
<td>CSU Monterey Bay</td>
<td>7,123</td>
<td>46%</td>
<td>3,277</td>
</tr>
<tr>
<td>CSUN (Northridge)</td>
<td>38,391</td>
<td>8%</td>
<td>3,071</td>
</tr>
<tr>
<td>Cal Poly Pomona</td>
<td>27,914</td>
<td>9%</td>
<td>2,512</td>
</tr>
<tr>
<td>Sacramento State</td>
<td>31,156</td>
<td>6%</td>
<td>1,869</td>
</tr>
<tr>
<td>Cal State San Bernardino</td>
<td>20,311</td>
<td>8%</td>
<td>1,625</td>
</tr>
<tr>
<td>San Diego State</td>
<td>35,081</td>
<td>15%</td>
<td>5,262</td>
</tr>
<tr>
<td>San Francisco State</td>
<td>28,880</td>
<td>13%</td>
<td>3,754</td>
</tr>
<tr>
<td>San José State</td>
<td>33,282</td>
<td>13%</td>
<td>4,327</td>
</tr>
<tr>
<td>Cal Poly San Luis Obispo</td>
<td>21,242</td>
<td>37%</td>
<td>7,860</td>
</tr>
<tr>
<td><strong>CSU San Marcos</strong></td>
<td>14,519</td>
<td>11%</td>
<td>1,597</td>
</tr>
<tr>
<td>Sonoma State</td>
<td>8,649</td>
<td>37%</td>
<td>3,200</td>
</tr>
</tbody>
</table>

### Extent of the Hazard

Various communicable diseases are categorized by the Center for Disease Control and Prevention (CDC) by levels of containment called Biosafety Levels (or BSLs). The higher the BSL, the greater the level of containment and level of effort necessary to prevent transmission of the disease, and therefore the greater the hazard.

Biosafety Levels prescribe procedures and levels of containment for a particular microorganism or material (including research involving recombinant or synthetic nucleic acid molecules) and procedures associated with that containment. BSLs also consider primary barriers (e.g., biosafety cabinets), secondary barriers, facility design, air handling, laboratory security, etc. BSLs are graded from 1 to 4; as the BSL increases so does the relative risk of the agent/procedures as well the stringency of procedures and facility design.

Figure 7-1 describes the different BSLs, and provides examples of communicable diseases that would typically fall in to these classifications, as well as the typical protections that would be necessary to prevent transmission of each of the diseases.
The Extent of CSU Dominguez Hills Communicable Disease Hazards Except COVID-19:

Besides COVID-19, there was no information provided on other communicable disease hazards on campus.

The Extent of CSU Dominguez Hills COVID-19 Communicable Disease Hazard:

As a microorganism, the SARS-CoV-2 (COVID-19) virus requires a high level of containment. It is therefore classified at BSL-3.11

History of the Hazard

Over an approximately one-year period, from mid-March, 2020 to March 23, 2021, there were a reported 99 cases of COVID-19 at CSU Dominguez Hills. CSU-campus-specific COVID-19 case data for CSU Dominguez Hills can be found in the “History of the Hazard” section below.

Most communicable disease data are maintained by at the state and at the county levels, and are not generally available at the municipal or campus levels, unless (a) the CSU campus falls under the jurisdiction of a city-level health department, or (b) a geographically specific outbreak occurs on campus or in the local community. The exception to this is the current COVID-19 pandemic, where both campus and County-level

case data have been collected. As a result, it is important to provide COVID-19 case statistics for both CSU campuses and the counties where CSU campus assets are located.

Tables 7-5 and 7-6 show campus-level and County-level COVID-19 Case data for CSU Dominguez Hills. These case data are updated on at least a weekly basis. (Please note that the COVID-19 case numbers here may not reflect the most recent updates.)

Table 7-5: Campus-Level COVID-19 Case Data for CSU Dominguez Hills (as of 3.19.2021)12

<table>
<thead>
<tr>
<th>Classification</th>
<th>On-Campus</th>
<th>Off-Campus</th>
</tr>
</thead>
<tbody>
<tr>
<td>Student</td>
<td>10</td>
<td>29</td>
</tr>
<tr>
<td>Employee</td>
<td>11</td>
<td>20</td>
</tr>
<tr>
<td>Contractor</td>
<td>29</td>
<td>0</td>
</tr>
<tr>
<td>TOTAL</td>
<td>50</td>
<td>49</td>
</tr>
</tbody>
</table>

Table 7-6: County-Level COVID-19 Case Data for CSU Dominguez Hills (as of 03.17.2021) from Los Angeles County13

<table>
<thead>
<tr>
<th>Total Cases</th>
<th>Total Deaths</th>
</tr>
</thead>
<tbody>
<tr>
<td>1,149,878</td>
<td>21,449</td>
</tr>
</tbody>
</table>

Potential Impacts of the Hazard

Communicable disease outbreaks and pandemics potentially have (and will continue to have) direct impact on life, health, and safety across the CSU system, including the CSU – Dominguez Hills campus. The extent of this impact is contingent on the type of infection or contagion, the severity of the outbreak, and the speed at which it is transmitted. Property and infrastructure integrity may be affected if large portions of the campus population contract communicable diseases at the same time and are therefore unable to perform maintenance, operations, and educational tasks. This would be particularly disruptive if those impacted are first responders or other essential personnel. Long-term outbreaks affecting large numbers of CSU – Dominguez Hills students could result in cancelled classes, delayed matriculation, or other disruptions to the CSU System’s mission. This has already occurred with the current COVID-19 pandemic, and could occur again with more virulent strains of communicable diseases, including COVID-19.

Communicable disease hazards found across the CSU system (including CSU – Dominguez Hills) vary both by level of containment (BSL) (described previously) and by

level of individual/public health risk, or Risk Group (RG) level. While BSLs describe the procedures and required levels of containment in a laboratory setting, Risk Groups (RGs) reflect the potential effects of disease exposure on humans or animals. Like BSLs, RGs range from Level 1 (RG1) to Level 4 (RG4), with Level 1 (RG1) posing minimal risk to healthy individuals and public health and Level 4 (RG4) posing a very serious or extreme risks to individuals and public. BSLs generally correlate with Risk Group (RG) Levels (e.g., a RG2 agent is worked with at BSL-2), but there are exceptions (e.g., production volumes, high-risk procedures, etc.).

The World Health Organization’s (WHO) Laboratory Biosafety Manual, 3rd ed., NIH Guidelines, categorizes Risk Groups (RGs) in the following way:

Table 7-7: WHO Risk Group Categorization

<table>
<thead>
<tr>
<th>Risk Group (RG)</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>RG1</td>
<td>Rarely associated with disease in healthy adult humans or animals and pose no-to-little public health risk (e.g., Saccharomyces cerevisiae, E. coli K-12 strain derivatives often used for recombinant/molecular biology, many environmental organisms)</td>
</tr>
<tr>
<td>RG2</td>
<td>Associated with mild to moderate disease for which preventative measures or post exposure treatments are often available; public health impact is limited (e.g., Streptococcus pyogenes, Salmonella, hepatitis B virus)</td>
</tr>
<tr>
<td>RG3</td>
<td>Associated with serious to lethal human disease for which preventative vaccines or post-exposure therapies may be scarce. Public health impact is limited-to-moderate (e.g., Mycobacterium tuberculosis, hantaviruses, West Nile virus, SARS)</td>
</tr>
<tr>
<td>RG4</td>
<td>Associated with serious to lethal human disease for which preventative vaccines or post exposure therapies are not usually available. Public health impact is high (e.g., Ebola virus, Marburg virus, smallpox virus, etc.)</td>
</tr>
</tbody>
</table>

Table 7-8 describes the four (4) Risk Group Levels (RGs), and provides examples of communicable diseases that would typically fall in to these classifications, and the typical protections that would be necessary to prevent transmission of the disease. It is important to note that all but two (2) communicable disease hazards identified by CSU campuses fall under either the lower-risk RG1 or RG2 categories. COVID-19 and tuberculosis are the two (2) communicable diseases fall under the higher-risk RG3

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category. However, with the advent of the recently-developed COVID-19 vaccine, and with the expectation of an increasingly robust vaccine supply, it is possible that the RG level for COVID-19 could be lowered in the future, thereby reducing both the extent and the potential impact of COVID-19.

Table 7-8: Risk Group Levels (RGs) with Example Diseases and Recommended Precautions\textsuperscript{16}

<table>
<thead>
<tr>
<th>Level</th>
<th>Examples</th>
<th>Typical Protection to Prevent Transmission</th>
</tr>
</thead>
<tbody>
<tr>
<td>Risk Group</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Level I</td>
<td>E. Coli</td>
<td>Precautions are minimal, most likely involving gloves and some sort of facial protection. Usually, contaminated materials are left in open (but separately indicated) waste receptacles. Decontamination procedures for this level are similar in most respects to modern precautions against everyday viruses (i.e.: washing one’s hands with anti-bacterial soap, washing all exposed surfaces of the lab with disinfectants, etc.).</td>
</tr>
<tr>
<td>Risk Group</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Level II</td>
<td>Chicken Pox</td>
<td>These bacteria and viruses cause mild disease in humans or are difficult to contract via aerosol. Routine diagnostic work with clinical specimens can be done safely at BSL-2, using BSL-2 practices and procedures.</td>
</tr>
<tr>
<td></td>
<td>Hepatitis A, B, C</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Lyme disease</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Salmonella</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Mumps</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Measles</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Malaria</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Scrapie</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Dengue Fever</td>
<td></td>
</tr>
<tr>
<td></td>
<td>HIV</td>
<td></td>
</tr>
</tbody>
</table>

\textsuperscript{16} CDC/National Institutes of Health. \textit{Biosafety in Microbiological and Biomedical Laboratories, 6\textsuperscript{th} Ed.} Print. Retrieved 05.03.2021 from: https://www.cdc.gov/labs/BMBL.html
<table>
<thead>
<tr>
<th>Level</th>
<th>Examples</th>
<th>Typical Protection to Prevent Transmission</th>
</tr>
</thead>
<tbody>
<tr>
<td>Risk Group</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Level III</td>
<td>Anthrax</td>
<td>These bacteria and viruses cause severe to fatal disease in human, but vaccines or other treatments do exist to combat them. Laboratory personnel have specific training in handling pathogenic and potentially lethal agents and are supervised by competent scientists who are experienced in working with these agents. This is considered a neutral or warm zone.</td>
</tr>
<tr>
<td></td>
<td>West Nile Virus</td>
<td></td>
</tr>
<tr>
<td></td>
<td>SARS Virus (Including COVID-19)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Tuberculosis</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Typhus</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Yellow Fever</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Hantaviruses</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Avian Flu</td>
<td></td>
</tr>
<tr>
<td>Risk Group</td>
<td>H5N1 (Bird Flu)</td>
<td>These viruses and bacteria cause severe to fatal disease in humans, for which vaccines or other treatments are not available. When dealing with biological hazards at this level the use of a Hazmat suit and a self-contained oxygen supply is mandatory. The entrance and exit of a BSL-4 lab will contain multiple showers, a vacuum room, an ultraviolet light room, autonomous detection system, and other safety precautions designed to destroy all traces of the biohazard. Multiple airlocks are employed and are electronically secured to prevent both doors opening at the same time. All air and water service going to and coming from a BSL-4 lab will undergo similar decontamination procedures to eliminate the possibility of an accidental release.</td>
</tr>
<tr>
<td>Level IV</td>
<td>Dengue Hemorrhagic Fever</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Marburg Virus</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Ebola Virus</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Smallpox</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Lassa Fever</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Crimean-Congo Hemorrhagic Fever</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Other Hemorrhagic Diseases</td>
<td></td>
</tr>
</tbody>
</table>

There are significant data limitations regarding non-COVID-19 communicable disease cases, as the information thereof is outdated, anecdotal, and/or inadequate. As a result, it is not feasible to provide quantitative probabilities of future occurrence for non-COVID-19 communicable disease hazards. However, based on the limited data, it is feasible to present qualitative probabilities of future occurrence based on ranges of communicable disease frequency.
Table 7-10 shows a probability scale of future occurrence for the nine (9) communicable disease hazards profiled in this assessment. This scale is divided into four (4) levels of probability:

Table 7-9: Likelihood of Future Hazard Occurrence

<table>
<thead>
<tr>
<th>Likelihood</th>
<th>Parameters for Determining Likelihood</th>
</tr>
</thead>
<tbody>
<tr>
<td>Highly Likely</td>
<td>76 – 100% probability that hazard will occur annually (high to very high frequency)</td>
</tr>
<tr>
<td>Likely</td>
<td>50 – 75% probability that hazard will occur annually (moderate to high frequency)</td>
</tr>
<tr>
<td>Possible</td>
<td>11 – 49% probability that hazard will occur annually (low to moderate frequency)</td>
</tr>
<tr>
<td>Unlikely</td>
<td>0 – 10% probability that hazard will occur annually (very low to low frequency)</td>
</tr>
</tbody>
</table>

Due to significant data limitations surrounding non-COVID communicable diseases, the probability of future occurrence of CSU-system-wide communicable disease is measured by the proportion of campuses that have identified a particular communicable disease as having an impact on the campus community. In this measure, the more frequent a communicable disease is seen as impactful CSU-wide, the greater the probability of future occurrence.

Note: Each communicable disease’s system-wide probability ranking (below) reflects the ranking at the individual CSU campus level unless noted otherwise.

Table 7-10: Probability of Future Occurrence of Communicable Disease Hazard for CSU System

<table>
<thead>
<tr>
<th>Collective List of Communicable Diseases Identified by All CSU Campuses</th>
<th>Number of CSU Campuses (Including Chancellor’s Office) Identifying Communicable Disease Having Significant Impact</th>
<th>Proportion of CSU Campuses Identifying Communicable Disease as Having Significant Impact System-Wide</th>
<th>CSU System-Wide Probability Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>COVID-19 (SARS-CoV-2)</td>
<td>24</td>
<td>1.00</td>
<td>Highly Likely</td>
</tr>
<tr>
<td>Meningitis</td>
<td>7</td>
<td>0.29</td>
<td>Possible</td>
</tr>
<tr>
<td>Measles</td>
<td>6</td>
<td>0.25</td>
<td>Possible</td>
</tr>
<tr>
<td>Influenza (Including H1N1/Swine Flu)</td>
<td>6</td>
<td>0.25</td>
<td>Possible</td>
</tr>
<tr>
<td>Tuberculosis</td>
<td>5</td>
<td>0.21</td>
<td>Possible</td>
</tr>
</tbody>
</table>
### Norovirus
- Count: 4
- Probability: 0.17
- Likelihood: Possible

### Mumps
- Count: 2
- Probability: 0.08
- Likelihood: Unlikely

### E. Coli
- Count: 2
- Probability: 0.08
- Likelihood: Unlikely

### Sexually Transmitted Diseases (STDs)
- Count: 2
- Probability: 0.08
- Likelihood: Unlikely

(Source: Interviews with staff at CSU campuses and at the CSU Chancellor’s Office.)

### Vulnerability to the Hazard

Vulnerability to a communicable diseases hazard resides in the population of a given area – both human and animal – not in the infrastructure or physical assets. While CSU assets and infrastructure could be impacted indirectly by the communicable disease hazard, these impacts would be secondary to the impact that the communicable disease hazard would have on students, faculty, staff, and visitors at the CSU – Dominguez Hills campus.

CSU campus settings are geographically diverse, with locations ranging from small towns to medium-sized cities to densely populated urban areas. Hundreds of thousands of people work, study, and/or pass through CSU campuses on any given day. (As of Fall 2019, the CSU System had 480,541 students and 53,763 faculty and staff.)

Each of these persons is vulnerable to communicable disease, particularly if it is a pathogen that individual has not been immunized against, or for which no immunization exists. Prolonged outbreaks could result in a loss of services, failure of infrastructure (from lack of operators or maintenance), and closure of facilities. This exact scenario has played out to some degree in the current COVID-19 pandemic on the Dominguez Hills campus.

### Estimate of Potential Losses

**COVID-19 Pandemic Health Impact on CSU Campuses and Surrounding Communities**

The most prescient metric for estimating losses from COVID-19 is loss of life. The nationwide campus-related COVID-19 death rate of 0.02% remains well below the average COVID-19 death rate in the U.S. However, due to data limitations, there is no information on CSU-campus-specific deaths by COVID-19 or by any other communicable diseases. In fact, COVID-19 is the only communicable disease for which case reports have been readily available for CSU campuses.

At some point in the future, CSU campuses will return to full capacity. Without adequate surveillance regarding campus access and student and employee interaction, CSU campuses (including CSU – Dominguez Hills) are at risk of developing an extreme

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17 The California State University. Enrollment. Retrieved 05.03.2021 from: https://www2.calstate.edu/csu-system/about-the-csu/facts-about-the-csu/enrollment/Pages/default.aspx
18 The California State University. Employee Head Count by Campus. Retrieved 05.03.2021 from: https://www2.calstate.edu/csu-system/faculty-staff/employee-profile/csu-workforce/Pages/employee-headcount-by-campus.aspx
incidence of COVID-19, and may become “super-spreaders” for adjacent communities.\textsuperscript{19} The emergence of more virulent COVID-19 variants would only add to the potential for high negative impacts on life safety, operations, and service delivery across the CSU system. (Other communicable diseases would also re-emerge, but with low to moderate negative impacts on life safety, operations, and service delivery.)

**Economic Impact of COVID-19 Pandemic on CSU Financial Health**

During the first few months of the COVID-19 pandemic in 2020, the CSU system suffered tremendous negative fiscal impacts. From March through July of 2020 alone, over $146 million worth of revenue losses were sustained across the CSU system due to refunds to students for parking, housing and dining service fees during Spring Semester, 2020. (See Table 7-12 below for the economic impact to the CSU – Dominguez Hills campus).

Several CSU campuses saw refund losses surpass $10 million.

Table 7-11: CSU COVID-19 Cost Tracking Showing Revenue Refund Losses and Increased Costs\textsuperscript{20}

Mitigative Relief from Federal Assistance


The $1.5 billion in total federal assistance sent to the CSU system will help relieve the losses of revenues from services like dorms, parking and dining services during a year of mainly empty campuses. (See Table 7-13) However, because of staggering COVID-related revenue losses, the CSU system is planning for three (3) years of fiscal duress.

Table 7-12: Total Federal Assistance to CSU for COVID-19 Related Losses, 2020 – 2021

<table>
<thead>
<tr>
<th>Institution</th>
<th>December, 2020 Stimulus</th>
<th>CARES Act</th>
<th>APLU Projection of HEERF Total ARP Act Funding Allocation</th>
<th>Total Estimated Federal COVID Relief Funding</th>
</tr>
</thead>
<tbody>
<tr>
<td>California Polytechnic State University</td>
<td>$20,752,799</td>
<td>$14,725,000</td>
<td>$37,000,928</td>
<td>$72,478,727</td>
</tr>
<tr>
<td>California State Polytechnic University, Pomona</td>
<td>$48,614,353</td>
<td>$31,102,000</td>
<td>$86,044,649</td>
<td>$165,761,002</td>
</tr>
<tr>
<td>California State University Channel Islands</td>
<td>$14,288,099</td>
<td>$8,512,000</td>
<td>$24,915,170</td>
<td>$47,715,269</td>
</tr>
<tr>
<td>California State University Maritime Academy</td>
<td>$1,381,700</td>
<td>$1,204,000</td>
<td>$2,472,622</td>
<td>$5,058,322</td>
</tr>
<tr>
<td>California State University - Sacramento</td>
<td>$59,891,260</td>
<td>$35,643,000</td>
<td>$104,900,133</td>
<td>$200,434,393</td>
</tr>
<tr>
<td>California State University, Bakersfield</td>
<td>$22,855,632</td>
<td>$12,483,000</td>
<td>$40,285,565</td>
<td>$75,624,197</td>
</tr>
<tr>
<td>California State University, Chico</td>
<td>$31,603,856</td>
<td>$20,019,000</td>
<td>$55,754,538</td>
<td>$107,377,394</td>
</tr>
</tbody>
</table>


| California State University, Dominguez Hills | $31,843,563 | $18,312,000 | $55,915,410 | $106,070,973 |
| California State University, East Bay | $24,243,652 | $14,394,000 | $42,929,208 | $81,566,860 |
| California State University, Fresno | $52,725,317 | $32,557,000 | $92,926,594 | $178,208,911 |
| California State University, Fullerton | $67,736,949 | $41,088,000 | $120,859,884 | $229,684,833 |
| California State University, Long Beach | $67,421,424 | $41,202,000 | $119,508,329 | $228,131,753 |
| California State University, Los Angeles | $61,905,561 | $40,067,000 | $108,543,672 | $210,516,233 |
| California State University, Monterey Bay | $13,455,716 | $8,705,000 | $23,922,768 | $46,083,484 |
| California State University, Northridge | $74,004,088 | $47,458,000 | $131,021,450 | $252,483,538 |
| California State University, San Bernardino | $42,438,131 | $27,924,000 | $74,982,459 | $145,344,590 |
| California State University, San Marcos | $26,602,684 | $15,542,000 | $46,496,808 | $88,641,492 |
| California State University, Stanislaus | $22,007,207 | $12,928,000 | $38,636,391 | $73,571,598 |
| Humboldt State University | $16,130,016 | $11,146,000 | $28,831,619 | $56,107,635 |
| San Diego State University | $45,914,127 | $30,394,000 | $80,592,385 | $156,900,512 |
| San Francisco State University | $47,404,409 | $30,000,000 | $83,075,470 | $160,479,879 |
| San Jose State University | $46,631,939 | $30,977,000 | $82,976,130 | $160,585,069 |
Vulnerability Assessment Conclusions

Before the COVID-19 pandemic, populations at all CSU campuses and CSU-affiliated facilities were substantial. Collectively, as of Fall 2019, CSU campuses had 480,541 students and 53,763 faculty and staff. All were at risk from the communicable disease events, with 534,304 people being directly vulnerable. The COVID-19 pandemic has caused campus population numbers to plummet to a small fraction of full capacity.

At some point in the future, campus population numbers will return to their pre-pandemic levels, and students, faculty, and staff will again be vulnerable to the communicable disease hazard. If just 10% of the total CSU population were to become ill with a highly infective communicable disease like influenza or another strain of SARS, this would mean that approximately 53,430 people would be sick at the same time. This scenario would likely overwhelm available on-campus medical services could even overwhelm portions of the larger community’s medical resources – especially if there were large numbers of infected people with immune system compromises or other underlying health problems. Table 7-14 shows the “10% outbreak scenario” projections both for the CSU – Dominguez Hills campus and for the entire CSU system.

Table 7-13: Scenario of Communicable Disease Hazard Affecting 10% of the CSU Population

<table>
<thead>
<tr>
<th>CSU Campus</th>
<th>Approximate Enrollment Population (Fall 2019)</th>
<th>Approximate Total FT/PT Faculty/Staff Population (Fall 2019)</th>
<th>Total Combined Approximate Student and Faculty/Staff Population</th>
<th>10% Outbreak Scenario (Students and Faculty/Staff Combined)</th>
</tr>
</thead>
<tbody>
<tr>
<td>CSU Bakersfield</td>
<td>11,199</td>
<td>1,277</td>
<td>12,476</td>
<td>1,248</td>
</tr>
<tr>
<td>CSU Channel Islands</td>
<td>7,093</td>
<td>994</td>
<td>8,087</td>
<td>809</td>
</tr>
<tr>
<td>Chico State</td>
<td>17,019</td>
<td>1,969</td>
<td>18,988</td>
<td>1,899</td>
</tr>
<tr>
<td><strong>CSU Dominguez Hills</strong></td>
<td><strong>17,027</strong></td>
<td><strong>1,761</strong></td>
<td><strong>18,788</strong></td>
<td><strong>1,879</strong></td>
</tr>
<tr>
<td>Cal State East Bay</td>
<td>14,705</td>
<td>1,764</td>
<td>16,469</td>
<td>1,647</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Institution</th>
<th>Total</th>
<th>Undergraduate</th>
<th>Graduate</th>
<th>Total Fulltime</th>
<th>Part-time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fresno State</td>
<td>24,139</td>
<td>2,534</td>
<td>26,673</td>
<td>2,667</td>
<td></td>
</tr>
<tr>
<td>Cal State Fullerton</td>
<td>39,868</td>
<td>3,736</td>
<td>43,604</td>
<td>4,360</td>
<td></td>
</tr>
<tr>
<td>Humboldt State</td>
<td>6,983</td>
<td>1,171</td>
<td>8,154</td>
<td>815</td>
<td></td>
</tr>
<tr>
<td>Cal State Long Beach</td>
<td>38,074</td>
<td>4,004</td>
<td>42,078</td>
<td>4,208</td>
<td></td>
</tr>
<tr>
<td>Cal State LA</td>
<td>26,361</td>
<td>2,821</td>
<td>29,182</td>
<td>2,918</td>
<td></td>
</tr>
<tr>
<td>Cal Maritime</td>
<td>911</td>
<td>329</td>
<td>1,240</td>
<td>124</td>
<td></td>
</tr>
<tr>
<td>CSU Monterey Bay</td>
<td>7,123</td>
<td>1,059</td>
<td>8,182</td>
<td>818</td>
<td></td>
</tr>
<tr>
<td>CSUN (Northridge)</td>
<td>38,391</td>
<td>3,832</td>
<td>42,223</td>
<td>4,222</td>
<td></td>
</tr>
<tr>
<td>Cal Poly Pomona</td>
<td>27,914</td>
<td>2,650</td>
<td>30,564</td>
<td>3,056</td>
<td></td>
</tr>
<tr>
<td>Sacramento State</td>
<td>31,156</td>
<td>3,228</td>
<td>34,384</td>
<td>3,438</td>
<td></td>
</tr>
<tr>
<td>Cal State San Bernardino</td>
<td>20,311</td>
<td>2,118</td>
<td>22,429</td>
<td>2,243</td>
<td></td>
</tr>
<tr>
<td>San Diego State</td>
<td>35,081</td>
<td>3,702</td>
<td>38,783</td>
<td>3,878</td>
<td></td>
</tr>
<tr>
<td>San Francisco State</td>
<td>28,880</td>
<td>3,401</td>
<td>32,281</td>
<td>3,228</td>
<td></td>
</tr>
<tr>
<td>San José State</td>
<td>33,282</td>
<td>3,568</td>
<td>36,850</td>
<td>3,685</td>
<td></td>
</tr>
<tr>
<td>Cal Poly San Luis Obispo</td>
<td>21,242</td>
<td>2,871</td>
<td>24,113</td>
<td>2,411</td>
<td></td>
</tr>
<tr>
<td>CSU San Marcos</td>
<td>14,519</td>
<td>1,687</td>
<td>16,206</td>
<td>1,621</td>
<td></td>
</tr>
<tr>
<td>Sonoma State</td>
<td>8,649</td>
<td>1,338</td>
<td>9,987</td>
<td>999</td>
<td></td>
</tr>
<tr>
<td>Stanislaus State</td>
<td>10,614</td>
<td>1,276</td>
<td>11,890</td>
<td>1,189</td>
<td></td>
</tr>
<tr>
<td>Office of the Chancellor</td>
<td>0</td>
<td>673</td>
<td>673</td>
<td>67</td>
<td></td>
</tr>
<tr>
<td>CSU System-Wide</td>
<td>480,541</td>
<td>53,763</td>
<td>534,304</td>
<td>53,430</td>
<td></td>
</tr>
</tbody>
</table>

*Note: Enrollment figures do not include non-specific CSU campus International Programs (455 students) or CALStateTEACH Program (933 students).*

While the case numbers of COVID-19 have been significantly lower (about 1% of the total CSU population) than those in the 10% scenario, the degree of virulence and resultant morbidity and mortality caused by COVID-19 have led to widespread campus shutdowns, educational disruption, and economic harm to the CSU system including CSU – Dominguez Hills. In short, the real-time COVID-19 communicable disease outbreak scenario has proven far more devastating than the 10% simulated scenario.

**Identified Data Limitations**
There is a wealth of technical information available for communicable disease. However, there is also limited non-COVID-19 communicable disease data available regarding risk or vulnerability of specific populations throughout the CSU. Much of the data that does exist is protected by privacy policies, and therefore cannot be obtained for more specific populations. As a result, performing a detailed quantitative assessment for this hazard is difficult.

Data that could be collected prior to the next update in order to improve this methodology includes:

- Data regarding infection rates at the campus level and for specific populations;
- Data regarding communicable disease case numbers and outcomes, by CSU campus;
- Data regarding projected population changes;
- Data regarding absenteeism; and
- Data regarding increased operating costs as a result of absenteeism (i.e., temporary shifting of duties resulting in business interruption).
**Dam and Levee Failure**

Description of the Hazard

A dam failure represents the structural collapse of a dam that stores water in a reservoir behind the dam. These failures are typically the result of structural age, damage to the structure caused by earthquake or flooding, inadequate discharge or spillway capacity, inadequate maintenance, improper construction materials, or extreme inflow of water into the reservoir. Prolonged precipitation may result in overtopping of the dam resulting in structural compromise. The tremendous energy generated by a sudden breach of the dam will have significant downstream effects. Flood damage resulting from dam failures potentially will result in economic losses, environmental damage, destruction of agriculture, and human casualties. This type of incident is extremely dangerous as it can occur rapidly, with no warning resulting in an inability to effectively evacuate threatened communities.

A levee failure is similar to dam failures as the result will be a breach causing flooding on the dry side of the levee. Levees are embankments whose primary purpose is to furnish flood protection from seasonal high water or divert the flow of water. Most levees in California are intended to withstand peak water levels generated by heavy precipitation or rapid snowmelt in a watershed. Other levees are designed to withstand fluctuating water levels on a continuous basis such as those in the California Delta exposed to tidal influences. Levees routinely extend for lengthy distances immediately protecting communities. Levees can be found throughout the state but are most prominent in the Sacramento and San Joaquin Valleys.

Levee failures can vary from overtoppings to small uncontrolled discharge to catastrophic failure. Areas downstream of the failure will be subject to inundation dependent on the volume of water released. These levee failures are also typically the result of structural age, damage to the structure caused by earthquake or flooding, slumping, seepage underneath the levee, high velocity flows eroding the levee, inadequate capacity, inadequate maintenance, improper construction materials, or extreme inflow of water into the system. Flood damage resulting from levee failures potentially will result in economic losses, environmental damage, destruction of agriculture, and human casualties.

A dam or levee failure flooding will vary depending on a number of factors including the extent of the collapse or breach, the volume of water behind the structure, and the nature of the exposed downstream features. This unpredictable flooding presents a threat to life and property in addition to critical infrastructure. Lifelines and supply routes will likely be damaged or made impassible by flood erosion or standing water. Water quality and health concerns would likely be cascading effects of dam or levee failures.

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Location of the Hazard

Los Angeles County is home to a variety of flood control facilities and levee systems mostly along the base of the various mountains and hills throughout the county. Levees have been constructed along numerous flood control channels providing community protection. The CSU Dominguez Hills campus is in general proximity to dams upstream along the Los Angeles River and Rio Hondo systems in addition to flood control channels lined with levees.

There are a number of dam facilities along the base of the San Gabriel Mountains and along the river systems extending from the mountains. The larger facilities include the San Gabriel Dam, Morris Dam, Santa Fe Dam, and Whittier Narrows. Each of these facilities regulate water flow along the San Gabriel River and Rio Hondo systems. The CSU Dominguez Hills campus lies outside of dam inundation zones for these facilities.

The Los Angeles River drains the San Gabriel Mountains and much of the Los Angeles Basin south towards Long Beach. A number of flood control systems feed into the Los Angeles River. The length of the Los Angeles River from downtown Los Angeles to the outlet into the ocean is a large concrete lined channel. The channel is located almost 3 miles east of the CSU Dominguez Hills campus, is separated from the campus by additional flood control channels, and is lower in elevation than the campus.

The Dominguez Channel is a flood control and drainage channel ¾ mile southwest of the campus that drains much of the urban water collection of the South Bay communities. The channel feeds into the Pacific Ocean at the Port of Los Angeles before extending 15 miles from Hawthorne and Inglewood. The Dominguez Channel is a concrete lined flood control channel fed by additional channels above the campus. The CSU Dominguez Hills campus is situated slightly higher in elevation from the Dominguez Channel and is outside of the levee protected zone.

The Compton Creek is an additional flood control channel that is located approximately 2 miles east of the campus. The 9-mile channel feeds into the Los Angeles River and ultimately into the Pacific Ocean at Long Beach. The channel drains the south Los Angeles and Compton areas. The CSU Dominguez Hills campus is situated slightly higher in elevation from the Compton Creek and is outside of the levee protected zone.
Extent of the Hazard

Dams are classified according to the hazard that they pose to life and property in the event of failure, rather than the likelihood of that failure.

- **High hazard potential dams** may result in loss of human life, and will likely result in economic, environmental, or lifeline losses.
- **Significant hazard potential dams** are not expected to result in loss of life, but are expected to cause economic, environmental, and lifeline losses.
- **Low hazard potential dams** are not expected to result in loss of life, and there is a low expectation of economic, environmental, or lifeline losses. What losses do occur are generally limited to the dam owner.
Dams classified as high hazard are required to have Emergency Action Plans (EAP). EAPS are formal documents that identify potential emergency conditions at the dam and specify preplanned actions to be followed in case of failure. An EAP is required for all high hazard dams and is recommended for all significant hazard dams.

Table 7-14: Los Angeles County Dams Upstream from CSU Dominguez Hills

<table>
<thead>
<tr>
<th>River</th>
<th>Dam</th>
<th>Storage</th>
<th>Hazard Severity</th>
</tr>
</thead>
<tbody>
<tr>
<td>San Gabriel</td>
<td>Morris</td>
<td>27,500af</td>
<td>High Hazard</td>
</tr>
<tr>
<td>San Gabriel</td>
<td>San Gabriel</td>
<td>45,832af</td>
<td>High Hazard</td>
</tr>
<tr>
<td>San Gabriel</td>
<td>Santa Fe</td>
<td>45,409af</td>
<td>High Hazard</td>
</tr>
<tr>
<td>San Gabriel</td>
<td>Whittier Narrows</td>
<td>66,702af</td>
<td>High Hazard</td>
</tr>
</tbody>
</table>

The CSU Dominguez Hills campus lies outside of the inundation zone of the dams listed above. In the event of a catastrophic failure of the identified dams, the CSU Dominguez Hills campus is expected to remain out of the inundation area. The inundation area is expected to spread water in areas upstream from the campus and remain within the flood control channels in proximity to the campus. However, there are multiple transportation corridors that lie within the dam inundation zones that could compromise transportation routes and areas the campus community reside or work. For these reasons, the planning committee ranks the extent of the hazard as **Low**.

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7-28
Extent – Levee Failure

Levees are used along numerous flood control channels and other waterways including the Los Angeles River, Dominguez Channel, and Compton Creek. The CSU Dominguez Hills campus lies outside of the levee flood protected area. In the event any of these channels were flowing at elevated levels and a failure of a levee were to occur, the community surrounding the campus would likely experience flood related damages. This specific hazard could alter the ability of the campus to maintain operations. For these reasons, the planning committee ranks the extent of the hazard as Low.

History of the Hazard

There are no records of dam or levee failures in areas that present a threat to the CSU Dominguez Hills campus. Los Angeles County has experienced the following dam failures:

28 California Department of Water Resources. Dam Breach Inundation Map Publisher. Retrieved 04.08.2021 from: https://fmds.water.ca.gov/webgis/?appid=dam_prototype_v2
Table 7-15: Los Angeles County Dam Failures

<table>
<thead>
<tr>
<th>Date</th>
<th>Dam</th>
<th>Release</th>
<th>Damage</th>
</tr>
</thead>
<tbody>
<tr>
<td>3/12/1928</td>
<td>St. Francis</td>
<td>38,000af</td>
<td>Extensive; 450 fatalities</td>
</tr>
<tr>
<td>12/14/1963</td>
<td>Baldwin Hills</td>
<td>770af</td>
<td>277 residences, 5 fatalities</td>
</tr>
</tbody>
</table>

Potential Impacts of the Hazard

Dam Failure Impacts - Water that is released due to a dam that has failed generates tremendous energy and force causing a flood that will be catastrophic to life and property. Water levels from the failed dam could be significantly higher than those experienced in worst case scenario flood events. Areas closer to the failed dam will be more likely to experience complete devastation while other areas within the inundation zone will see varying levels of flood waters. The extent of the impacts of a failed dam would vary based on a number of factors such as the volume of water released, the base flow of the river, the time of the failure, the amount of warning provided, and the distance from the dam. Impacts resulting from a dam failure include:

- Loss of life
- Property destruction or damage
- Loss of property contents
- Infrastructure damage
- Flooded or destroyed lifelines/supply routes
- Damaged or destroyed utilities
- Loss of community economic base
- Employment losses
- Agricultural (crops and livestock) damages or destruction
- Environmental damage
- Floods generating threats to public health
- Flood generated debris
- Damage or destruction of academic materials, fine arts, and research
- Damage or destruction of university computer systems and networks
- Damaged university infrastructure
- Reduced or eliminated student engagement with academic programs
- Reductions in campus revenues

Levee Failure Impacts

A levee failure may result in substantial amounts of water to enter into developed areas protected by the levee. The force and volume of water that is generated by a levee failure may cause extensive structural damage in close proximity to the breach and effects of flooding spreading well beyond the point of the failure. The extent of the impacts would
vary based on a number of factors such as the volume of water released, the time of the failure, the amount of warning provided, the location of the breach, elevation, and distance from the breach. Potential impacts resulting from a levee failure include:

- Loss of life
- Property destruction or damage
- Loss of property contents
- Infrastructure damage
- Public health hazards resulting from mold, mildew, and disease due to flood water
- Flooded or destroyed lifelines/supply routes
- Damaged or destroyed utilities
- Loss of community economic base
- Employment losses
- Agricultural (crops and livestock) damages or destruction
- Environmental damage
- Prolonged periods of necessary dewatering
- Disruptions to education delivery to community
- Damage or destruction of academic materials, fine arts, and research
- Damage or destruction of university computer systems and networks
- Damaged university infrastructure
- Reduced or eliminated student engagement with academic programs
- Reductions in campus revenues

**Probability of Future Occurrence of the Hazard**

Los Angeles County is determined to be at risk from dam and levee failure in many parts of the county. The location of the CSU Dominguez Hills campus downstream from the Santa Fe Springs Dam and other flood control facilities along the Los Angeles River and Rio Hondo demonstrates that the potential exists for future dam related issues. However, the distance from the river channel provides an additional mitigating factor. The City of Carson including the CSU Dominguez Hills campus resides outside of known dam inundation zones. Levees protecting flood control channels are located 2 miles east and ¾ of a mile west of the campus. However, the campus remains outside of levee protected zones. There are no official recurrence intervals that have been calculated for dam or levee failures.

The probability of future occurrence for both dam and levee failures is **Unlikely**.

**Vulnerability to the Hazard**

Given High Priority dam monitoring and maintenance practices in place, a catastrophic dam or levee failure is highly unlikely. In addition, the campus does not lie within an inundation zone. However, in the unlikely event of a catastrophic failure, the effects of flooding from compromised dams and levees on campus would most likely be limited to
indirect or secondary effects in terms of disruption to regional transportation networks and services, and the amount of time to respond to the needs of the campus community prior to inundation will be limited.

Any breach along a levee is impossible to predict where a failure may occur. It is likely that response action will not be fully implemented until the incident situational intelligence provides adequate information as to compromised locations. These variables place all those working and living within the dam inundation and flood protection zones in vulnerable locations.

The distributed placement of levees, most near development may expose significant vulnerabilities to other areas of the region even if the campus is unaffected. There is potential the campus community will be affected as a breach may cause flooding and damages to the homes of students, faculty, and staff or to access/supply routes, utilities, or other critical services. The potential for flood damaged structures being left uninhabitable including campus residence halls will result in the vulnerability of numerous displaced individuals and households. The lack of flood insurance will cause additional extreme financial burdens on those affected.

Vulnerability to a dam or levee failure on the CSU Dominguez Hills campus will vary depending on when the failure was to occur. The risk to the campus population will be lessened during periods when classes are not in session or during periods of breaks. Conversely, during the days and hours that classes are in session and staff are at their workplaces, the human vulnerability increases. However, in region-wide events this vulnerability may be shared with the homes and workplaces of members of the campus community and their families.

Certain campus populations will experience greater challenges to a post-flood / failure environment. Vulnerable populations will likely need to navigate through flood generated debris, face extreme health safety issues from flood waters, experience extreme stresses of a disaster, an inability to communicate to or gain access to support networks, and find difficulty in accessing equipment or supplies to aid in a specific need.

**Estimate of Potential Losses**

Estimates of potential losses will be influenced by a variety of factors. The volume and force of the water will determine the scale of damages affecting campus infrastructure, equipment, and other impacted features. The proximity to the failure and elevation above flood waters will affect the level of damage and individuals exposed. The time of the academic year, the day of week, and hour in which the failure was to occur will influence the number of people on campus and potential casualties. Losses will be generated by the physical damages, the loss of revenue, loss of academic research, loss of building contents, and community wide economic reductions.

Based on estimate replacement costs of facilities and structures on campus, the total replacement costs due to dam or levee failure are $142,163,477. However, it is unlikely for a dam or levee failure event to cause catastrophic destruction at CSU Dominguez Hills.
Vulnerability Assessment Conclusions

While the occurrence of dam and levee failures have not been historically relevant near the CSU Dominguez Hills campus, the potential for hazards related to the region’s levees and dams still exist. Additionally, the presence of earthquake faults in proximity to the existing dam and levee structures presents a valid danger to downstream locations in the event of an earthquake. In the unlikely event of a high priority dam’s total failure, the consequences of a dam failure would generate catastrophic results to downstream communities. The potential for dam or levee failure further generates the added potential for a number of cascading effects such as disruptions to the local economy, utility failures, disruptions to providing for the needs of the community, and development of public health hazards. These effects would be exacerbated by effects of seasonal flooding, ongoing heavy precipitation, or excessive run-off from the watershed contributing to the river system. The potential for widespread flooding and damage of structures due to the force of water has exponentially powerful impacts on particular populations among the campus community including those with access or functional needs, international students, the homeless, and students residing in the residence halls.

Identified Data Limitations

Missing campus structural replacement costs and complete inventory of building construction features or mitigation efforts to lessen the impact due to flood inundation.
**Drought**

**Description of the Hazard**

Drought is defined as a condition where moisture levels fall significantly below normal for an extended period of time over a large area that adversely affects plants, animal life, and humans. Drought is a gradual phenomenon. Although droughts are sometimes characterized as emergencies, they differ from typical emergency events. Most natural disasters, such as floods or forest fires, occur relatively rapidly and afford little time for preparing for disaster response. Droughts occur slowly, over a multi-year period, and it is often not obvious or easy to quantify when a drought begins and ends.

Throughout California, one dry year does not normally constitute a drought. California’s extensive system of water supply infrastructure (reservoirs, groundwater basins, and conveyance assets) mitigates the effect of short-term dry periods for most water users. Defining when a drought begins is a function of drought impacts to water users. Drought in one location may not constitute a drought for all water users, as some users in relative proximity may have a different water supply. For example, individual water suppliers may use a combination of sources such as rainfall/runoff, water in storage, or expected supply from a water wholesaler to define their water supply conditions.

Drought can be characterized as one or more of the four following types:

- **Meteorological drought** is defined on the basis of the degree of dryness (in comparison to some “normal” or average amount) and the duration of the dry period. A meteorological drought must be considered as region-specific since the atmospheric conditions that result in deficiencies of precipitation are highly variable from region to region.

- **Hydrological drought** is associated with the effects of periods of precipitation (including snowfall) shortfalls on surface or subsurface water supply (e.g., streamflow, reservoir and lake levels, ground water). The frequency and severity of hydrological drought is often defined on a watershed or river basin scale. Although all droughts originate with a deficiency of precipitation, hydrologists are more concerned with how this deficiency plays out through the hydrologic system. Hydrological droughts are usually out of phase with or lag the occurrence of meteorological and agricultural droughts. It takes longer for precipitation deficiencies to show up in components of the hydrological system such as soil moisture, streamflow, and ground water and reservoir levels. As a result, these impacts are out of phase with impacts in other economic sectors.

- **Agricultural drought** focus is on soil moisture deficiencies, differences between actual and potential evaporation, reduced ground water or reservoir levels, and so forth. Plant water demand depends on prevailing weather conditions, biological characteristics of the specific plant, its stage of growth, and the physical and biological properties of the soil.
• **Socioeconomic drought** refers to when physical water shortage begins to affect health, well-being, and quality of life of people, or when the drought starts to affect the supply and demand of an economic product that relies on water.

The drought issue in California is further compounded by water rights. The central challenge is how to prioritize water usage among a broad variety of contexts. It is for this reason that water is a commodity possessed and utilized under a variety of legal doctrines. As such, many competing sets of interests create a dynamic prioritization process between, for example, farming and federally protected fish habitats and water supply for municipal/public use (including usage for CSU - Dominguez Hills) versus water usage for wildfire abatement or natural resource protection.

### Location of the Hazard

Drought conditions have been identified in Los Angeles County and the city of Carson) where CSU - Dominguez Hills is located. Drought is not a location-specific hazard and affects the entire planning area equally. Drought location is not isolated to each campus footprint but occurs as a geographic sub-set of drought conditions occurring at larger scales. From 2000-2020, drought conditions existed continuously somewhere in the state, with 80-100% of the state impacted for 12 of the last 20 years.29

### Extent of the Hazard

Given the historical occurrence of severe drought impacts throughout Los Angeles County (which encompasses the planning area) and across the state and the potential future impact exacerbated by climate change, the CSU Planning Committee recognizes that drought will continue to pose a high degree of risk, potentially impacting crops, livestock, water resources, the natural environment at large, buildings and infrastructure (from land subsidence), and local economies. In addition, although drought affects the entire planning area, the potential impacts may be variable and specific to each campus/jurisdiction, depending on contextual factors such as the degree of assets and activities, historically impacted by drought within each jurisdiction. In addition, land subsidence has occurred and will continue in areas where the groundwater basin has been subject to overdraft and long-term recharge is inadequate to maintain the water table elevation, leaving underground voids. Subsidence levels in California have been measured up to 30-feet with subsidence bowls covering hundreds of square miles. As such, drought-related subsidence may result in serious structural damage to buildings, roads, irrigation ditches, underground utilities, and pipelines. These concerns should be considered applicable to the campus over the long term.30

The U.S. Drought Monitor developed tables of impacts reported during past droughts in California in order to depict the extent of drought risk for each level of drought on the


U.S. These possible extent conditions for California complement the general impacts column of the U.S. Drought Monitor Classification Scheme.

Table 7-16: Impacts of Drought Levels as Determined by US Drought Monitor\textsuperscript{31}

<table>
<thead>
<tr>
<th>Category</th>
<th>Impact</th>
</tr>
</thead>
</table>
| D0       | Soil is dry; irrigation delivery begins early  
          | Dryland crop germination is stunted  
          | Active fire season begins  
          | Winter resort visitation is low; snowpack is minimal |
| D1       | Dryland pasture growth is stunted; producers give supplemental feed to cattle  
          | Landscaping and gardens need irrigation earlier; wildlife patterns begin to change  
          | Stock ponds and creeks are lower than usual |
| D2       | Grazing land is inadequate  
          | Producers increase water efficiency methods and drought-resistant crops  
          | Fire season is longer, with high burn intensity, dry fuels, and large fire spatial extent; more fire crews are on staff  
          | Wine country tourism increases; lake- and river-based tourism declines; boat ramps close  
          | Trees are stressed; plants increase reproductive mechanisms; wildlife diseases increase  
          | Water temperature increases; programs to divert water to protect fish begin  
          | River flows decrease; reservoir levels are low and banks are exposed |
| D3       | Livestock need expensive supplemental feed, cattle and horses are sold; little pasture remains, producers find it difficult to maintain organic meat requirements  
          | Fruit trees bud early; producers begin irrigating in the winter  
          | Federal water is not adequate to meet irrigation contracts; extracting supplemental groundwater is expensive  
          | Dairy operations close  
          | Marijuana growers illegally tap water out of rivers |

\textsuperscript{31} United States Drought Monitor. \textit{Drought Classification}. Retrieved 05.04.2021 from: https://droughtmonitor.unl.edu/About/AbouttheData/DroughtClassification.aspx
<table>
<thead>
<tr>
<th>Category</th>
<th>Impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fire season lasts year-round; fires occur in typically wet parts of state; burn bans are implemented</td>
<td></td>
</tr>
<tr>
<td>Ski and rafting business is low, mountain communities suffer</td>
<td></td>
</tr>
<tr>
<td>Orchard removal and well drilling company business increase; panning for gold increases</td>
<td></td>
</tr>
<tr>
<td>Low river levels impede fish migration and cause lower survival rates</td>
<td></td>
</tr>
<tr>
<td>Wildlife encroach on developed areas; little native food and water is available for bears, which hibernate less</td>
<td></td>
</tr>
<tr>
<td>Water sanitation is a concern, reservoir levels drop significantly, surface water is nearly dry, flows are very low; water theft occurs</td>
<td></td>
</tr>
<tr>
<td>Wells and aquifer levels decrease; homeowners drill new wells</td>
<td></td>
</tr>
<tr>
<td>Water conservation rebate programs increase; water use restrictions are implemented; water transfers increase</td>
<td></td>
</tr>
<tr>
<td>Water is inadequate for agriculture, wildlife, and urban needs; reservoirs are extremely low; hydropower is restricted</td>
<td></td>
</tr>
<tr>
<td>Fields are left fallow; orchards are removed; vegetable yields are low; honey harvest is small</td>
<td></td>
</tr>
<tr>
<td>Fire season is very costly; number of fires and area burned are extensive</td>
<td></td>
</tr>
<tr>
<td>Many recreational activities are affected</td>
<td></td>
</tr>
<tr>
<td>Fish rescue and relocation begins; pine beetle infestation occurs; forest mortality is high; wetlands dry up; survival of native plants and animals is low; fewer wildflowers bloom; wildlife death is widespread; algae blooms appear</td>
<td></td>
</tr>
<tr>
<td>Policy change; agriculture unemployment is high, food aid is needed</td>
<td></td>
</tr>
<tr>
<td>Poor air quality affects health; greenhouse gas emissions increase as hydropower production decreases; West Nile Virus outbreaks rise</td>
<td></td>
</tr>
<tr>
<td>Water shortages are widespread; surface water is depleted; federal irrigation water deliveries are extremely low; junior water rights are curtailed; water prices are extremely high; wells are dry, more and deeper wells are drilled; water quality is poor;</td>
<td></td>
</tr>
</tbody>
</table>

History of the Hazard
Historically, drought has been so prevalent in California that its presence is almost continuous, including the region and the Los Angeles municipal area surrounding the CSU - Dominguez Hills footprint. That said, no campus data for drought occurrence at the campus level is available.

Figure 7-4: Periods of Drought in LA County, 2000 – 2020

According to the National Drought Mitigation Center, over 3,500 reports and publications covering 370 drought-related events took place across the state (many of which were statewide events) between 2000-2020. In addition, the National Center for Environmental Information (NCEI) reports more than 500 events statewide during this same time period. These events produced a comprehensive range of impacts to water supply, regulations and allocations to businesses and municipalities, budgets and resources for firefighting, water law and policy, and physical impacts to built and natural environments. As such, data records of previous occurrences can be viewed as separate time and event demarcations for a hazard almost continuously in effect across the state with cascading impact potential.

According to the Department of Water Resources, droughts exceeding three years are relatively common in Southern California, but relatively rare in Northern California - the region is the geographic source of much of the state’s developed water supply. The 1929-34 drought established the criteria commonly used in designing storage capacity and yield of large Northern California reservoirs.

According to the US Drought Monitor’s time series data, from 2000-2021 (with the exception of a 2–3-month period in 2000 and 2011), some degree of drought conditions

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34 National Drought Mitigation Center, University of Nebraska. *Drought Impact Reporter*. Retrieved 05.01.2021 from: https://droughtreporter.unl.edu/map/
have been continuously in effect somewhere in California. In fact, 80% - 100% of the state has been subjected to drought conditions for 12 of the last 20 years, with the most severe drought being the 100% state-wide event from 2012-2017.

Figure 7-5: Periods of Drought in the State of California, 2001 – 2021

![California Percent Area](https://droughtmonitor.unl.edu/Data/Timeseries.aspx)

Given the extent of the drought risk in California, the following drought event was selected as an exemplar due to its broad and significant impacts on the state and (according to US Drought Monitor, Time Series data), on Los Angeles County which surrounds the CSU - Dominguez Hills campus planning area:

**2012 – 2017** – Drought produced severe impacts to water wells throughout the state of California, with a high number of wells running dry. Land subsidence due to increased groundwater pumping also occurred in numerous areas of the state such as the San Joaquin and Central Valleys. Crop damage was widespread as well. Water allotments were drastically reduced in many towns and water agencies, with extremely high costs for procuring water. In addition, job loss occurred with many families requiring food supply assistance, and water supply assistance provided to home-owners with dry wells. According to a report released by UC Davis Center for Watershed Sciences, the 2012-2017 period of the California drought cost the state's agriculture industry about $1 billion in lost revenue, with a total statewide economic cost of the drought calculated to be $2.2 billion. The report says, “it is responsible for the greatest water loss ever seen in California agriculture - about one third less than normal.” The report calls the groundwater situation in California "a slow-moving train wreck." Spring snowpack at Donner Summit reached record low levels in 2014, exceeded in 2015 by a remarkable April 1 snow-water-equivalent value of only 5% of average. Decreased precipitation since contributed to near-record low levels in the Shasta Reservoir. The ongoing drought has

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contributed to declines in crop values across the state. For example, crops including cotton, corn silage and barley (the field crop category) fell by 42 percent.38

Potential Impacts of the Hazard

Drought impacts are wide-reaching and may be economic, environmental, and/or societal. This assessment of its impact recognizes that historic occurrences of drought throughout the planning area are a sub-set of larger and inter-connected local and regional droughts, and that the (related) historic impacts provide a sound basis for understanding potential (future) impacts.

Though no campus impacts have been recorded, the most significant potential impact associated with drought across the CSU - Dominguez Hills campus planning area is a potential reduction in water availability for the municipal area tied to campus. Other impacts include crop loss and damage to trees and other natural resources (See Tree Mortality below). The footprint of CSU - Dominguez Hills to some extent includes these vulnerable resources based on the campus landscape (trees) and the presence (and footprint size) of any agricultural research crops and/or field stations.

As a secondary impact of drought, wildfire is directly attributable to dry atmospheric conditions. Wildfires almost always coincide with drought in California, though not limited to such.39 However, the wildfire hazard is analyzed separately in this plan. (See Section X for coverage of the wildfire hazard).

In reviewing the occurrences of drought for Los Angeles County (where the CSU - Dominguez Hills is located), the US Drought Monitor and the National Drought Mitigation Center report that tens of millions of trees died during the (2012-2017) state-wide drought disaster. Though data sources do not provide data for tree mortality specific to CSU - Dominguez Hills, the broad geographic extent of the impact makes it likely that tree mortality occurred to some degree on the campuses. Due to the lasting and ongoing effects of drought on the landscape, trees will continue to be impacted within the municipalities, counties and regions wherein lies the CSU campus system as long as drought conditions continue.

Given the absence of data, in order for the CSU Committee to assess the impact of tree mortality, it is useful to view it as a risk sub-set to the probability, location, extent, severity and duration of the drought hazard within each campus=located municipality, county and region. Regarding potential impacts, standing dead trees could fall, posing a risk to people, buildings, power lines, roads and other infrastructure. In addition, drought-impacted trees become susceptible to diseases and insect infestations (bark beetle) further adding to the risk of tree mortality and related potential impacts. No data is

currently available for tree mortality on campus, however, the CSU Planning Team will pursue data on this issue in the future.

As a potential tertiary impact, prolonged and repeated drought conditions over time can produce land subsidence and the risk of damage to building foundations and infrastructure on campus resulting from ground instability and collapse. Land subsidence is defined as the vertical sinking of the land over manmade or natural underground voids. Subsidence is often the direct result of groundwater over-extraction in response to drought conditions, as well as oil and gas extraction. Weight can accelerate the process of subsidence resulting from surface development and infrastructure such as roads and buildings, vibrations from construction blasting and heavy truck or train traffic. For example, the State Water Project’s 444-mile-long California Aqueduct has required repairs such as the raising of canal linings, bridges, and water control structures on the Aqueduct – in the Central Valley a five-mile reach of the Eastside Bypass was impacted by subsidence, and the Department of Water Resources estimated that it may cost in the range of $250 million to acquire flowage easements and levee improvements to restore the design capacity of the subsided area.40

At present, drought related damage to campus buildings and infrastructure at CSU - Dominguez Hills has not been reported, but the potential for such impacts is possible. With regard to overall potential impact, water supply/availability for CSU - Dominguez Hills is ultimately tied to broader inter-dependent, and more intensive modes of water use at local and regional scales such as agriculture and ranching, wildfire protection, larger metropolitan/municipal usage, manufacturing and commerce, tourism, recreation, and wildlife preservation. During drought periods, the State of California’s regulated water allocations are modified and often reduced, which can result in reduced water availability for all usage contexts, including CSU - Dominguez Hills. A reduction of electric power generation and water quality deterioration are also potential impact factors.

Table 7-17: Summary of Drought Impacts on Water Resources41

<table>
<thead>
<tr>
<th>Resource</th>
<th>Type of Impact</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sea Level</td>
<td>Direct</td>
<td>Sea level is rising and will likely impact coastal areas</td>
</tr>
<tr>
<td>Soil Moisture</td>
<td>Direct</td>
<td>Prolonged dry seasons can lead to decreases in soil moisture; drier vegetation</td>
</tr>
<tr>
<td>Vegetation</td>
<td>Indirect</td>
<td>Longer and more intense fire season with increased extent of area burned</td>
</tr>
</tbody>
</table>

### Stream Conditions

<table>
<thead>
<tr>
<th>Stream Conditions</th>
<th>Direct/Indirect</th>
<th>Effect</th>
</tr>
</thead>
<tbody>
<tr>
<td>Snowpack</td>
<td>Indirect</td>
<td>Increases in temperature will lead to decreases in snowpack</td>
</tr>
<tr>
<td>Runoff</td>
<td>Direct</td>
<td>Warmer temperatures are likely to lead to a shift in peak runoff from spring to winter and a likely decrease in summer base flow</td>
</tr>
<tr>
<td>Hydropower</td>
<td>Indirect</td>
<td>Decreased summer flows resulting from earlier snowmelt and a shift in peak runoff could affect hydropower generation during summer months</td>
</tr>
<tr>
<td>Precipitation</td>
<td>Direct</td>
<td>Warmer winter temperatures will result in a greater percentage of precipitation falling as rain rather than as snow</td>
</tr>
<tr>
<td>Groundwater</td>
<td>Indirect</td>
<td>Reduction in snowpack and extended periods of drought are likely to increase dependency on groundwater</td>
</tr>
</tbody>
</table>

### Probability of Future Occurrence of the Hazard

**Highly Likely** — The US Drought Monitor’s time series data (2000-2020) indicates that some degree of drought has nearly a 100% probability of occurrence in the state in any given year. Given that CSU - Dominguez Hills lies within a drought impacted region, it is prudent to extend this likelihood of occurrence to the planning area.

### Vulnerability to the Hazard

In California, rising temperatures are projected to increase the average lowest elevation at which snow falls, reducing water storage in the snowpack, particularly at those lower mountain elevations which are now on the margins of reliable snowpack accumulation. Higher spring temperatures will also result in earlier melting of the snowpack. The shift in snow melt to earlier in the season is critical for California’s water supply because flood control rules require that water be allowed to flow downstream and that water cannot be stored in reservoirs for use in the dry season. As such, state-level drought risk factors that have led to drought’s state-wide severity and extent, and potential impacts also create drought vulnerabilities at the level of the CSU - Dominguez Hills campus.

Moreover, climate change will likely adversely impact the vulnerability of watersheds and ecosystems in their ability to deliver important ecosystem services. These changes may limit the natural capacity of healthy forests to capture water and regulate stream flows. Sierra Nevada mountain winters and springs are warming, and on average, precipitation as snowfall relative to rain is decreasing. A warming climate with reduced snowpack will result in earlier snowmelt and will subsequently reduce downstream water availability during summer and early fall.
As such, the state and the CSU - Dominguez Hills planning area stakeholders potentially have less capacity to address future drought risks due to projected temperature increases and shortages in water; ground-water withdrawals have been occurring at a deficit rate of 1 – 2 million acre feet per year, where the impacts of drought include decreased availability of water for agriculture and environmental uses. In forested and other vegetated areas, prolonged drought decreases the moisture content of forest fuels and increases the risk of high severity wildfires.

It should be pointed out that California is the single most productive agricultural state and its agricultural industry relies heavily on reservoir water supplied by snowmelt and rainfall runoff. Yearly variations in snowpack depths have implications for water availability as snowmelt from the winter snowpack feeds a network of reservoirs. Spring snowpack at Donner Summit reached record low levels in 2014, exceeded in 2015 by a remarkable April 1 snow-water-equivalent value of only 5% of average. Decreased precipitation since 2011 has contributed to near-record low levels in the Shasta Reservoir.

Vulnerability of Populations

Drought vulnerabilities for California’s population include agricultural sector job loss, secondary economic losses to local businesses and public recreational resources, increased cost to local and state government for large-scale water acquisition and delivery, and water rationing and water wells running dry for individuals and families. As drought is often accompanied by prolonged periods of extreme heat, negative health impacts such as dehydration can also occur, where children and elderly are most susceptible. Air quality often declines in times of drought which can affect those with respiratory ailments. These same vulnerabilities apply to the students, faculty and staff of the CSU - Dominguez Hills campus.

Property Vulnerability

The historical and potential impacts of drought on property include crop loss, injury and death of livestock and pets, and damage to infrastructure, homes and other buildings resulting from the secondary drought impact of land subsidence. The related drought impacts of tree mortality and land subsidence pose risks to vulnerable critical infrastructure and property. These same vulnerabilities apply to the properties of the CSU - Dominguez Hills campus.

Natural Environment Vulnerability

The historical and potential impacts of drought on the natural environment are widespread throughout public and private lands within the state, including tree mortality,

impacts to all flora and fauna, and destabilization (subsidence) of land along streams and rivers, and within watersheds.

The core issue shaping drought vulnerabilities throughout California is water supply and demand. Several factors play into the issue including groundwater basins, surface water run-off, public and agricultural demand, and surface water storage water sheds. A USGS led analysis was first conducted in 2010 through the Forest and Rangeland Assessment and ongoing through the USGS Forest and Rangeland Ecosystem Science Center to identify threats and assets where water supply would benefit from environmental management designed to protect or enhance water resources, the key effort which, in part, both defines and mitigates the severity of drought risk and vulnerabilities.

With regard to overall threat and asset findings shaping the potential severity of drought, the watersheds in the Sierra region contribute most greatly to the state’s water supply, but are under threat from climate change, wildfire and development. In addition, groundwater basins in the San Joaquin Valley and Sacramento Valley bioregions are an abundant resource that is heavily threatened by over pumping.

**Critical Facilities Vulnerabilities**

Drought vulnerabilities for CSU - Dominguez Hills’s critical facilities include water shortfalls for facility operations and critical functions, and potential structural destabilization and damage resulting from land subsidence.

**Estimate of Potential Losses**

An estimate of potential losses from drought has not been calculated for the campus or the CSU system as a whole. However, drought related losses to the city and county of Los Angeles, and the surrounding region such as crop loss and cost increases for water resources have re-occurred over time. Please consult city and county level government, and/or state agricultural agencies for data on the financial impacts from drought.

**Vulnerability Assessment Conclusions**

The CSU Planning Committee understands that the high degree of vulnerability posed by drought will be exacerbated by greater climate variation in the future and therefore greater variation and uncertainty regarding the availability of water supplies which are already under tremendous stress. In response to such vulnerability, state legislation passed in 2014 requires local governments to regulate pumping and recharge to better manage groundwater supplies, and groundwater-dependent regions are required to halt overdraft and bring basins into sustainable levels of pumping and recharge by the early 2040s. That said, the Committee will continue to work with local, regional and state partners and stakeholders to explore solutions for mitigating the drought hazard on its campuses by accessing the best available data and resources on climate change and its relationship to drought.

**Identified Data Limitations**
Data is limited concerning campus-related agricultural assets as well as data on campus tree mortality.

**Earthquake**

Description of the Hazard

An earthquake is a sudden motion or shaking caused by the release of pressure accumulated along the edge of tectonic plates covering the earth. These huge plates are constantly moving and move ever so slowly under, over, or by passing one another. This movement is gradual however the plates may lock together accumulating enormous amounts of energy. When this energy builds, stress develops, and the adjoining plates will eventually break free and result in ground shaking – an earthquake.

Large earthquakes may result in fissuring, ground settlement, and/or vertical or horizontal displacement. Earthquakes occur without warning and can result in extensive damages and human casualties. Damages associated to earthquake generated ground shaking is normally confined to a narrow area along fault trend from the earthquake epicenter. However, seismic waves may generate ground shaking resulting in damages in areas outside of the fault trend.

**Fault Rupture** – The rupture of faults is the differential movement of the two sides of the earth’s plates at the point of the fault. Horizontal or vertical displacement may be significant and occur over great distances. The movement and energy that occurs along a fault is released in waves resulting in ground shaking. The intensity of ground shaking varies based on the magnitude of the earthquake, the proximity to the earthquake epicenter, the composition of the ground sediment or rock the waves travel through, and the depth of the earthquake.

**Liquefaction** – In addition to the primary fault rupture that occurs right along a fault during an earthquake, the ground many miles away can also fail during intense shaking. As seismic waves travel through saturated granular soil; the soil begins to liquefy and act as a fluid. Soil strength and stability is lost causing the effects of ground shaking to intensify and for ground deformation to occur. These water saturated soils when shaken quickly lose the ability to support buildings, bridges, utilities, and other structures. Areas susceptible to liquefaction include places where sandy sediments have been deposited by rivers along their course or by wave action along beaches. The greater the magnitude of an earthquake and longer duration of strong ground shaking will result in an enhanced potential for liquefaction to occur. Settlement can cause damage when the amount settlement varies significantly across the length of a structure. Lateral spreading occurs when liquefaction occurs on gently sloping ground and the liquefied material at depth allows the area to slide, often toward a vertical discontinuity or “free face” such as a creek or stream channel. Liquefaction can occur in susceptible soils below bodies of water, and settlement and lateral spreading can damage structures built on or adjacent to these areas. Transportation bridges across water bodies, wharves, piers and other
structures at ports and harbors, and underwater utility lines can be severely damaged by this hidden hazard.

Subsidence - Changes in the local environment that cause subsidence or sinkholes are called triggering mechanisms. Water is the primary factor that affects the local environment and causes subsidence. Water level decline, changes in groundwater flow, increased loading, and deterioration (such as abandoned mines) are all triggering mechanisms. Water level decline may occur naturally, or it may be the result of human action. Factors that lead to water decline are pumping (from wells), localized drainage (for construction activities), dewatering, or drought. Changes in groundwater flow can result from an increase in the velocity of groundwater movement, and increase in the frequency of water table fluctuations, and changes in discharge (either increase or decrease). Increased loading can cause pressure in the soil, leading to the failure of underground cavities and space, such as caves. Vibrations from earthquakes, heavy machinery, and blasting may result in structural collapse, followed by surface resettlement.

Location of the Hazard

The State of California is particularly vulnerable to earthquake activity due to California’s location residing between two large tectonic plates. CSU Dominguez Hills is located in the southern portion of the Los Angeles Basin. In general, fault systems surround and traverse through Los Angeles and Orange Counties including the area of CSU Dominguez Hills. Throughout the basin the ground is saturated with sediment eroded from the mountains and foothills via multiple stream and river channels and resulting in liquefaction zones scattered across the region.

The Pacific Plate and the North American Plate come together at the San Andreas Fault 50-60 miles northeast of the CSU Dominguez Hills campus. In addition to the San Andreas Fault, Los Angeles County is home to or near additional fault systems with the potential to generate strong ground shaking. The Newport-Inglewood Fault traverses south to north paralleling the Orange County coastline extending within ½ mile of the CSU Dominguez Hills campus. The Palos Verdes Fault crosses the Palos Verdes Peninsula approximately 6 miles southeast of the campus. The 40-mile-long Compton Fault parallels the Palos Verdes Fault in a southeast to northwest direction 5 miles southeast of the CSU Dominguez Hills campus. The Whittier-Elsinore Fault extends from the eastern base of the Santa Ana Mountains and western base of the Puente Hills 16 miles to the northeast of the campus. There are numerous additional faults in the area on all sides of the campus.
Figure 7-6A: Fault Lines Through CSU Dominguez Hills
Extent of the Hazard

The extent or severity of earthquake damage is expressed in terms of magnitude, intensity and duration. The amount of energy released during an earthquake is normally conveyed as a magnitude measured from a seismogram. Magnitude is expressed in numbers and decimals representing the physical size of the earthquake. The strength and effect of the shaking on the surface of the earth is classified as the intensity. Intensity is further defined from the effects the earthquake has on people, structures, and the natural environment. The intensity of an earthquake in terms of measuring magnitude and evaluating its effects is generally expressed using the Modified Mercalli (MM) Intensity Scale. Duration is the length of time the earthquake’s energy is released.

The Richter magnitude scale (Table 7-19 below) was developed in 1935 by Charles F. Richter of the California Institute of Technology as a mathematical device to compare the size of earthquakes. The Richter Scale is the best-known scale for measuring the magnitude of earthquakes. The magnitude value is proportional to the logarithm of the amplitude of the strongest wave during an earthquake. A recording of 7, for example,
indicates a disturbance with ground motion 10 times as large as a recording of 6. The energy released by an earthquake increases by a factor of 31 for every unit increase in the Richter scale.

Table 7-18: Earthquake Intensity and Frequency Comparisons

<table>
<thead>
<tr>
<th>Magnitude</th>
<th>Mercalli Intensity</th>
<th>Potential Damage</th>
<th>Global Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 2.0</td>
<td>I</td>
<td>None</td>
<td>Continually</td>
</tr>
<tr>
<td>2.0 - 2.9</td>
<td>I to II</td>
<td></td>
<td>&gt; IM per year</td>
</tr>
<tr>
<td>3.0 - 3.9</td>
<td>II to IV</td>
<td></td>
<td>&gt; 100,000 per year</td>
</tr>
<tr>
<td>4.0 - 4.9</td>
<td>IV to VII</td>
<td>Light</td>
<td>10K to 15 K per year</td>
</tr>
<tr>
<td>5.0 - 5.9</td>
<td>VI to VII</td>
<td>Moderate</td>
<td>1K to 1,500 per year</td>
</tr>
<tr>
<td>6.0 - 6.9</td>
<td>VII to X</td>
<td>Heavy</td>
<td>100 to 150 per year</td>
</tr>
<tr>
<td>7.0 - 7.9</td>
<td>VII &lt;</td>
<td></td>
<td>10 - 20 per year</td>
</tr>
<tr>
<td>8.0 - 8.9</td>
<td>VII &lt;</td>
<td>Very Heavy</td>
<td>1 per year</td>
</tr>
<tr>
<td>&gt; 9.0</td>
<td>VII &lt;</td>
<td></td>
<td>1 per 10-50 years</td>
</tr>
</tbody>
</table>

The Modified Mercalli Intensity Scale provides descriptive values of earthquake intensity that may provide greater meaning to the broader population as the description of intensity refers to the effects actually experienced. This scale uses an arbitrary ranking based on observed earthquake effects. The scale is composed of increasing levels of intensity ranging from shaking that is not recognizable to intense shaking resulting in catastrophic damages and casualties. The Modified Mercalli Intensity Scale is demonstrated below:

Table 7-19: Modified Mercalli Intensity Scale\(^{44}\)

<table>
<thead>
<tr>
<th>Intensity</th>
<th>Shaking</th>
<th>Description / Damage</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Not felt</td>
<td>Not felt except by a very few under especially favorable conditions.</td>
</tr>
<tr>
<td>II</td>
<td>Weak</td>
<td>Felt only by a few persons at rest, especially on upper floors of buildings.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Intensity</th>
<th>Shaking</th>
<th>Description / Damage</th>
</tr>
</thead>
<tbody>
<tr>
<td>III</td>
<td>Weak</td>
<td>Felt quite noticeably by persons indoors, especially on upper floors of buildings. Many people do not recognize it as an earthquake. Standing motor cars may rock slightly. Vibrations similar to the passing of a truck. Duration estimated.</td>
</tr>
<tr>
<td>IV</td>
<td>Light</td>
<td>Felt indoors by many, outdoors by few during the day. At night, some awakened. Dishes, windows, doors disturbed; walls make cracking sound. Sensation like heavy truck striking building. Standing motor cars rocked noticeably.</td>
</tr>
<tr>
<td>V</td>
<td>Moderate</td>
<td>Felt by nearly everyone; many awakened. Some dishes, windows broken. Unstable objects overturned. Pendulum clocks may stop.</td>
</tr>
<tr>
<td>VI</td>
<td>Strong</td>
<td>Felt by all, many frightened. Some heavy furniture moved; a few instances of fallen plaster. Damage slight.</td>
</tr>
<tr>
<td>VII</td>
<td>Very strong</td>
<td>Damage negligible in buildings of good design and construction; slight to moderate in well-built ordinary structures; considerable damage in poorly built or badly designed structures; some chimneys broken.</td>
</tr>
<tr>
<td>VIII</td>
<td>Severe</td>
<td>Damage slight in specially designed structures; considerable damage in ordinary substantial buildings with partial collapse. Damage great in poorly built structures. Fall of chimneys, factory stacks, columns, monuments, walls. Heavy furniture overturned.</td>
</tr>
<tr>
<td>IX</td>
<td>Violent</td>
<td>Damage considerable in specially designed structures; well-designed frame structures thrown out of plumb. Damage great in substantial buildings, with partial collapse. Buildings shifted off foundations.</td>
</tr>
<tr>
<td>X</td>
<td>Extreme</td>
<td>Some well-built wooden structures destroyed; most masonry and frame structures destroyed with foundations. Rails bent.</td>
</tr>
</tbody>
</table>

The graph below illustrates the increasing intensity of energy that is released and as the measured magnitude increases. While each whole number increases in magnitude represents a tenfold increase in the measured amplitude, it represents an increasing rate
of 32 times more energy released in the same increase in magnitude. As the magnitude of an earthquake is measured higher, the intensity of the earthquake worsens progressively from one category to the next.

Figure 7-8: Earthquake Magnitude and Equivalent Energy Release

<table>
<thead>
<tr>
<th>Magnitude</th>
<th>Earthquakes</th>
<th>Energy Equivalents</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>great earthquake near total destruction</td>
<td>56,000,000,000,000</td>
</tr>
<tr>
<td>9</td>
<td>major earthquake, severe economic impact</td>
<td>1,800,000,000,000</td>
</tr>
<tr>
<td>8</td>
<td>strong earthquake, large loss of life</td>
<td>56,000,000,000</td>
</tr>
<tr>
<td>7</td>
<td>moderate earthquake, property damage</td>
<td>1,800,000,000</td>
</tr>
<tr>
<td>6</td>
<td>light earthquake, some property damage</td>
<td>56,000,000</td>
</tr>
<tr>
<td>5</td>
<td>minor earthquake felt by humans</td>
<td>1,800,000</td>
</tr>
<tr>
<td>4</td>
<td>Average Tornado</td>
<td>56,000</td>
</tr>
<tr>
<td>3</td>
<td>Large Lightning Bolt</td>
<td>1,800</td>
</tr>
<tr>
<td>2</td>
<td>Oklahoma City Bombing</td>
<td>56</td>
</tr>
</tbody>
</table>

Based on the location of the campus at the end of a fault line, the earthquake shaking potential in the Los Angeles Basin, the proximity to the above listed fault systems, the probability of seismic ground shaking generating damage, the planning committee ranks the extent of the hazard as Moderate.

History of the Hazard

The State of California has a long history of chronic and destructive earthquakes throughout the state. On average, earthquakes strong enough to result in structural damages occur three to four times a year in California, while earthquakes Magnitude 6.0 to 6.9 occur once every two to three years. Los Angeles County also has a long history of earthquake activity. The entire area of Los Angeles County is at risk to seismic activity and has a history of significant earthquakes resulting in damages.

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Table 7-20: Historic Earthquakes Near Carson, CA

<table>
<thead>
<tr>
<th>Date</th>
<th>Location</th>
<th>Magnitude</th>
<th>Damages</th>
</tr>
</thead>
<tbody>
<tr>
<td>12/8/1812</td>
<td>San Juan Capistrano</td>
<td>7.5</td>
<td></td>
</tr>
<tr>
<td>3/10/1933</td>
<td>Long Beach</td>
<td>6.4</td>
<td>120 fatalities, $40 million</td>
</tr>
<tr>
<td>2/9/1971</td>
<td>San Fernando</td>
<td>6.6</td>
<td>58-65 fatalities, $553 million</td>
</tr>
<tr>
<td>10/1/1987</td>
<td>Whittier</td>
<td>5.9</td>
<td>8 fatalities, $358 million</td>
</tr>
<tr>
<td>2/28/1990</td>
<td>Upland</td>
<td>5.7</td>
<td>30 injuries, $12.7 million</td>
</tr>
<tr>
<td>6/28/1991</td>
<td>Sierra Madre</td>
<td>5.6</td>
<td>1 fatality, $40 million</td>
</tr>
<tr>
<td>1/17/1994</td>
<td>Northridge</td>
<td>6.7</td>
<td>57 fatalities, $40 billion</td>
</tr>
<tr>
<td>7/29/2008</td>
<td>Chino Hills</td>
<td>5.5</td>
<td>Minor</td>
</tr>
<tr>
<td>3/28/2014</td>
<td>La Habra</td>
<td>5.1</td>
<td>$10 million</td>
</tr>
</tbody>
</table>

The January 9, 1994 Northridge Earthquake became the costliest seismic event in California history. The earthquake caused extensive damage to structures, the transportation infrastructure, utility systems, water storage, communications, and critical facilities. This level of damage due to the fault that ruptured was directly underneath a densely populated urban area. The Northridge Earthquake was found to raise the nearby mountains by as much as 70 centimeters. The earthquake was provided a federal disaster declaration (DR-1008).

The October 1, 1987 Whittier Narrows Earthquake shook a large part of southern California. The earthquake caused $358 million in damages, especially in the Alhambra, Pasadena, and Whittier areas. The earthquake resulted in extensive infrastructure damages, multiple injuries, and 8 fatalities. The earthquake was provided a federal disaster declaration (DR-799).

The February 9, 1971 Magnitude 6.5 San Fernando Earthquake struck the San Fernando Valley in Los Angeles just after 6am. The intense shaking caused the collapse of freeway overpasses, hospitals, and other infrastructure. It damaged thousands of homes and businesses, a reservoir, and critical infrastructure. 65 people were killed and 2,000 more were injured. The shaking was felt for 300 miles including in Las Vegas, Nevada. The earthquake was provided a federal disaster declaration (DR-299).

The March 10, 1933 Long Beach Earthquake registered at a Magnitude 6.4 occurred along the Newport-Inglewood Fault. The earthquake resulted in over $50 million in damages, 500 injuries, and 120 fatalities. Unreinforced masonry structures were the source of most of the casualties. 70 schools were destroyed and 120 were damaged. This earthquake

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promoted statewide standards in building design and construction for schools and other structures to better withstand seismic events.

**Potential Impacts of the Hazard**

The shaking of the ground from earthquakes can result in building collapse, bridge failure, utility disruptions and other structural collapse. Large earthquakes can additionally cause natural gas lines to break resulting in structure fires. The proximity to the unstable soils surrounding the campus presents a potential for liquefaction creating greater ground instability during seismic events. A major earthquake in the Los Angeles area would likely result in region-wide social disruptions in addition to structural damages. The region-wide structural damages may disrupt lifelines and supply chain routes limiting the campus from effective evacuation routes and receiving necessary supplies or equipment.

Most injuries resulting from earthquakes are from collapsing walls, flying glass, or other objects moved by ground shaking. The lack of warning allows individuals minimal time to react and find areas of safety. A moderate earthquake occurring near Carson could cause injuries or fatalities to members of the campus community or support networks the campus relies on. These earthquake effects might be aggravated by collateral incidents such as fire, flooding, hazardous material spills, dam/levee compromises, and other cascading events. A catastrophic earthquake near Carson could result in extensive casualties, expansive structural damages, panic, widespread utility outages, communication failures, and secondary emergencies such as fire. A catastrophic earthquake would certainly affect the broader Los Angeles County and Orange County region limiting immediate assistance that the campus may normally expect.

Local impacts to CSU Dominguez Hills campus caused by an earthquake could include:

- Damage to nearby refineries and petrol-chemical plants
- Damage and secondary fires to industrial buildings to the east of campus
- Potential hazardous material releases on and off campus
- Infrastructure damage to freeway system
- Structural damage to bridges over waterways and flood control channels
- Potential isolation of campus from community
- Potential isolation among on-campus residents
- Structural damage to Dominguez Channel levees
- Structural damage to campus academic and support buildings
- Structural damage to residence halls resulting in displaced student populations
- Structural damage to nearby residences
- Community members arriving on campus for refuge from damaged homes
- Damaged university communications, computer systems, and networks
- Considerable stress and fear among community
- Closure or reduction of service to campus operations
- Reduction of campus revenue
Probability of Future Occurrence of the Hazard

The Working Group on California Earthquake Probabilities (WGCEP), a collaboration between the United States Geological Survey (USGS), the Southern California Earthquake Center (SCEC), and the California Geological Survey (CGS) develops Uniform California Earthquake Forecasts (UCERFs) using the best currently available science and technology. The UCERF Version 3 provides a three-dimensional view of the likelihood a region in California will experience a Magnitude 6.7 or greater earthquake in the next 30 years. The likelihood for the Los Angeles County fault systems surrounding Carson is included in the following table.

Table 7-21: Major Potentially Active Faults in Proximity to CSU Dominguez Hills

<table>
<thead>
<tr>
<th>Fault Zone</th>
<th>Recurrence</th>
<th>Maximum Magnitude</th>
<th>UCERF3 Likelihood</th>
</tr>
</thead>
<tbody>
<tr>
<td>Compton</td>
<td>Historic: Unknown</td>
<td>6.5 to 7.1</td>
<td>1%</td>
</tr>
<tr>
<td>Hollywood</td>
<td>Historic: 1,600 years</td>
<td>5.8 to 6.5</td>
<td>1-2%</td>
</tr>
<tr>
<td>Newport-Inglewood</td>
<td>Historic: Unknown</td>
<td>6.0 to 7.4</td>
<td>1%</td>
</tr>
<tr>
<td>Palos Verdes</td>
<td>Historic: Unknown</td>
<td>6.0 to 7.0</td>
<td>3%</td>
</tr>
<tr>
<td>San Andreas</td>
<td>Varies: 100-300 years</td>
<td>6.8 to 8.0</td>
<td>18-20%</td>
</tr>
<tr>
<td>Santa Monica</td>
<td>Historic: Unknown</td>
<td>6.0 to 7.0</td>
<td>1%</td>
</tr>
<tr>
<td>Sierra Madre</td>
<td>Historic: 1,000-3,000 years</td>
<td>6.0 to 7.0</td>
<td>1-2%</td>
</tr>
<tr>
<td>Verdugo</td>
<td>Historic: Unknown</td>
<td>6.0 to 6.8</td>
<td>1%</td>
</tr>
<tr>
<td>Whittier</td>
<td>Historic: Unknown</td>
<td>6.0 to 7.2</td>
<td>1%</td>
</tr>
</tbody>
</table>

Based on the earthquake shaking potential in the Los Angeles Basin, the proximity to the above listed fault systems, the probability of seismic ground shaking generating damage is considered Possible.

Vulnerability to the Hazard

A considerable challenge regarding earthquakes is they generally occur without warning. The fault systems surrounding the region all cross major transportation routes potentially reducing the availability of access and the supply chain. The geographic location of the Dominguez Hills campus sits surrounded by areas composed of alluvial soils. In many cases, these sediment-based soils are loose and expose the potential for liquefaction. The

majority of the interior Los Angeles Basin has identified a moderate risk of liquefaction including neighborhoods on the north, south, and east of the campus.

The known fault systems generating the threat to Los Angeles County exist on all sides of the area including near the CSU Dominguez Hills campus. As such, the proximity and potential for large earthquake development from these surrounding systems expose significant vulnerabilities. The potential for earthquake damaged structures being left uninhabitable including campus residence halls will result in numerous displaced individuals and households. Campus buildings and equipment will be exposed to significant damages resulting in reduction of services and capabilities of the campus to address post incident response and stabilization needs. The lack of earthquake insurance will cause extreme financial burdens on those affected.

Elements of the vulnerability to a major earthquake on the CSU Dominguez Hills campus will vary depending on when the earthquake were to strike. The primary basis of vulnerability is based on the population affected and the built environment exposed. In general, newer construction will be more earthquake resistant than older buildings as building codes and construction technology have improved. A locally centered earthquake, even from moderate events, would have the potential for more damaging results when associated with the moderate liquefaction zones of the area. This would particularly be seen with greater damages to unreinforced masonry buildings.

The risk to the campus population will be lessened during periods when classes are not in session or during periods of breaks. Conversely, during the days and hours that classes are in session and staff are at their workplaces, the human vulnerability increases. Generally, people are safer when at home in wood frame structures as earthquakes tend to generate less structural damage to wood construction than in commercial or industrial facilities. The greater number of people on campus at the time of an earthquake will result in more people being exposed to effects from damaged campus facilities or equipment and require greater evacuation assistance. However, in region-wide events this vulnerability may simply shift to the homes and workplaces of members of the campus community and their families.

The aftermath of a major earthquake will likely result in widespread search and rescue operations for trapped and injured individuals. The demand on emergency services will be great, potentially requiring the campus community to be prepared for these scenarios and initiate response actions as needed. There will be needs for emergency medical care, shelter, water, and food for individuals who have been displaced by the earthquake. In earthquakes causing significant damages, there may be a necessity to provide assistance with identification and support to local agencies in mass fatality management.

There may be a need to evacuate members of the campus community from the campus and to other locations that are deemed to be safer locations. Certain campus populations will experience greater challenges to a post-earthquake environment. Vulnerable populations including those that rely on specific services, require electrical power, homeless students, experience disabilities, non-English speakers, those whose age make evacuating difficult, and others will be most affected. These individuals will likely need to
navigate through earthquake generated debris, extreme stresses of a disaster, an inability to communicate to or gain access to support networks, and find difficulty in accessing equipment or supplies to aid in a specific need.

**Estimate of Potential Losses**

Estimates of potential losses will be influenced by a variety of factors. The intensity of the earthquake will determine what scale of damages affecting campus infrastructure, equipment, and other impacted features. Losses will be generated by the physical damages, the loss of revenue, loss of academic research, loss of building contents, and community wide economic reductions.

Based on estimate replacement costs of facilities and structures on campus, the maximum total replacement costs due to earthquake are $142,163,477.

Table 7-22: HAZUS Peak Ground Acceleration Zone (PGA) Estimated Losses

<table>
<thead>
<tr>
<th>PGA Zone Designation</th>
<th>Intensity</th>
<th>No. of Buildings</th>
<th>Maximum Replacement Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Extreme</td>
<td>X+</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Violent</td>
<td>IX</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Severe</td>
<td>VIII</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Very Strong</td>
<td>VII</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Strong</td>
<td>VI</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Moderate</td>
<td>V</td>
<td>37</td>
<td>$142,164,477</td>
</tr>
<tr>
<td>Light</td>
<td>IV</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Weak</td>
<td>II-III</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Not Felt</td>
<td>I</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>NA</td>
<td>NA</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>No Building Value Data Provided*</td>
<td>NA</td>
<td>17</td>
<td>Unknown</td>
</tr>
</tbody>
</table>

*Buildings with no value defined are also included in the respective Zones they are found in.*

**Vulnerability Assessment Conclusions**

It is difficult to predict the severity of casualties, property, and cascading impacts generated by future seismic events affecting the Los Angeles Basin and the CSU Dominguez Hills campus. Each of the earthquake generated effects will vary widely based on the intensity of the earthquake, location of the epicenter, proximity to people and development, time of day and year, the soil composition under the impacted structures, building construction, among others. In any case, the potential for a major earthquake exists affecting the campus and causing extensive challenges to the CSU Dominguez Hills campus and community.
In the event that a major earthquake was to strike along the fault systems surrounding Carson, the effects could be significant to the campus community and campus operations. The widespread impacts generated by a major earthquake would extend the effects of casualties, damages, and other impacts to the broader Los Angeles Basin creating large-scale regionwide needs for critical assistance and a heavy demand on limited emergency resources. The threat and impacts presented to the campus will be shared with the campus community from their homes and places of work. The campus will likely be required to address critical needs independently during early phases of the disaster.

The campus population are additionally vulnerable to the effects of major ground shaking that are far reaching. The psychological and social impacts a major earthquake will give rise to will potentially harm individuals and cause tremendous fear. The willingness to return indoors may be hampered especially as after-shock continue. These effects are magnified for populations having specific vulnerabilities or access limitations.

**Identified Data Limitations**

Missing campus structural replacement costs and an inventory of building construction types to include status of earthquake retrofitting. HAZUS generated analysis is focused on the broader community level versus finetuning the analysis to the micro-level for facilities such as a university campus.

**Erosion**

**Description of the Hazard**

The US Geological Survey (USGS) defines erosion as “the process whereby materials of the earth’s crust are loosened, dissolved, or worn away and simultaneously moved from one place to another.” Erosion may occur in areas of streams and rivers, along bluffs, around immovable objects (such as buildings or bridge abutments), or as a cascading result of other natural hazards, such as earthquakes or wildfires. When erosion occurs along bodies of water, the removal of material causes the shore to move further landward.

Forces such as sea level rise and changes in sediment supply impact erosion gradually and can be difficult to recognize. In contrast, the impacts of short-term events, such as storms and flooding, can be severe and are immediately recognizable. Along the Pacific coast, rain, wind, and waves can induce significant short-term erosion.

**Location of the Hazard**

Erosion is a severe hazard in coastal communities, where sea level rise and storms contribute to de-sedimentation and the retreat of coastal cliffs, bluffs, and beaches. While

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coastal erosion can happen in any storm, it is more likely during El Niño events, which occur every 5-7 years. As such, for the purpose of this campus-level analysis, the erosion hazard poses a consistent risk across those areas of the CSU-Dominguez Hills campus with erosion-prone characteristics. While it is understood that such conditions exist generally, no specific locations under threat of erosion or erosion-in-process have been identified. Such an assessment may be conducted by campus leadership at some point in the future, given one previous occurrence which has been mitigated.

Other incidents of erosion, such as occurs around buildings, is relatively non-spatial and can occur in any locations with conducive soil structure and a source of movement, such as water or wind. An area’s potential for erosion is determined by several factors, including rainfall, topography, soil characteristics, and vegetative cover.

Extent of the Hazard

Erosion is occurring on the Pacific coastline west of CSU Dominguez Hills. While there is no published scale of severity or extent for this geologic hazard on the CSU Dominguez Hills campus, erosion is likely to occur if conditions are favorable. However, given some historical occurrence of erosion on campus, the planning committee ranks the extent of this hazard as Moderate.

History of the Hazard

In 2014, an erosion problem on campus was causing silt to clog the draining pipes that transport water runoff from the health center. Grounds management crews improved water retention in the area by creating a miniature fairy garden.

Potential Impacts of the Hazard

Coastal erosion can result in severe impacts to infrastructure, including the undermining of foundations, exposure of underground infrastructure, and breaches of natural or constructed protections. The latter can expose communities to the destructive forces of floodwaters, surge, and debris impacts. On campus, areas of erosion can create pedestrian and transportation hazards, and structures may become unsafe if erosion is not controlled. Public health and safety, structures, and infrastructure can all be negatively impacted, damaged, or destroyed by the erosion hazard.

In agricultural areas, the erosion of soil degrades the quality of the soil, which can lead to reduced crop yields. At The Urban Farm, soil erosion can create significant concerns for agriculture and research. Eroded test plots can negatively impact experiments and tests, resulting in a loss of knowledge and data.

Probability of Future Occurrence of the Hazard

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Erosion is an on-going and dynamic process that occurs regularly. As climate change induces more frequent and intense weather events, coastal and other erosion may generally become more widespread or severe. These events can cause erosion or exacerbate areas already experiencing erosion. As a result, and in consideration of the potential extent of erosion on campus, the probability of at least a limited degree of erosion taking place somewhere on campus in the future is High over the long term.

Vulnerability to the Hazard

Topography, soil structure, land use, and precipitation are all factors of erosion. CSU Dominguez Hills infrastructure, buildings, and agriculture located on steep slopes, in areas with little vegetation, or in areas with conducive soil types are more vulnerable to erosion. CSU leadership would consider performing an analysis on specific at-risk buildings, slopes and soil types in the future.

In the wider Carson community, erosion vulnerabilities include agricultural sector job loss, degradation of riverine ecosystems and coastlines, and loss of water quality.

Estimate of Potential Losses

The historic and potential impacts of erosion on property statewide include reduced agricultural productivity, lower surface water quality, and damaged drainage networks. Current modeling is not precise enough to allow for an assessment of potential losses to buildings and infrastructure on campus.

Vulnerability Assessment Conclusions

While the ability to predict future erosion on the CSU Dominguez Hills campus is limited, the core issues shaping erosion vulnerability on campus are flora and landscaping. If left unchecked, erosion can cause significant damage to campus infrastructure and the surrounding environment.

Identified Data Limitations

The complex interactions between soil erosion factors make predictive modeling, determination of hazard areas, and quantification of loss difficult. Localized data on this hazard is also limited, resulting in more generalized findings.
**Extreme Temperatures (Includes Extreme Cold and Extreme Heat)**

**Heat**

**Description of the Hazard**

What is considered an excessively hot temperature varies according to the normal climate for that region. However, when temperatures are extremely high, people are at higher risk for heat-related illnesses, such as dehydration, heat exhaustion, heat stroke, and in severe cases, death.\(^{51}\)

Hazards from extreme heat are made worse when high temperatures are accompanied by high levels of humidity, which is defined as the amount of moisture in the air.\(^{52}\) As the temperature climbs, the air is able to hold more moisture. High humidity prevents the human body from cooling down naturally, which leads people to perceive that the temperatures “feels” hotter. The combination of temperature and humidity is known as the heat index.\(^{53}\)

Heat stroke, the most serious heat-related illness, occurs when the body is unable to control its temperature. Body temperature rises rapidly, the sweating mechanism fails, and the body cannot cool down.\(^{54}\) In extreme cases, heat stroke can cause confusion and unconsciousness, so the victim is unable to seek treatment without assistance.

There are several groups of people who are uniquely vulnerable to the effects of extreme heat, such as infants and children, older adults aged 65 and up, athletes and outdoor workers, low-income households, and individuals with certain chronic medical conditions.\(^{55}\)

**Location of the Hazard**

Extreme heat events are non-spatial hazards, and may occur anywhere at the CSU Dominguez Hills campus.

**Extent of the Hazard**

Extreme heat has a wide range of extent and severity markers and characteristics. Monthly average maximum temperatures in June through October range approximately from the mid-70s to upper-70s in Carson, California. Given no excessive heat events in the City of Carson since 1952, the planning committee ranks the extent of the hazard as **Low**.


\(^{53}\) Ibid.


The National Weather Service issues a Heat Advisory when the heat index value is expected to reach 100° – 104° F within the next 12 to 24 hours. Excessive Heat Warnings are issued when there is an anticipated heat index of 105° F or greater that will last for two (2) or more hours. Excessive Heat Warnings are issued by the county when any location in the county is expected to reach that criteria. In anticipation of an Excessive Heat Warning, an Excessive Heat Watch may be issued 1 to 2 days in advance, when the Heat Warning criteria is 50 – 79% likely to occur.

Figure 7-8 (following) depicts the National Weather Service’s methodology for determining the heat index, using the % humidity and the actual temperature.

Figure 7-9: Methodology for Determining Heat Index

As the heat index rises, so does the potential danger to people and animals. Table 7-24 (following) shows the health hazards associated with extreme heat.

Table 7-23: Health Risks Associated with Heat Index

<table>
<thead>
<tr>
<th>Category</th>
<th>Heat Index</th>
<th>Health Hazards</th>
</tr>
</thead>
<tbody>
<tr>
<td>Extreme Danger</td>
<td>130° F or higher</td>
<td>Heat stroke / sunstroke is likely with continued exposure.</td>
</tr>
<tr>
<td>Danger</td>
<td>105° – 129° F</td>
<td>Sunstroke, heat cramps, and/or heat exhaustion is likely with prolonged exposure and/or physical activity.</td>
</tr>
</tbody>
</table>

Extreme Caution  
90° – 104° F  
Sunstroke, heat cramps, and/or heat exhaustion is possible with prolonged exposure and/or physical activity.

Caution  
80° – 89° F  
Fatigue is possible with prolonged exposure and/or physical activity.

Based on no record of extreme heat events on campus, along with LA County’s established protocols of providing the public with advanced notice of heat events with directives for mitigating impacts, the planning committee ranks the extent of this hazard on campus as Low.

History of the Hazard

Based on data gathered from the National Centers for Environmental Information (NCEI) Storm Events Database, there have been no excessive heat events in the City of Carson since 1952. The larger Los Angeles County area has had five such events, all in 2007 and 2008.

Potential Impacts of the Hazard

Should an excessive heat event occur, CSU Dominguez Hills may experience impacts from extreme heat due to cancelled classes or postponed outdoor events in order to protect students, faculty, and staff from the weather.

In addition to the threat extreme heat poses to humans, high temperatures also pose a threat to utility production, which in turn threaten facilities and operations that rely on utilities. As temperatures rise, more people stay indoors, increasing the demand for air conditioning, fans, and other electronics. This puts a strain on the electrical grid, which can cause temporary outages. These outages can impact operations throughout campus, resulting in interruptions and delays in service. Outages may also negatively impact research efforts on campus, as the inability to maintain a steady, constant temperature may impact research specimens and experimental results.

Probability of Future Occurrence of the Hazard

There have been no extreme heat events in the City of Carson, California. Therefore, it is unlikely that the hazard will occur annually. Notably, the City of Carson does not include excessive heat events as a potential hazard in its local hazard mitigation plan. The County of Los Angeles considers extreme heat as a hazard, but only as one small part of a larger discussion regarding the effects of climate change.\textsuperscript{58} Based on these conditions, the planning committee ranks the probability of occurrence as \textbf{Low}.

Vulnerability to the Hazard

\textsuperscript{58} 2019 County of Los Angeles All-Hazards Mitigation Plan. \textit{4.1 Climate Change}. Print. Retrieved 01.27.21 from: https://lacounty.gov/emergency/county-of-los-angeles-all-hazards-mitigation-plan/
When dealing with an extreme heat event, the most common impacts are those generally felt by the people living in the targeted area. For people in particular, heat can kill when the body is pushed beyond its limits. Most heat disorders occur because the victim has been overexposed to heat. As discussed, the major human risks associated with extreme heat include dehydration, sunburn, fatigue, heat exhaustion, heat stroke, and in severe cases, death.

Some portions of the population are more at risk to the effects of extreme heat. The very young, the elderly, and certain groups with chronic medical conditions (such as asthma or other pulmonary illnesses, heart disease, poor blood circulation, neurological illnesses, and obesity) are generally more vulnerable to the effects of extreme heat, and are more likely to suffer illness or death as a result. 59 This is especially true if exposure is extended for a period of time and preventative measures are not taken immediately.

CSU Dominguez Hills is aware of the potential for extreme heat events as a campus located in the Southern area of the state, so while this is a hazard that the campus may experience, staff has enough familiarity with the hazard to handle the risks and vulnerabilities.

Estimate of Potential Losses

Based on the previous historical occurrences, annualized losses are considered to be negligible. In an extreme heat event, loss of human life or health impacts are a greater concern than is property damage.

Vulnerability Assessment Conclusions

While the ability to predict future heat events at the CSU Dominguez Hills campus is limited, the effects of climate change may provide some information. According to the Environmental Protection Agency (EPA), Southern California has warmed about three degrees on average over the last century, with less rainfall. This may lead to stronger heat events, drought, and an increased risk of wildfires. 60

Identified Data Limitations

Quantitative data on extreme heat impacts, such as public health impacts or impacts to campus power sources or air conditioning equipment is not available at this time.

Cold

Description of the Hazard

What is considered an excessively cold temperature varies according to the normal climate for that region. However, when temperatures are far below normal, with higher wind speeds, heat leaves the human body more rapidly, which increases the possibility of negative effects from these extreme temperatures.\textsuperscript{61}

The greatest danger from extreme cold is to people, as prolonged exposure can cause frostbite or hypothermia, and can become life threatening. When someone is suffering from hypothermia, body temperatures can become so low that they affect the brain, making it difficult for the victim to think clearly or move well. In the case of frostbite, the frozen tissue becomes numb and the victim may be unaware that anything is wrong until someone else notices.\textsuperscript{62} This makes hazards from extreme cold particularly dangerous, as people may not understand what is happening to them or what to do about it.

The primary hazards from extreme cold are frostbite and hypothermia. Frostbite is caused by freezing of the skin and underlying tissue. It causes a loss of feeling and color in the affected areas of the body, and most often affects the nose, chin, fingers, or toes.\textsuperscript{63} It can be permanently damaging if not treated promptly and can lead to infection, nerve damage, or amputation in severe cases.\textsuperscript{64} The risk of frostbite is increased in people with preexisting conditions, the elderly, people with reduced blood circulation, and people who are not dressed warmly enough for the conditions.

Hypothermia occurs when the body loses heat faster than it can produce heat, causing a dangerously low body temperature. A normal body temperature is around 98.6° F. Hypothermia occurs when your body temperature falls below 95° F.\textsuperscript{65} As this happens, the heart and other essential organs cannot work properly. If hypothermia is not treated, it can lead to heart failure, respiratory failure, and eventually to death.

Excessive or extreme cold can accompany severe winter weather, or it can occur without severe weather. For this reason, extreme cold is considered a separate hazard from severe winter storms.

Location of the Hazard

Extreme cold events are non-spatial hazards, and may occur throughout the CSU Dominguez Hills campus.

Extent of the Hazard

Extreme cold has a wide range of extent and severity markers and characteristics. Average nighttime winter temperatures in the City of Carson are typically

\textsuperscript{61} National Weather Service. \textit{Stay Safe in the Extreme Cold}. Retrieved 01.29.21 from: https://www.weather.gov/dlh/extremecold
\textsuperscript{63} Mayo Clinic. \textit{Frostbite: Overview}. Retrieved 01.29.21 from: https://www.mayoclinic.org/diseases-conditions/frostbite/symptoms-causes/syc-20372656
\textsuperscript{64} Ibid.
\textsuperscript{65} Mayo Clinic. \textit{Hypothermia: Overview}. Retrieved 01.29.21 from https://www.mayoclinic.org/diseases-conditions/hypothermia/symptoms-causes/syc-20352682

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in the high 40s. Based on just 2 frost/freeze events in Los Angeles County since 1997, and no extreme cold events, the planning committee ranks the extent of this hazard as **Low**.

The National Weather Service issues Extreme Cold Warnings when the temperature feels like it is -30° F or colder across a wide area for a period of at least several hours. When possible, these advisories are issued a day or two in advance of the conditions.66

The most common extent/severity marker for extreme cold is the Wind Chill scale. Figure 7-9 (following) depicts the National Weather Service’s methodology for determining the wind chill, using wind speed and actual temperature. Although wind chill is not necessarily related to extreme cold as a single cause, the advisory system that the NWS currently uses relies on wind chill to relay warning and advisory information to the public. Extreme cold severity is a function of wind chill and other factors, such as precipitation amount (rain, sleet, ice, and/or snow).

Figure 7-10: Methodology for Determining Wind Chill

**History of the Hazard**

Based on data gathered from the National Centers for Environmental Information (NCEI) Storm Events Database, Los Angeles County has experienced two frost/freeze events, one

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in December 1998 and one in January 2007, but no extreme cold hazards. *[Records for this hazard were first recorded in 1996]*.

**Potential Impacts of the Hazard**

Should an extreme cold event occur, CSU Dominguez Hills might experience impacts due to cancelled classes.

In addition to the threat posed to humans, extreme cold weather poses a significant threat to utility production, which in turn threatens facilities and operations that rely on utilities, specifically climate stabilization. As temperatures drop and stay low, increased demand for heating places a strain on the electrical grid, which can lead to temporary outages. These outages can impact operations throughout the campus, which can result in interruptions and delays in services. These outages may also negatively impact research efforts throughout the campus, as the inability to maintain a steady, constant temperature may result in unintended effects on research specimens.

**Probability of Future Occurrence of the Hazard**

The City of Carson has experienced freeze/frost events, but has never experienced an extreme cold event. Due to the City’s location and its fairly temperate climate, it is unlikely that this hazard will occur annually.

**Vulnerability to the Hazard**

When dealing with an extreme cold event, the most common impacts are those generally felt by the people living in the targeted area. As discussed, the major human risks associated with extreme cold include frostbite, hypothermia, and in severe cases, death. However, due to Carson’s moderate climate, the campus does not exhibit extreme cold vulnerabilities.

In summary, CSU Dominguez Hills is aware of the potential for extreme cold events, but due to its location, its climate is fairly moderate throughout the year and faces little risk of extreme cold events.

**Estimate of Potential Losses**

Based on the previous historical occurrences, annualized losses are considered to be negligible. In an extreme heat event, loss of human life or health impacts are a greater concern than is property damage.

**Vulnerability Assessment Conclusions**

While the ability to predict future extreme cold events at the CSU Dominguez Hills campus is limited, the effects of climate change may provide some information. According to the Environmental Protection Agency (EPA), Southern California has
warmed about three degrees on average over the last century, with less rainfall. This may lead to stronger heat events, drought, and an increased risk of wildfires.67

**Identified Data Limitations**

Numerous public and private actors conduct research, acquire data and disseminate meteorological information and forecasting to the general public, including the CSU university system. Currently, it is assumed that, apart from regular access to climate change models on changes to temperature extremes over time, the CSU community maintains sufficient access to the data needed to plan for, respond to, and mitigate the effects of extreme heat and cold.

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Flood

Description of the Hazard

The incredible geographic diversity in California presents tremendous challenges for flood planning and response. The state is home to extensive mountain ranges such as the Sierra Nevada, Cascades, Klamath, Coastal Ranges, and the Southern California Transverse Range all creating tremendous watersheds. Large river systems drain the mountains traveling through populated communities including the Sacramento and San Joaquin Rivers draining into the California Delta. The state has a complex system of reservoirs, dams, and levees providing water storage and flood protection. Finally, California’s 840-mile coastline exposes the coastal regions to tidal influences.

Floods are characterized by the rising and overflowing of excess water from a water source such as a stream, river, lake, canal, or coastal body onto an area of normally dry floodplain. A floodplain is a lowland area downstream and adjacent to water bodies that are subject to flood events. Flooding is a naturally occurring event that become hazardous when populations and property are affected.

Flooding can result from excessive precipitation from weather systems generating prolonged rainfall, excessive snowmelt from watersheds upstream from the floodplain, infrastructure failure, exceeding the capacity of dams or levees, tidal influences, or a combination from any of the previous factors.

Flooding represents one of the costliest and most frequent natural disasters that influence human suffering and economic impact in the United States. Flooding will likely result in significant damage to structures, infrastructure, utilities, landscapes, and the environment. Erosion of stream banks, roadways, other features may result from the movement of flood waters. The saturated ground resulting from standing flood waters may cause ground instability, collapse, erosion, or other damages. Further, floods will often generate substantial debris that will accumulate and be deposited throughout the flooded areas.

Flooding can be either slow-rise or rapid onset floods. With slow rise floods, there is often warning preceding water rise by hours or days before dangerous conditions present themselves. Slow rise floods that are expected to enter into populated areas generally allow for some time to initiate evacuation and sand bagging efforts. Flooding that occurs rapidly conversely are water events that present with extremely limited warning times and a limited ability to take response actions until flooding has already begun to occur.

Flooding may take on different forms:

- **Flash Flooding** – Flash flooding is typically characterized by a rapid rise, short duration, and large volume of water in a localized area. Heavy rainfall in areas that have limited drainage capacities often contribute to flash flooding conditions. These flooding events frequently occur with limited notice requiring immediate evacuation or rapid response efforts such as sand bagging. Flash flooding may arrive with fast moving water creating added hazardous conditions.
Riverine Flooding – Riverine flooding is usually caused by prolonged rainfall or rainfall combined with heavy snowmelt. When soils are already saturated, the ability for the ground to absorb water is minimized. In a riverine flood, the waterway exceeds channel capacity and extends into areas outside of the channel, often in developed communities. In California, riverine flooding is most likely to occur from November through April. The duration of riverine floods may vary from a period of hours to weeks.

Localized Flooding – Localized flooding is commonly the result of stormwater drainage systems being overwhelmed by unusually heavy rainfall. These flooding events frequently occur in areas that are urbanized or developed with greater amounts of impervious surfaces not allowing ground absorption. This generates added runoff into the drainage systems and onto roadways creating backups.

Infrastructure Failure – Failures of dams or levees presents a serious flooding concern for areas downstream from the compromised structure. This situation may result in a catastrophic flood with limited warning time and widespread areas affected.

Coastal Flooding – Coastal flooding can occur in multiple areas along the California coastline. Flooding may result from intense storms coming from the Pacific Ocean that generate elevated water levels or storm surge. The size, duration, winds generated, and intensity of the storm will influence the effect the waves will have on the shoreline. Periods of high tide can aggravate the conditions allowing greater wave impingement into coastal areas.

Atmospheric River

California, including the location of this campus, is subject to the effects of a phenomenon referred to as atmospheric rivers. These weather events consist of long, narrow regions in the atmosphere transporting tremendous amounts of water vapor from the tropics. These weather regions behave like rivers in the sky. They can carry heavy volumes of water vapor compared to the amount of water flow at the mouth of the Mississippi River. As these atmospheric rivers arrive into California they tend to generate significant rain and snow.

Atmospheric rivers can arrive in many different shapes and sizes. The larger events are able to generate extreme rainfall amounts resulting in flooding. They can stall over watersheds vulnerable to flooding, often saturated with heavy snow amounts. The atmospheric rivers known as a “Pineapple Express” coming from the tropics and arriving with warmer air may produce heavy rains that will melt ground snow adding to the water volume that will be added in the flood runoff.

These events can produce heavy amounts of precipitation creating extensive damages. However, these events may present as weaker systems that produce precipitation that is enough to be beneficial for the local water supply. At the higher elevations in the California mountains, these events have the potential to generate a tremendous snowpack providing a source of water during the dry summer months.
The science behind atmospheric rivers

An atmospheric river (AR) is a flowing column of condensed water vapor in the atmosphere responsible for producing significant levels of rain and snow, especially in the Western United States. When ARs move inland and sweep over the mountains, the water vapor rises and cooks to create heavy precipitation. Though many ARs are weak systems that simply provide beneficial rain or snow, some of the larger, more powerful ARs can create extreme rainfall and floods capable of disrupting travel, inducing mudslides and causing catastrophic damage to life and property. Visit www.research.noaa.gov to learn more.

Location of the Hazard

CSU Dominguez Hills is found in the South Bay region in the City of Carson bordering the City of Long Beach. Carson is a community within the densely populated Los Angeles Basin. The entire CSU Dominguez Hills campus sits within a Special Flood Hazard Area (SFHA) Zone X: Area of Minimal Flood Risk designation on the Flood Insurance Rate Map. The neighborhoods south and east of the campus reside in a Zone X: Area with Reduced Flood Risk Due to Levee. See Figure 7-12 below. The access routes into and out of the campus servicing locations to the north and west are found in areas primarily designated as Zone X: Area of Minimal Flood Hazard, access routes to and from the south and east are primarily located in Zone X: Area with Reduced Flood Risk Due to Levee.

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Figure 7-12: Special Flood Hazard Areas at CSU Dominguez Hills
Extent of the Hazard

The CSU Dominguez Hills campus resides in a minimally threatened flood zone. However, flood events are still possible and isolated heavy precipitation events can still pose flooding hazards. The CSU Dominguez Hills campus is located in general proximity to a number of flood control channels along the Los Angeles River and Rio Hondo systems. The Los Angeles River drains the San Gabriel Mountains and much of the Los Angeles Basin south towards Long Beach. A number of flood control systems feed into the Los Angeles River. The length of the Los Angeles River from downtown Los Angeles to the outlet into the ocean is a large concrete lined channel. The channel is located almost 3 miles east of the CSU Dominguez Hills campus, is separated from the campus by additional flood control channels and is lower in elevation than the campus.

The Dominguez Channel is a flood control and drainage channel ¾ mile southwest of the campus that drains much of the urban water collection of the South Bay communities. The CSU Dominguez Hills campus is situated slightly higher in elevation from the

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69 FEMA Flood Map Service Center. Retrieved 05.05.2021 from: https://msc.fema.gov/portal/home
Dominguez Channel and is outside of the levee protected zone. In addition, the Compton Creek flood control channel is located approximately 2 miles east of the campus. The CSU Dominguez Hills campus is situated slightly higher in elevation from the Compton Creek and is outside of the levee protected zone. Based on the (above) factors, and no flood history on campus, the planning committee ranks the extent of the flood hazard on campus as **Low**.

In support of the NFIP, FEMA identifies those areas that are more vulnerable to flooding by producing Flood Hazard Boundary Maps (FHBM), Flood Insurance Rate Maps (FIRM), and Flood Boundary and Floodway Maps (FBFM). Several areas of flood hazards are commonly identified on these maps, including the 1% annual chance flood zone. Flood zones are further delineated by risk and are assigned a letter signifier. The flood zone designations are defined and described in the following table.

### Table 7-24: Flood Zone Designations and Descriptions

<table>
<thead>
<tr>
<th>Zone Designation</th>
<th>Percent Annual Chance of Flood</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Zone V</td>
<td>1%</td>
<td>Areas along coasts subject to inundation by the 1% annual chance of flooding with additional hazards associated with storm-induced waves. Because hydraulic analyses have not been performed, no base flood elevations (BFEs) or flood depths are shown.</td>
</tr>
<tr>
<td>Zones VE and V1-30</td>
<td>1%</td>
<td>Areas along coasts subject to inundation by the 1% annual chance of flooding with additional hazards associated with storm-induced waves. BFEs derived from detailed hydraulic analyses are shown within these zones. (Zone VE is used on new and revised maps in place of Zones V1-30.)</td>
</tr>
<tr>
<td>Zone A</td>
<td>1%</td>
<td>Areas with a 1% annual chance of flooding and a 26% chance of flooding over the life of a 30-year mortgage. Because detailed analyses are not performed for such areas, no depths or BFEs are shown within these areas.</td>
</tr>
<tr>
<td>Zone AE</td>
<td>1%</td>
<td>Areas with a 1% annual chance of flooding and a 26% chance of flooding over the life of a 30-year mortgage. In most instances, BFEs derived from detailed analyses are shown at selected intervals within these zones.</td>
</tr>
</tbody>
</table>
Zone AH  
1%  
Areas with a 1% annual chance of flooding where shallow flooding (usually areas of ponding) can occur with average depths between 1 – 3 feet.

Zone AO  
1%  
Areas with a 1% annual chance of flooding, where shallow flooding average depths are between 1 – 3 feet.

Zone X (shaded)  
0.2%  
Represents areas between the limits of the 1% annual chance of flooding and 0.2% chance of flooding.

Zone X (unshaded)  
Undetermined  
Areas outside of the 1% annual chance floodplain and 0.2% annual chance floodplain; areas of 1% annual chance sheet flow flooding where average depths are less than one (1) foot; areas of 1% annual chance stream flooding where the contributing drainage area is less than one (1) square mile, or areas protected from the 1% annual chance flood by levees. No BFE or depths are shown within this zone.

History of the Hazard

Although flood events on campus have not been recorded, flooding in Carson and the broader Los Angeles County region have typically occurred during the winter months when Pacific storms are more common. The occurrences of significant flooding typically have been the result of successive intense storms with heavy precipitation. The region has experienced flood events that have caused tens of millions of dollars in damages and casualties. The following provides insight into information of past flooding events that are significant to the CSU Dominguez Hills campus.

Table 7-25: Historic Flood Events in Los Angeles County

<table>
<thead>
<tr>
<th>Date</th>
<th>Event</th>
<th>Declaration</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>March 1962</td>
<td>Flood</td>
<td>DR-122-CA</td>
<td>Countywide</td>
</tr>
<tr>
<td>October 1962</td>
<td>Flood</td>
<td>DR-138-CA</td>
<td>Countywide</td>
</tr>
<tr>
<td>February 1963</td>
<td>Flood; Heavy Rains</td>
<td>DR-145-CA</td>
<td>Countywide</td>
</tr>
<tr>
<td>February 1978</td>
<td>Flood; Winter Storms</td>
<td>DR-547-CA</td>
<td>Countywide</td>
</tr>
</tbody>
</table>

### Potential Impacts of the Hazard

A flood will potentially result in extensive amounts of water entering onto developed areas. The force and volume of water that is generated by a flood may cause extensive structural damage in areas subject to standing or moving water. The effects of flooding may spread over significant distances covering large areas of land. The extent of the impacts would vary based on a number of factors such as the volume of water flooding, the time of the flood event, the amount of warning provided, the location and extent of the flood boundary, facility elevation, and distance from the flood source. Potential impacts resulting from flooding include:

- Injuries or loss of life
- Property destruction or damage
- Loss of property contents
- Infrastructure damage including roadways, bridges, other transportation means
- Public health hazards resulting from mold, mildew, and disease due to flood water
- Flooded or destroyed lifelines/supply routes
- Damaged or destroyed utilities
- Loss of community economic base

<table>
<thead>
<tr>
<th>Year</th>
<th>Event Description</th>
<th>DR-Number</th>
<th>Scope</th>
</tr>
</thead>
<tbody>
<tr>
<td>February 1980</td>
<td>Flood; Winter Storms</td>
<td>DR-615-CA</td>
<td>Countywide</td>
</tr>
<tr>
<td>December 1988</td>
<td>Winter Storms</td>
<td>DR-812-CA</td>
<td>Countywide</td>
</tr>
<tr>
<td>February 1992</td>
<td>Winter Storms</td>
<td>DR-935-CA</td>
<td>Countywide</td>
</tr>
<tr>
<td>January 1993</td>
<td>Winter Storms</td>
<td>DR-979-CA</td>
<td>Countywide</td>
</tr>
<tr>
<td>January 1995</td>
<td>Flash Flood; Heavy Rains</td>
<td>DR-1044-CA</td>
<td>Countywide</td>
</tr>
<tr>
<td>March 1995</td>
<td>Flash Flood; Heavy Rains</td>
<td>DR-1046-CA</td>
<td>Countywide</td>
</tr>
<tr>
<td>December 1996</td>
<td>Flood; Winter Storms</td>
<td>DR-1155-CA</td>
<td>Countywide</td>
</tr>
<tr>
<td>January 1997</td>
<td>Flood</td>
<td>DR-1155-CA</td>
<td>Countywide</td>
</tr>
<tr>
<td>February 1998</td>
<td>Flood; Winter Storms</td>
<td>DR-1203-CA</td>
<td>Countywide</td>
</tr>
<tr>
<td>January 2005</td>
<td>Flood; Winter Storms</td>
<td>DR-1577-CA</td>
<td>Countywide</td>
</tr>
<tr>
<td>February 2005</td>
<td>Flood; Debris Flows</td>
<td>DR-1585-CA</td>
<td>Countywide</td>
</tr>
<tr>
<td>March 2010</td>
<td>Flood; Debris Flows</td>
<td>DR-1884-CA</td>
<td>Countywide</td>
</tr>
<tr>
<td>January 2017</td>
<td>Flood; Winter Storms</td>
<td>DR-4305-CA</td>
<td>Countywide</td>
</tr>
</tbody>
</table>
- Employment losses
- Agricultural (crops and livestock) damages or destruction
- Environmental damage
- Prolonged periods of necessary dewatering
- Flooding erosion may alter natural drainage channels
- Societal and community impacts
- Psychological impacts of impacted populations
- Disruptions to education delivery to community
- Damage or destruction of academic materials, fine arts, and research
- Damage or destruction of university computer systems and networks
- Damaged university infrastructure
- Inability for campus operations to resume
- Reduced or eliminated student engagement with academic programs
- Reductions in campus revenues

**Probability of Future Occurrence of the Hazard**

Flooding occurs on average every three years from heavy precipitation that could generate potential 50- or 100-year floods in the CSU Dominguez Hills area. That said, the location of the CSU Dominguez Hills campus residing within a Zone X (Area of Minimal Flood Hazard). As such, the planning committee rates the probability of future occurrence for flooding on campus as **Unlikely**.

**Vulnerability to the Hazard**

The CSU Dominguez Hills campus is subject to the effects of limited small-scale flooding or ponding resulting primarily from excessive precipitation and isolated strong storms. There is a more remote potential for flooding and damage on campus and surrounding residential and commercial areas of Carson due to overflow or damage to flood control systems. The flood control channels and drainage systems that surround the campus have limited storage or volume capacities.

Vulnerability to flooding on the CSU Dominguez Hills campus will vary depending on when the flood were to occur and the location of people and assets located within any low lying areas. The risk to the campus population will be lessened during periods when classes are not in session or during periods of breaks. Conversely, during the days and hours that classes are in session and staff are at their workplaces, the human vulnerability increases. Members of the campus community may become trapped on campus depending on the level of flooding occurring on surface streets. However, in rare region-wide events this vulnerability may be extended to the homes and workplaces of members of the campus community and their families.

CSU Dominguez Hills is in proximity to a variety of industrial and petrol-chemical facilities. When these facilities are inundated with flood water, the potential for chemical release exists presenting possible exposures to individuals from the campus community.
These facilities additionally line many of the primary access routes in and out of the campus.

During low probability, severe flood events, some campus buildings and infrastructure in low lying areas might be vulnerable to large-scale flooding if it reaches the university. Campus utilities and communication capabilities could be impacted by flood waters rendering them disabled. A rare flood covering a large portion of the city might affect communication capabilities well beyond the boundaries of the campus. Remaining flood waters will leave behind molds and other health concerns in affected campus buildings and facilities likely requiring extensive restoration or demolishing. The residents of the on-campus residence halls, if located in low lying, flood prone areas, may have transportation limitations requiring evacuation and alternative housing procedures to be implemented if populated. In such areas, flood waters may result in damage to campus equipment, communication systems, protected documents, artwork, academic materials, computer systems, research, and other critical activities on lower levels of buildings.

Certain campus populations will experience greater challenges to a post-flood / failure environment. Vulnerable populations will likely need to navigate through flood generated debris, face extreme health safety issues from flood waters, experience extreme stresses of a disaster, an inability to communicate to or gain access to support networks, and find difficulty in accessing equipment or supplies to aid in a specific need.

Estimate of Potential Losses

Estimates of potential losses will be influenced by a variety of factors. The volume and force of the water will determine the scale of damages affecting campus infrastructure, equipment, and other impacted features. The location and elevation above flood waters will affect the level of damage and individuals exposed. The time of the academic year, the day of week, and hour in which the flooding was to occur will influence the number of people on campus and potential casualties. The severity of the storms producing precipitation, the speed of the storms moving across the area, the level of snowpack in the higher elevations, and amount of resulting snowmelt will produce varying effects on damages produced and costs incurred. Losses will be generated by the physical damages, the loss of revenue, loss of academic research, loss of building contents, and community wide economic reductions.

Based on estimate replacement costs of facilities and structures on campus, the maximum total replacement costs due to flood are $142,163,477. However, it is unlikely for flood to cause destructive losses to the entire campus.

Table 7-26: Special Flood Hazard Area (SFHA) Estimated Losses

<table>
<thead>
<tr>
<th>Zone Designation</th>
<th>No. of Buildings</th>
<th>Maximum Replacement Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Zone V</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Zone VE &amp; V 1-30</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>
Vulnerability Assessment Conclusions

While the campus is located in an area of minimal flood potential (Zone X), the primary vulnerabilities to flood on campus are people and assets in low lying areas exposed to mostly localized flooding and ponding from overflow of campus creeks or low probability, large-scale storms that produce heavy amounts of precipitation directly over the campus and surrounding neighborhoods. The proximity to the Dominguez Channel, Compton Creek, and Los Angeles River presents additional flood risk factors for the campus.

As discussed above, those factors creating the potential for flooding in the Dominguez Hills area and on the campus generate the potential for a number of cascading effects such as disruptions to the local economy, utility failures, disruptions to providing for the needs of the campus community, and development of public health hazards. These effects would be exacerbated by effects of seasonal flooding, ongoing heavy precipitation, or excessive run-off from the watershed contributing to the river system. The potential for widespread flooding and damage of structures due to the force of water, while unlikely, has exponentially powerful impacts on particular segments of the campus community including those with access or functional needs, international students, the homeless, and students residing in the residence halls.

Identified Data Limitations

Missing campus structural replacement costs and complete inventory of building construction features or mitigation efforts to lessen the impact due to flood inundation. HAZUS generated analysis is focused on the broader community level versus finetuning the analysis to the micro-level for facilities such as a university campus.
Hazardous Materials

Description of the Hazard

A hazardous material is defined in California’s State Hazardous Materials Incident Contingency Plan (1991) as “a substance or combination of substances which, because of quantity, concentration, physical, chemical, or infectious characteristics may: cause, or significantly contribute to an increase in deaths or serious illnesses; and/or pose a substantial present or potential hazard to humans or the environment.” Hazardous materials are one or more of the following: flammable, corrosive or an irritant, oxidizing, explosive, toxic (poisonous or infectious), thermally unstable or reactive, or radioactive. Hazardous materials are ubiquitous in modern society and may be found at all stages of production, consumption, and disposal.

Federal and state laws permit the intentional release of some hazardous materials into the environment such that the risk to human health and the environment is thought to be acceptable. However, sometimes releases are unintentional, resulting from leaks, accidents, or natural hazards. This section focuses on such accidental releases and fall into the following key categories:

**Fixed Hazardous Materials Incident:** A fixed hazardous materials incident is the accidental release of chemical substances or mixtures during production or handling at a fixed facility.

**Transportation Hazardous Materials Incident:** A transportation hazardous materials incident is the accidental release of chemical substances or mixtures during highway, waterway or air transport. Populations, built and natural environments are potentially impacted.

**Pipeline Incident:** A pipeline transportation incident occurs when a break in a pipeline creates the potential for an explosion or leak of a dangerous substance (oil, gas, etc.) possibly requiring evacuation. An underground pipeline incident can be caused by environmental disruption, accidental damage, or sabotage. Incidents can range from a small, slow leak to a large rupture where an explosion is possible. Inspection and maintenance of the pipeline system along with marked gas line locations and an early warning and response procedure can lessen the risk to those near the pipelines.

Hazardous materials can also be classified according to worker safety and health. Information provided by California Division of Safety and Health includes guidelines related to:

- **Safety hazards** (fire and fire byproducts, electricity, flammable gases, unstable structures, demolition, sharp or flying objects, excavations)

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73 California Department of Industrial Relations. *Worker Safety and Health During Fire Cleanup.* Retrieved 04.18.2021 from: [https://www.dir.ca.gov/dosh/wildfire/Worker-Health-and-Safety-During-Fire-Cleanup.html](https://www.dir.ca.gov/dosh/wildfire/Worker-Health-and-Safety-During-Fire-Cleanup.html)
• **Health hazards** (carbon monoxide ash, soot and dust; asbestos; hazardous liquids; other hazardous substances; heat illness)

**Natural-Technological Incidents (Natechs):** During the past two decades, increasing attention has been given to hazardous materials releases resulting from Natechs or a natural disaster event that triggers a technological hazard event. Natechs are of particular concern for the following reasons:

- They can produce a simultaneous effect on many industrial facilities
- Can overwhelm response capacity
- Containment systems may fail
- May produce cascading disasters
- Response may be hindered by a disaster’s impact on the physical environment

**Location of the Hazard**

Hazardous materials and infrastructure such as fuel tanks, rail lines, chemicals, hazardous waste sites and gas pipelines to varying degrees are located within the CSU system and/or within its surrounding communities. At larger scales (beyond the campus planning area) hazardous materials are located throughout the town of Carson, and the city and county of Los Angeles, and reflect different types, configurations and scales dispersed across these geographic areas.

**Extent of the Hazard**

There is no comprehensive statewide vulnerability assessment available at this time. As such, the true extent of the hazardous materials risk in California and its communities is not known, meaning no overarching conclusions have been reached which have been able to integrate all qualitative and quantitative risk factors to produce a comprehensive measure of the extent of the hazard. However, for the CSU – Dominguez Hills planning committee, although no hazmat events have taken place on campus, and hazardous materials are limited to chemicals in the science building, and fuel at the physical plant, based on the types and levels of hazardous materials in the larger community, it is prudent to rank the extent of the hazard for the CSU – Dominguez Hills campus as Moderate and to consider worst case scenarios as the main driver of policy in order to fully mitigate all possible hazardous materials event outcomes.

For example, 400 hazardous materials problems are tied to 32 past earthquakes, including more than 495 documented hazardous materials releases due to the Loma Prieta Earthquake alone (this number excludes innumerable leaks in Pacific Gas & Electric’s

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natural gas distribution system).\textsuperscript{77} That said, it is likely that many such hazardous materials releases have received little attention in the past because public authorities, the media, and the public have overlooked them in the rush to address and recover from immediate disaster threats, and that responsible parties may have an incentive to understate the extent of releases or not to report them at all.

History of the Hazard

According to the CA Governor’s Office of Emergency Services’ Hazardous Materials Spill Report, the state experiences from 10 to 30 spill events daily. As of April 2021, a total of 2,096 spill events had occurred so far this year. Such events have occurred in all the cities and/or counties where CSU campuses are located.\textsuperscript{78}

No hazmat incidents have taken place on the CSU – Dominguez Hills campus.

Potential Impact of the Hazard

A large hazardous materials release could affect an entire community or city under certain conditions related to direction of air flow (air-based chemical release) and population density or the contamination of a community’s main water supply. Either type of release could necessitate large scale evacuation. By contrast, in the rural unincorporated areas where population densities are low, even in the event of a large release, the number of homes that may need to be evacuated would be significantly lower than in an urban environment. The occurrence of a hazmat incident can also result in the shut-down of transportation corridors which can last for hours at a time while the impacted area is stabilized.

The release of some toxic gases may cause immediate death, disablement, or sickness if absorbed through the skin, injected, ingested, or inhaled. Contaminated water resources become unsafe and unusable, depending on the amount of contaminant. Some chemicals cause painful and damaging burns if they come in direct contact with skin. Prolonged and concentrated exposure to such chemicals can produce severe long-term impacts to respiratory, endocrine and nervous systems, heart and brain health.

The potential impacts of chemicals and toxic gases discussed here also apply to the students, staff and environment on the CSU – Dominguez Hills campus.

With regard to the natural environment overall, contamination of air, ground, or water may result in harm to fish, wildlife, livestock, and crops. The release of hazardous materials into the environment may cause debilitation, disease, or birth defects over a long period of time. Loss of livestock and crops may lead to economic hardships within the community.


Recent California examples include the 2016 Aliso Canyon methane gas leak\(^7\), which caused evacuation of nearby residents, many of whom experienced temporary health problems such as difficulty breathing and eye irritation; and the 2016 Fruitland metal recycle plant fire in Maywood, which released heavy metals such as lead, magnesium, copper, aluminum, antimony, calcium, iron, sulfur, tin, potassium, and zinc which pose severe risks to public health.\(^8\) Health effects from exposure to these metals included short-term symptoms such as irritation to the eyes, nose, throat, and lungs.

**Potential Impact of the Hazard (Natechs)**

Natural disasters, including earthquake, flood, and fire also pose risks to public health and the environment. For example, following the Northridge Earthquake, California State University (CSU) Northridge laboratories and chemical storage rooms experienced multiple chemical spills. Such incidents, triggered by a natural disaster, pose a significant risk to students, faculty, staff, and first responders. At a minimum, all CSU campuses with a science lab (including CSU – Dominguez Hills) is at risk of potential impact from a natural-technological (combined impact) event.

In a severe flood event, floodwaters are often contaminated with hazardous materials posing a threat to public and animal health, groundwater, and other parts of the environment. These hazardous materials may be released from damaged or flooded underground tank sites (e.g., gas stations or chemical storage facilities), propane tanks, manure or human waste handling facilities, fertilizer and pesticide storage, agricultural sites, and household hazardous waste.

In a fire event, (such as the October 2017 Northern California firestorms which destroyed approximately 6,000 residences) entire neighborhoods can be burned to the ground. Hazardous material release creates public health concerns which can delay the initial steps of fire recovery, including reopening burned areas to residents and initiating debris removal activities. The post-fire “toxic sweep” poses a risk of coming into contact with toxic substances due to the presence of synthetic and hazardous materials.

**Probability of Future Occurrence of the Hazard**

The probability of occurrence for a hazmat event on the CSU – Dominguez Hills campus can be viewed in two different ways: the history of occurrence serves as a sound predictor of future probability assuming current risk and vulnerability factors remain somewhat constant. For the purposes of the current estimate, no current data clearly indicates otherwise. As such, the probability of occurrence is Low because the CSU – Dominguez Hills campus has not experienced hazmat events. That said, hazmat occurrences are largely based on human error, and any changes in risk and vulnerability factors such as a decreased vigilance in materials oversight and handling practices or


changes in the amount of chemicals or exposure will likely increase the probability on campus.

**Vulnerability to the Hazard**

Hazardous materials pose a risk to the CSU – Dominguez Hills campus. As identified by the campus planning committee and on the hazmat map, the following vulnerabilities are present on campus: chemicals are present in the science lab and at the physical plant which, if spilled or released, could impact human health and campus operations.

Although it is quite difficult to produce a quantitative measure of vulnerability because (unlike natural hazards) the probability of occurrence is dependent on human error, which itself is variable based upon a fluctuating set of interrelated factors, some of which lack prediction or control, given the complexity of how all natural and built environments and hazmat risks factors interrelate at the local or campus level, it is prudent to assume for planning purposes that the campus’ vulnerability is a sub-set of the larger community’s vulnerability. As such, the CSU – Dominguez Hills leadership maintains vigilance to mitigate the campus’ vulnerabilities identified above at a minimum.

**Estimate of Potential Losses**

As discussed previously, it is difficult if not impossible to produce an accurate quantitative measure of vulnerability because of the variable nature of a hazardous materials spill. For example, the release of a toxic airborne chemical in a populated area has severe impact potential, whereas the impact potential of a small chemical spill in a remote or rural area is most likely limited to remediation of soil. And, in both cases, the probability of occurrence is dependent on human error, which itself is variable based upon a fluctuating set of interrelated factors, some of which lack prediction or control. In all cases, different types and amounts of hazardous materials interact with fluctuating combinations of human error to produce different event outcomes with variable impact costs.

**Vulnerability Assessment Conclusions**

It is well understood that with regards to hazmat vulnerability, each campus and its surrounding community (including CSU – Dominguez Hills) operates through a complex and dynamic interaction between industrial and commercial inputs and outputs and the natural and built environment. Such activity produces hazardous materials that move through the environment along both convergent and divergent routes and across all levels of land-use from site to campus to city and county and beyond. It is also clear from a review of the Los Angeles County hazard mitigation plan and Cal OES’ records of hazardous material spills, that such events occur with great frequency and varying degrees of severity across jurisdictions statewide. As such, in assessing the vulnerability of the CSU – Dominguez Hills campus, campus-level risks and vulnerabilities are not discreet or isolated but can become exacerbated or augmented through connections to broader community-level hazmat risks and vulnerabilities.
Finally, in order to draw conclusions on vulnerability, it should be noted that any identified vulnerabilities at the campus level and/or community level are circumscribed and potentially reduced by targeted policy and program interventions. Numerous policies and programs have been established in recent years in response to California’s widespread and complex and integrated hazardous materials risks - California established the Unified Program which consolidates and integrates the administrative requirements, permits, inspections, and enforcement activities of the following environmental and emergency response programs: the Aboveground Petroleum Storage Act (APSA) Program, Area Plans for Hazardous Materials Emergencies, the California Accidental Release Prevention (CalARP) Program, the Hazardous Materials Release Response Plans and Inventories (Business Plans), Hazardous Material Management Plan (HMMP) and Hazardous Material Inventory Statement (HMIS) requirements (California Fire Code), the Hazardous Waste Generator and Onsite Hazardous Waste Treatment (tiered permitting) Programs, and the Underground Storage Tank Program.

Identified Data Limitations

The CSU – Dominguez Hills planning committee has provided information on campus-level hazmat materials and risks. Data limitations pertain to a comprehensive understanding of human activity and error related to materials control over the long term.
Landslide

Description of the Hazard

A landslide is a down-slope movement of soil, rock, or other debris, and can also be referred to as a mass movement or slope failure. These geological hazards can range in size from a few feet to over a mile in length and width and, when heavy and rapidly moving, can cause serious damage and loss of life.

Landslides are classified based on the type of material and type of movement involved. They can range from slow-moving earth flows to fast-moving debris flows, though many large slope failures involve more than one type of movement. The primary natural triggers of slope failures are water, seismic activity, and volcanic activity. Slope saturation by water can occur from intense rainfall, snowmelt, changes in ground-water levels, and surface-water level changes along coastlines. In winter months, El Niño storms or other high rainfall events may saturate soils and trigger slope failure.

Deep-Seated Landslides

Deep-seated landslides, ranging in depth from ten to several hundred feet, occur as a result of geologic and hydraulic changes, such as earthquakes or increased levels of groundwater. These landslides can move slowly or quickly and can cause extensive property damage, but rarely result in loss of life.

Debris Flows Related to Shallow Landslides

Shallow landslides may mobilize into rapidly moving debris flows and typically occur after sudden saturation of the ground. These types of debris flows are typically more dangerous because they move rapidly, causing both property damage and loss of life.

Debris flows may also occur as a result of post-fire conditions, where wildfires have left barren ground exposed to heavy rainfall. Intense rainfall, generally greater than .5 inch per hour, has the potential to trigger a post-fire debris flow. These landslides may impact lives and properties within the deposition zone and can result in downstream flooding. Post-fire debris flows often occur during the fall and winter following major summer fires.

Location of the Hazard

The susceptibility of an area to landslides depends on several variables, including magnitude of slope gradients, water content, ground cover, presence of erosion, and slope material and structure. However, landslides are most prevalent in terrain with weak material and steep slopes, and the highest risk is found in areas with high rainfall or high

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earthquake potential. Slope failures are also most likely to occur in areas where they have occurred in the past. In California, the most landslide-prone areas are found along the coast and in the northern Franciscan Formation.

General landslide vulnerability can be estimated from the distribution of weak rocks and steep slopes as seen in Figure 7-13. Based on Figure 7-13 (below), the east/southeast border of the CSU-Dominguez Hills campus is located adjacent to a class V landslide susceptibility area.

Figure 7-14: Deep-Seated Landslide Susceptibility Surrounding CSU-Dominguez Hills

Extent of the Hazard

In Los Angeles, landslides are more likely to occur in the steep slopes outside of Los Angeles and along the coastline. The San Gabriel mountains, both steep and erosive, contain steeply walled canyons above areas with high population density. When heavy rain occurs, there is significant potential for floods and landslides throughout the County, and the indirect impacts of landslides may cover a larger geographical extent. Given the campus’ location somewhat adjacent, but not connected to the moderate) landslide zone,

and no history of occurrence on or near the campus, the planning committee ranks the extent of the hazard as **Low**.

**History of the Hazard**

FEMA has declared thirteen major disasters involving landslides, mudslides, debris flows, or mud flows in Los Angeles County since 1978. NOAA has recorded five debris flow events in the County since 2004, most of which occurred in the areas directly surrounding metropolitan Los Angeles. The 2018 Southern California Mudflows damaged 40 to 45 homes in Sun Valley and caused a vehicle to strike a natural gas pipeline, which began to leak. No landslide events have occurred on the campus.

**Potential Impacts of the Hazard**

CSU Dominguez Hills may be impacted by the disruption of services as a result of landslides in the region. Landslides can result in physical damage to buildings and property and have the potential to significantly effect infrastructure. As a landslide moves, it distresses structural foundations by settlement, cracking, and tilting. Fast-moving flows can remove entire structures in one instance, while other types of flows can cause damage gradually.

Transportation and utility infrastructure are particularly vulnerable to landslides, since the failure of any component can disrupt service over a large area. The loss of power and communication and disruption of transportation can have cascading effects throughout an area, including impaired disposal of sewage, contamination of water supplies, and the release of flammable fuels. Transportation routes are also often expensive to clean up, and prolonged obstruction can disrupt the movement of people and goods for long periods of time.

**Probability of Future Occurrence of the Hazard**

Slope failures are often triggered by other natural hazards such as heavy rainfall and earthquakes, so landslide frequency is somewhat related to the frequency of these other hazards. As climate change impacts the frequency and intensity of triggers such as rain events, fires, and coastal erosion, landslides may generally occur more often. Historically, landslides have occurred frequently in the San Gabriel Mountains and therefore are highly likely to occur in the future. Given the location of the campus adjacent but not connected to the landslide zone, and no occurrence of landslides on or near the campus, the planning committee ranks the annual probability of the landslide hazard for the campus as **Unlikely**.

**Vulnerability to the Hazard**

The vulnerability of the built environment to landslides depends on exposure and is more likely to incur damage as a result of proximity, rather than inferior structural design. The structures most vulnerable to landslides are buildings and utility/transportation lifelines, which can be impacted by either impact or ground deformation. Utilities and transportation infrastructure are particularly vulnerable, due to their geographic extent.
and susceptibility to physical distress. Based on the mapping, the CSU-Dominguez Hills campus may exhibit building and/or infrastructure vulnerabilities to some degree at its east/southeast border. See the landslide location map in relation to the campus assets mapped adjacent to the identified landslide severity zones. Campus leadership may decide to more broadly assess asset vulnerability in the future.

Overall, any population proximal to a landslide when it occurs is vulnerable to its impacts.

**Estimate of Potential Losses**

There are no current models for estimating potential losses from a landslide directly impacting the campus.

Although the economic impact of landslide damage can exceed that of the direct repair costs, there are currently no applicable methods for estimating indirect costs related to CSU Dominguez Hills.
Vulnerability Assessment Conclusions

Based on the campus’ proximity to a class V landslide zone, landslides could impact the campus in a variety of ways, primarily related to indirect impacts to transportation and utilities. Utility outages can impact health, particularly for vulnerable populations, and can cause interruptions in operations. Interruptions may impact student and employee’s ability to travel to campus and the delivery of classes and events.

Identified Data Limitations

The ability to predict future landslides at the CSU Dominguez Hills campus is limited. However, the USGS estimates that climate change-induced shifts in weather will increase the frequency of post-wildfire landslides, which are expected to occur almost every year in California.
**Power Outage**

Description of the Hazard

Dominguez Hills is a large community in southern Los Angeles County that makes up the South Bay along with cities like, San Pedro, Redondo Beach, Carson, and others. The area is bounded by the Pacific Ocean on the south and west and generally by the City of Los Angeles on the north and east. The South Bay of Los Angeles is home to major refinery and industrial facilities, along with the peninsula where LA’s largest shipping yards lie, all of which rely on consistent electrical power.

Most aspects of modern life rely on the near continuous availability of utilities, such as electricity, water, and natural gas, and CSU Dominguez Hills is no exception as it is a highly populated community within one of the county’s most densely populated areas. An interruption in the supply or distribution of these services can leave highly populated areas, like Dominguez Hills, without electricity or sanitation. These interruptions can produce cascading effects from other hazards, such as major windstorms, leading to intentional disruptions of transmission lines due to safety concerns.

A power outage event can interrupt day-to-day operations of the campus, like in-person classes, impede, or limit digital, telephonic or radio communications, create traffic jams around the busy avenues and boulevards surrounding the campus, close the student health center and close restaurants around campus and outside the campus. Additionally, thousands of CSUDH student residents in on-campus housing would also be affected by a power outage on campus and in the surrounding area.

An electric power disruptions and outages fall into two categories: intentional and unintentional.

The four types of **intentional** disruptions:

- Planned: Some disruptions are intentional and can be scheduled based maintenance or upgrading needs.
- Unscheduled: Some intentional disruptions must be done "on the spot" in response to an emergency.
- Demand-Side Management: Some customers (i.e., on the demand side) have entered into an agreement with their utility provider to curtail their demand for electricity during periods of peak system loads.
- Load Shedding: When the power system is under extreme stress due to heavy demand and/or failure of critical components, it is sometimes necessary to intentionally interrupt the service to selected customers to prevent the entire system from collapsing. These intentional interruptions result in rolling blackouts.
Unintentional or unplanned disruptions are outages that come with essentially no advance notice or warning. This type of disruption is the most problematic. The following are categories of unplanned disruptions:

- Accident by the utility, utility contractor, or others.
- Malfunction or equipment failure.
- Equipment overload (utility company or customer).
- Reduced capability (equipment that cannot operate within its design criteria).
- Tree contact other than from storms.
- Vandalism or intentional damage.
- Weather, including lightning, wind, earthquake, flood, and broken tree limbs taking down power lines.
- Wildfire that damages transmission lines.

Location of the Hazard

Although power outages can take place within a certain area, it has the potential to affect the entire planning area equally.

Extent of the Hazard

In order to anticipate outage conditions and reduce impacts, campus facility managers and others keep track of conditions and data provided by the media, municipal utilities and the California Independent System Operator (CAISO) which is tasked with managing the power distribution grid that supplies most of California, except in areas served by municipal utilities. CAISO is thus the entity that coordinates statewide flow of electrical supply. CAISO uses a series of stage alerts to the media based on system conditions. The alerts are as follows:

- Stage 1 - reserve margin falls below 7 percent.
- Stage 2 - reserve margin falls below 5 percent.
- Stage 3 - reserve margin falls below 1.5 percent.

Rotating blackouts become a possibility when Stage 3 is reached. Utility agencies aim to advise affected areas approximately 48 hours in advance of a potential PSPS event and will attempt notification again approximately 24 hours before power is shut off. Campus staff respond accordingly.

Given the prevalence of rolling blackouts and other power outages in California, the campus maintains safety precautions, situational awareness, access to emergency power generators and other protocols for managing campus power outages. Given that recorded outages have taken place on campus, the planning committee ranks the extent of the power outage hazard as Moderate.
History of the Hazard

CSU Dominguez Hills has experienced power outages for various reasons. The university worked with the community’s local electric utility company to restore energy to the campus for its facilities, assets, resident halls, and classrooms. CSU Dominguez Hills has experienced power outages in the past and has experienced impacts because of the outages.

In 2015, a thirty-minute power outage affected the campus, which resulted in the majority of the campus losing power. The blackout was due to Southern California Edison repairing over-head wires located near the campus. The repair was due to a blown fuse that affected the campus. The majority of the campus reported losing power which affected lights, computers and Wi-Fi enabled devices. Classrooms were not evacuated as it was deemed safe for students, staff and faculty were deemed safe to remain in their classes and offices.

Potential Impacts of the Hazard

Instructors, campus residents, staff and administration rely on electricity for basic survival and operations. During a widespread power failure, it may take days to restore operations. Electrical power is the only cooling source for many individuals around the campus and its community, and long-term outages can potentially put people’s health and life at risk. Disruptions in the supply of heating fuel may put people and property at risk during extremely cold weather if it relies on electric generation or heating mechanisms instead of gas. Additionally, many medical devices, communications devices, and security rely on power to maintain their functions.

Climate Change and Energy Shortage

Climate change is expected to bring more frequent and intense natural disasters. These changes have created a variability at a rate that makes historical data a poor predictor of future climate. For example, the warmest years on record in California occurred in 2014, 2015, and 2016. The 2016-2017 year broke the record as the wettest ever recorded in the northern Sierra Nevada Mountains.

Changes in temperatures, precipitation patterns, extreme events, and sea-level rise have the potential to decrease the efficiency of thermal power plants and substations, decrease the capacity of transmission lines, render hydropower less reliable, spur an increase in electricity demand, and put energy infrastructure at risk of flooding.

With climate warming, higher costs from increased demand for cooling in the summer are expected to outweigh the decreases in heating costs in the cooler seasons. Hotter temperatures in California will mean more energy (typically measured in “cooling-degree days”) needed to cool homes and businesses both during heat waves and on a daily basis, during the daytime peak of the diurnal temperature cycle. During future heat waves, historically cooler coastal cities (e.g., San Francisco and Los Angeles) are
projected to experience greater relative increases in temperature, such that areas that never before relied on air conditioning will experience new cooling demands.

Secondary impacts of energy shortages are most often felt by vulnerable populations. For example, those who rely on electric power for life-saving medical equipment, such as respirators, are extremely vulnerable to power outages. Also, during periods of extreme heat emergencies, the elderly and the very young are more vulnerable to the loss of cooling systems requiring power sources.

**Probability of Future Occurrence of the Hazard**

The probability of California experiencing a power outage can be difficult to quantify but is a hazard that occurs annually during the same seasonal periods of temperature variance throughout the calendar year. Dominguez Hills, Carson and LA county experience such outages. As such, the probability ranking for the Carson area is Likely; although the campus may have recorded fewer events than the surrounding area, based on campus history of events, it is prudent to assign this same **Likely** ranking for the campus.

Climate models suggest summer global temperatures are likely to increase while changes between temperature extremes would be more pronounced. As such, it is expected that power outages will occur more frequently in the future.

**Vulnerability to the Hazard**

Based on the data available, and in consideration of the increasing effects of climate change, the campus remains vulnerable to power outages in terms of impacts to people, power infrastructure and campus operations. Nonetheless, as discussed campus leadership works to reduce vulnerabilities through consistent use of safety and operational protocols and emergency power sources to ensure it is able to mitigate an interruption to electrical power.

**Estimate of Potential Losses**

The data provided by Cal State Dominguez Hills does not report any value for potential losses due to power outage.

**Vulnerability Assessment Conclusions**

The primary concern for campus leadership is that a loss of power can lead to potential hazards to students, faculty, and staff at Channel Islands. Safety and operations protocols center on the following “direct impact” set of concerns:

Elevators, entry ways, air filtration systems and lighting provide the campus community with the necessary infrastructure and systems to function and navigate through the campus and, to maintain a safe campus environment and visibility during nighttime hours. The vulnerable population (especially students with physical disabilities) may be the most heavily affected by loss of power as they rely on elevators, entry ways with automatic doors, and locks and lights may impede on a disabled student’s ability to travel and utilize the campus and its structures safely.
The use of communication devices, billing, records, and electrical tools may also become unusable due to a loss of electricity. Many records and billing items may be needed for continuity of operations. Additionally, classrooms may not be usable if lighting equipment is not functioning impacting a semester or quarter’s progress for the academic year.

**Identified Data Limitations**

Cal State Dominguez Hills did not report any monetary or life losses due to a power outage. Also, the campus did not report any incidents involving a power outage directly affecting the campus community and operations.
**Volcano (Associated Air Quality)**

Description of the Hazard

The US Geological Service defines volcanoes as “openings or vents where lava, tephra (small rocks), and steam erupt on to the Earth’s surface. Through a series of cracks within and beneath the volcano, the vent connects to one or more linked storage areas of molten or partially molten rock (magma). This connection to fresh magma allows the volcano to erupt over and over again in the same location.”

A volcanic eruption occurs when magma, lighter than surrounding rock, is driven upwards by its buoyancy and by pressure from the dissolved gases contained within it. Gases are released from magma as it reaches the surface and pressure decreases. Magma can be erupted in several ways and violent eruptions typically cause tiny pieces of tephra (ash) to be carried away by the wind. This ash is hard, does not dissolve in water, is extremely abrasive and mildly corrosive, and conducts electricity when wet.

The gases released in an eruption include carbon dioxide, sulfur dioxide, hydrogen sulfide, and hydrogen halides. Depending on their concentration, these are potentially hazardous to people, animals, agriculture, and property.

Location of the Hazard

There are eight volcanic areas located throughout California. Seven of these - Medicine Lake Volcano, Mount Shasta, Lassen Volcanic Center, Clear Lake Volcanic Field, Long Valley Volcanic Region, Coso Volcanic Field, and Salton Buttes – are considered active volcanoes. No portion of CSU Dominguez Hills or Los Angeles County is located within a volcano hazard zone.

Extent of the Hazard

Volcanic hazards are most severe within a few miles of the volcano vent and the severity generally decreases with distance. Ash impact zones can range from tens to hundreds of miles from the vent source. The US Geological Survey has estimated zones surrounding active volcanoes wherein two (2) inches or more of ashfall following an eruption is possible. While CSU Dominguez Hills does not fall within an estimated ashfall zone, lighter dustings of ash outside of those zones may directly or indirectly impact the campus. As such, the planning committee ranks the extent of the hazard for the campus as **Low**.

History of the Hazard

No historical eruption events in California have affected the campus. Over the last 1,000 years, there have been at least 12 eruptions in California. The most recent volcanic

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eruption in California occurred at Lassen Peak about 100 years ago, when a major explosion delivered windborne ash over 275 miles away.

Potential Impacts of the Hazard

The specific impacts vary widely and depend on which type of volcano erupts, the style of explosion, the volume of lava, the eruption duration, and the local water conditions. As CSU Dominguez Hills is not proximal to an active volcano, only the potential impacts of ashfall and gases have been detailed. While both these hazards can be widespread, their most severe impacts are generally seen closer to the volcanic source.

Although ashfall is typically a nonlethal volcanic hazard, it is the most widespread and disruptive. Falling ash can damage crops, electronics, and machinery. It can also impact human health by irritating the respiratory tract, eyes, and skin. The particles may enter drinking water and structures and may cause structure failure if it is thick and heavy enough. Even a fine layer of ash can disrupt utilities. A portion of California’s major electric transmission lines, aerial telecommunication lifelines, transportation corridors, and water storage and conveyance lie within the state’s volcano hazard zones. Impacts to any of these can impact operations at CSU Dominguez Hills.

The potential impacts of gases released during volcanic eruptions are as follows:

- Carbon dioxide typically becomes diluted very quickly and is not life threatening. However, it can become trapped in higher concentrations in low-lying areas and has the potential to be fatal.
- Sulfur dioxide can cause acid rain and air pollution downwind of a volcano.
- Hydrogen sulfide can cause irritation of the upper respiratory tract. At high concentrations it can cause unconsciousness and death.
- Hydrogen halides can coat ash particles and, once deposited, poison drinking water, agricultural crops, and grazing land.

Probability of Future Occurrence of the Hazard

The US Geological Survey, based on the record of volcanic activity in California, estimates that the probability of another small- to moderate-sized eruption in the next thirty years is about 16 percent. As such, the annual probability of future occurrence for the campus is ranked by the committee as Unlikely.

Vulnerability of the Hazard

Populations living near volcanoes are the most vulnerable to eruptions and lava flows. However, volcanic ash can travel and affect populations miles away. The location and thickness of ash in any given area is a function of the severity of the eruption and wind speed and direction. For CSU Dominguez Hills, there is low vulnerability to the immediate impacts of volcanic eruptions due to the limited area affected and remote potential of an eruption. In the event of a widespread ashfall event, the elderly, infants, and populations with existing respiratory disease will be at higher risk.
Estimate of Potential Losses

Impacts to critical infrastructure, agriculture, and property from ashfall have the potential to cause widespread disruption, damage, and economic loss throughout the state. In the event of a widespread ashfall event, impacts will be immediate.

Current modeling is not precise enough to allow for an assessment of potential losses from ashfall to structures or infrastructure on or surrounding the campus.

Vulnerability Assessment Conclusions

CSU Dominguez Hills is unlikely to experience the direct impacts of a volcanic event. While the campus may be indirectly impacted by ashfall elsewhere in the state, direct ashfall impacts are generally unlikely but possible in a widespread event. However, the likelihood of any volcanic eruption in the state impacting the campus is very low.

Identified Data Limitations

Not all active volcanoes in California have been zoned for hazards by the US Geological Survey. This, together with the infrequent occurrence of volcanic explosions and number of factors determining type and extent of impacts, make the quantification of potential loss difficult.
Wildfire

Description of the Hazard

While wildfires are a natural part of California’s ecosystem, wildfires in California represent a hazard that presents one of the greatest probabilities of destruction along with a demonstrated history of catastrophic fire events in recent years. The destructive fire seasons of 2017 to 2020 illustrated the destructive forces fire presents to communities across the state. Wildfires may result in the structural loss, infrastructure loss, dangerous air quality, environmental damages, economic impacts, injuries, and loss of life. In many communities throughout California, wildfire presents greatest risk to human life and property.

Wildfires have been defined as any free burning vegetation fire that initiates from an unplanned ignition, whether natural or human caused demanding fire suppression actions to contain. These fires are prone to become uncontrolled, spreading through vegetative fuels rapidly exposing people and structures to harm. Wildfires present a significant risk to communities across the state, as evidenced by increasing trends of structural losses from wildland fires. This risk is elevated in areas where development and community growth has intersected, also known as the wildland-urban interface (WUI). In the interface setting, development itself can provide additional fuel for large fires. Recent fires have also demonstrated the ability of fire to consume populated areas in extreme conditions.

California’s Mediterranean climate in combination with its geography and vast population create a combination of factors that promotes an optimal environment for large fire growth and consequences. As there is great diversity of geographic characteristics across the state, the risks and potential consequences of wildfire must be assessed locally. The physical location, weather patterns, local fuel types and volume, extent of the WUI, topography, and additional factors will factor differently from part of the state to another.

The behavior of wildfires in California is significantly influenced by three distinct geographic factors. These factors will help shape the size, direction of spread, rate of combustion, fire intensity, and ability to pre-heat fuels. The physical factors contributing to wildfire behavior include:

- **Topography** – The rate in which wildfires spread increases with greater slopes in topography. The greater the slope will result in more pre-heating of fuel above the advancing fire. The direction that a slope faces will also influence fire behavior as south facing slopes receive greater solar radiation and thus drier vegetation that is more susceptible to combustion. Ridgetops often denote the end of fire spread as fire has greater difficulty spreading downhill.
- **Weather** – Weather factors substantially in influencing the behavior of wildfires. Wind, temperature, humidity, lightning, and lack of precipitation all contribute to a

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fire’s ability or inability to spread and intensify. California routinely experiences conditions in which these factors are in alignment to contribute to extreme fire behavior during the summer and fall seasons. High winds, low humidity, and high temperatures provide an environment promoting extreme fire activity.

- **Fuels** – Certain types of vegetation are increasingly prone to igniting and promote more intense burning. Areas with greater “fuel loading” (amount of fuel present in terms of weight of fuel per unit of area) increases the amount of fuel to fuel a fire. Greater volumes of dead or dry vegetation compared to live plants is a critical factor. Vegetation during drought conditions will experience decrease in moisture content increasing the conditions for combustion. Fuels close proximity to one another allows for rapid spread through contact or radiant exposures.

A risk assessment for wildfires should be implemented within a geospatial context focusing on the specific location features and incorporates the three components of the wildfire risk triangle – likelihood, intensity, and susceptibility.

**Location of the Hazard**

Substantial portions of the State of California are exceptionally vulnerable to wildfire activity or reside in a wildland-urban interface (WUI) area due to the vast open spaces, rangelands, forests and other lands with high susceptibility to fire occurring throughout the state. CSU Dominguez Hills and the City of Carson are located in the southern end of the of the Los Angeles Basin. This region is dominated by urban and suburban communities with limited direct exposures to wildland fire. CSU Dominguez Hills has extensive residential neighborhoods to the north, south, and west of the campus. Large industrial land uses are located to the east of the campus and beyond the neighboring residential areas. The closest areas with a wildfire hazard is the Palos Verdes Hills 7 miles to the southwest. There are no open land uses that would provide an environment for large-scale wildfire development.

The CSU Dominguez Hills campus is located in the Los Angeles Basin surrounded by the Santa Monica, San Gabriel, San Bernardino, and Santa Ana Mountains. These mountain ranges host three national forests with extensive history of large fire development. The fires that burn in these areas have the potential to develop vast quantities of smoke that can fill the basin in the right wind conditions. The geography of the Los Angeles Basin and San Gabriel, San Fernando, and San Bernardino Valleys creates a topography that captures air pollutants including smoke with surrounding mountains and inversion layers. The CSU Dominguez Hills campus is located in a region in which wildfire smoke can saturate the air around the campus.
Extent of the Hazard

The area immediately surrounding the CSU Dominguez Hills campus is not in proximity to fire hazard zones designated as a High Fire Hazard Severity Zones, and the campus does not have a history of wildfire activity occurring within proximity to the campus. Although the campus is not surrounded by High fire severity zones, given frequent events in the San Gabriel mountains surrounding the campus, and the extensive history of wildfire related smoke impacting the campus, the planning committee ranks the extent of the wildfire hazard for the campus as Moderate.

The National Fire Danger Rating System (NFDRS) is the current system in use for rating and classifying the potential danger of fire. The NFDRS tracks the effects of previous weather events on both dead and live fuel loads and adjusts accordingly based on future or predicted weather conditions. These complex relationships and equations are computed, and the outputs are expressed in terms that users can quickly and easily

understand. The current NFDRS is used by all federal and most state agencies to assess fire danger conditions.

The following table depicts the NFDRS, from the US Forest Service’s Wildland Fire Assessment System.

Table 7-27: National Fire Danger Rating System

<table>
<thead>
<tr>
<th>Rating</th>
<th>Basic Description</th>
<th>Detailed Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>CLASS 1: Low Danger (L)</td>
<td>Fires not easily started</td>
<td>Fuels do not ignite readily from small firebrands. Fires in open or cured grassland may burn freely a few hours after rain, but wood fires spread slowly by creeping or smoldering and burn in irregular fingers. There is little danger of spotting.</td>
</tr>
<tr>
<td>COLOR CODE: Green</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CLASS 2: Moderate Danger (M)</td>
<td>Fires start easily and spread at a moderate rate</td>
<td>Fires can start from most accidental causes. Fires in open cured grassland will burn briskly and spread rapidly on windy days. Woods fires spread slowly to moderately fast. The average fire is of moderate intensity, although heavy concentrations of fuel -- especially draped fuel -- may burn hot. Short-distance spotting may occur but is not persistent. Fires are not likely to become serious and control is relatively easy.</td>
</tr>
<tr>
<td>COLOR CODE: Blue</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CLASS 3: High Danger (H)</td>
<td>Fires start easily and spread at a rapid rate</td>
<td>All fine dead fuels ignite readily, and fires start easily from most causes. Unattended brush and campfires are likely to escape. Fires spread rapidly and short-distance spotting is common. High intensity burning may develop on slopes or in concentrations of fine fuel. Fires may become serious and their control difficult, unless they are hit hard and fast while small.</td>
</tr>
<tr>
<td>COLOR CODE: Yellow</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CLASS 4: Very High Danger (VH)</td>
<td>Fires start very easily and spread at a very fast rate</td>
<td>Fires start easily from all causes and immediately after ignition, spread rapidly and increase quickly in intensity. Spot fires are a constant danger. Fires burning in light fuels may quickly develop high-intensity characteristics - such as long-distance spotting - and fire whirlwinds when they burn into heavier fuels. Direct attack at the head of such fires is</td>
</tr>
<tr>
<td>COLOR CODE: Orange</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

rarely possible after they have been burning more than a few minutes.

Fires under extreme conditions start quickly, spread furiously, and burn intensely. All fires are potentially serious. Development into high intensity burning will usually be faster and occur from smaller fires than in the Very High Danger class (4). Direct attack is rarely possible and may be dangerous, except immediately after ignition. Fires that develop headway in heavy slash or in conifer stands may be unmanageable while the extreme burning condition lasts. Under these conditions, the only effective and safe control action is on the flanks, until the weather changes or the fuel supply lessens.

Due to the impacts of wildfires on public health, agencies across the nation have adopted the use of the Air Quality Index (AQI) to communicate and provide a consistent approach to air quality measurements and categorization. The AQI primarily focuses on the health effects caused by pollutants in the air such as smoke. The goal of the AQI is to provide advisories to assist the public in determining when to reduce exposures to inhalation of air pollution as pollution levels rise.

Table 7-28: Air Quality Index for Ozone and Particulate Pollution

<table>
<thead>
<tr>
<th>Daily AQI Color</th>
<th>Levels of Concern</th>
<th>Values of Index</th>
<th>Description of Air Quality</th>
</tr>
</thead>
<tbody>
<tr>
<td>Green</td>
<td>Good</td>
<td>0 to 50</td>
<td>Air quality is satisfactory, and air pollution poses little or no risk.</td>
</tr>
<tr>
<td>Yellow</td>
<td>Moderate</td>
<td>51 to 100</td>
<td>Air quality is acceptable. However, there may be a risk for some people, particularly those who are unusually sensitive to air pollution.</td>
</tr>
<tr>
<td>Orange</td>
<td>Unhealthy for Sensitive Groups</td>
<td>101 to 150</td>
<td>Members of sensitive groups may experience health effects. The general public is less likely to be affected.</td>
</tr>
</tbody>
</table>

### History of the Hazard

The State of California has a long history of chronic and destructive wildfires throughout the state. On average, 8,300 wildfires have caused burnt 928,245 acres across the state over the 20-year period between 2000 and 2020. Los Angeles County also has a long history of wildfire activity primarily in the foothills and mountains of the San Gabriel and Santa Monica Mountains. Wildfires occurring in Los Angeles County have resulted in hundreds of thousands of acres burned and hundreds of millions of dollars in damages.

The area immediately surrounding the CSU Dominguez Hills campus is not in proximity to fire hazard zones designated as a High Fire Hazard Severity Zones. The campus does not have a history of wildfire activity occurring within proximity to the campus. However, the County is surrounded by areas that are considered to be of high fire threat that would produce vast quantities of smoke and particulates into the air. The Dominguez Hills campus has experienced multiple days of poor air quality due to fires burning in Los Angeles, Orange, Riverside, and San Bernardino Counties. The 2017, 2018, and 2020 fire seasons in particular illustrated the increase in wildfire generated smoke saturating the air of communities throughout the state including Los Angeles County. CSU Dominguez Hills personnel reported the ongoing development of policies and procedures to address the response to poor air quality days.

### Potential Impacts of the Hazard

The location of the CSU Dominguez Hills campus surrounded by areas or urban development removed from areas with a fire hazard places a minimal direct threat from wildfire to the campus. The potential impacts to wildfire exist with members of the campus community who reside or work in these fire hazard zones.

Potential impacts to the campus community resulting from wildfires include:

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90 California Department of Forestry and Fire Protection. *Stats and Events*. Retrieved 05.03.2021 from: [https://www.fire.ca.gov/stats-events/](https://www.fire.ca.gov/stats-events/)
• Injuries or loss of life
• Campus property destruction or damage
• Residential property destruction or damage
• Commercial property destruction or damage
• Loss of property contents
• Infrastructure damage
• Damaged or destroyed lifelines/supply routes
• Damaged or destroyed utilities
• Damaged or destroyed critical facilities supporting campus emergency support needs
• Loss of community economic base
• Employment losses
• Loss to ground supporting vegetation on hillsides resulting in erosion or landslides in future precipitation events
• Agricultural (crops and livestock) damages or destruction
• Environmental damage
• Societal and community impacts
• Damage to organizations and facilities providing support services to vulnerable populations
• Greater evacuation challenges for those most vulnerable
• Psychological impacts of impacted populations
• Disruptions to education delivery to community

Potential impacts resulting from wildfire generated smoke include:
• Dangerous levels of air pollution
• Human Health Effects
• Air conditioning systems overwhelmed
• Greater demands on air filtration systems
• Greater demands on healthcare systems
• Reduced outdoor work productivity
• Closures of academic sessions

Additionally, there remains a number of secondary impacts from wildfires that could affect the campus community. Utilities feeding areas of Los Angeles County including the campus may be damaged resulting in power outages. Fire related damage in the watersheds will likely cause future landslides, degradation to plants supporting hillsides, and impact the hydroelectric power capabilities. Fires may present threats to areas of recreation, scenic value, and wildlife that are a part of the culture of the campus community.

Probability of Future Occurrence of the Hazard

The CSU Dominguez Hills campus is located in an area not considered to have a high wildfire risk, as it is not in proximity to fire hazard zones designated as a High Fire Hazard
Severity Zones. Also, the campus does not have a history of wildfire activity occurring within proximity to the campus. Furthermore, the location of the CSU Dominguez Hills campus surrounded by densely developed residential, commercial, and industrial land uses mitigates any vulnerabilities of wildfire hazards to the campus community or facilities. Based on the wildfire threat potential in the area surrounding the CSU Dominguez Hills campus, including the distance to Fire Hazard Severity Zones and density of residential and commercial development, the probability of wildfire related damage is considered Unlikely.

Based on the wildfire threat potential in the area surrounding the Dominguez Hills campus, and the frequency of wildfire events in Southern California including the hills and mountains throughout Los Angeles County, the probability of wildfire smoke impacts is considered Likely.

Vulnerability to the Hazard

The CSU Dominguez Hills campus is not likely to be subject to direct impact from wildfire due to the campus location in an urban/suburban area of Carson. The vulnerabilities to the effects of wildfire would largely lie within the campus community who may reside or work in locations that are exposed to the Fire Hazard Severity Zones outside of Carson. Wildfires occurring in other areas of the region may result in the displacement of large numbers of people. These effects may spill onto the campus in the form of evacuees or facility support to emergency resources.

Fire directly threatening the campus would likely take the form of localized fires involving single structures or small areas. Smaller vegetation fires are possible surrounding the campus in the urban forest or fields surrounding the city. These incidents would likely have little impact to the campus.

The primary basis of vulnerability is based on the population affected and the built environment exposed. In general, newer construction will be more fire resistant than older buildings as building and fire codes and construction technology have improved. Density of buildings and proximity of fuels to buildings or equipment at risk of combustion would additionally influence the fire’s ability to spread to structures.

The greater concerns regarding vulnerabilities to wildfire on CSU Dominguez Hills are related to the smoke that fires in the area would produce. The recent summer seasons have clearly demonstrated the reality of large wildfires producing enough smoke to fill the Los Angeles Basin even from substantial distances away. These recent fires have displayed how the effects of this smoke impact the general population and especially vulnerable populations. CSU Dominguez Hills students, faculty, and staff both on campus and off campus face these same vulnerabilities related to smoke filled air.

Smoke generated from large wildfires pose a threat in terms of diminished air quality that would be exposed to the population within the area of smoke distribution. Individuals with existing health problems such as respiratory or cardiac illnesses are increasingly vulnerable to wildfire generated smoke. Staff who work in roles requiring outdoor activity will be increasingly exposed during days where the air quality index is considered
unhealthy or worse. Student athletes participating in outdoor sports and engaging in aerobic activities are increasingly vulnerable to the effects of wildfire.

The vulnerability to members of the campus community in which wildfire generated smoke on the CSU Dominguez Hills campus will vary depending on when the air quality was to reach unhealthy levels. The risk to the campus population will be lessened during periods when classes are not in session or during periods of breaks. Conversely, during the days and hours that classes are in session and staff are at their workplaces, the human vulnerability increases. However, in region-wide events this vulnerability may be shared with the homes and workplaces of members of the campus community and their families.

Vulnerable populations will likely face disproportionate health safety issues from smoke filled air, experience increased stresses, may require the need to remain away from the campus enclosed at home, and may find difficulty in accessing equipment or supplies to aid in a specific need.

Estimate of Potential Losses

Estimates of potential losses will be influenced by a variety of factors. Costs would also be likely to include mitigation or repairs of HVAC systems, sealing of doors and windows, and other methods of keeping smoke from entering buildings. Secondary costs would include lost academic days during campus closures, lost staff on campus productivity, and health and medical interventions for affected members of the campus community.

Based on estimate replacement costs of facilities and structures on campus, the maximum total replacement costs due to wildfire are $142,163,477. Due to the lack of a complete inventory of building and facility costs, the total replacement estimate is likely much higher. However, the location of the campus in an urban/suburban setting removed from hazard prone areas makes wildfire related damages unlikely.

Table 7-29: Wildfire Hazard Potential (WHP) Zone Estimated Losses

<table>
<thead>
<tr>
<th>WHP Zone</th>
<th>No. of Buildings</th>
<th>Maximum Replacement Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Extreme</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Very High</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>High</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Moderate</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Low</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Very Low</td>
<td>7</td>
<td>$106,490,060</td>
</tr>
<tr>
<td>Non-Burnable</td>
<td>30</td>
<td>$35,673,417</td>
</tr>
<tr>
<td>No Building Value Data Provided*</td>
<td>17</td>
<td>Unknown</td>
</tr>
</tbody>
</table>
Vulnerability Assessment Conclusions

The occurrence of wildfires has been a frequent event in Los Angeles County; however, wildfire incidents do not pose a direct risk to the CSU Dominguez Hills campus. The location of the CSU Dominguez Hills campus surrounded by densely developed residential, commercial, and industrial land uses mitigates any vulnerabilities of wildfire hazards to the campus community or facilities.

Communities located within or near the Wildland Urban Interface may be subject to damaging fires. These same communities may be home to members of the campus community. The students, faculty, and staff of CSU Dominguez Hills who live or work in these hazard areas may experience vulnerabilities to the direct exposure to wildfire not likely at the campus. These effects may create tremendous challenges that could impact their ability to maintain engagement with university academic or professional activities. The potential for large-scale wildfires in the region further generates the added potential for a number of cascading effects such as disruptions to the local economy, utility failures, disruptions to providing for the needs of the community, and development of public health hazards.

Additionally, the topography of Southern California surrounded by mountains allows for smoke filled air to linger in the valleys of the Los Angeles Basin with the potential for unhealthy air quality depending on wind conditions. Fires in surrounding mountains generating tremendous quantities of smoke present tremendous health related vulnerabilities to members of the campus community. The campus community exposed to these unhealthy air conditions are vulnerable to a variety of potential health related effects.

Identified Data Limitations

Missing campus structural replacement costs and an inventory of building construction types to include status of earthquake retrofitting. HAZUS generated analysis is focused on the broader community level versus finetuning the analysis to the micro-level for facilities such as a university campus.

Severe Weather (Wind, Tornado, Hail, and Lightning)

Description of the Hazard

Severe weather can be described as a variety of weather or climate events that are beyond or near the ends of the range of observed weather patterns and behavior. These events can include high or extreme winds, storms, lightning, hail, tornadoes, heat waves,
unusually cold temperatures, extreme rainfall, and flooding. According to the Intergovernmental Panel on Climate Change (IPCC), to be classified as severe (or extreme), the occurrence of each value of a climate or weather variable (e.g., wind, hail, lightning, tornado, etc.) must be “above (or below) a threshold value near the upper (or lower) ends of the range of observed values of the variable.”

Severe weather in California can be generated by local, regional, and/or global weather and climate influences. From the individual thunderstorm to the Santa Ana wind event to the strong El Niño, damaging weather elements that are produced by and accompany severe weather and climate phenomena (e.g., damaging winds, hail, lightning, and tornadoes) occur throughout California and the California State University (CSU) system.

Global Scale Influences on Severe Weather in California: El Niño, La Niña, and ENSO

The El Niño-Southern Oscillation (ENSO) is a recurring climate pattern involving changes in the temperature of waters in the central and eastern tropical Pacific Ocean. On periods ranging from about three (3) to seven (7) years, the surface waters across a large swath of the tropical Pacific Ocean warm or cool by anywhere from 1°C to 3°C, compared to normal. This oscillating warming and cooling pattern, referred to as the ENSO cycle, directly affects rainfall distribution in the tropics and can have a strong influence on weather across the United States and other parts of the world.

El Niño and La Niña are extreme phases of the ENSO cycle, with a third phase occurring between them called the Neutral phase. The El Niño phase is characterized by unusually warm ocean temperatures and weaker-than-normal east winds in the Equatorial Pacific, while the La Niña phase is characterized by unusually cold ocean temperatures and stronger-than-normal east winds in the Equatorial Pacific. Both extreme ENSO phases lead to significant differences from the average ocean temperatures, winds, surface pressure, and rainfall across parts of the tropical Pacific. The Neutral phase indicates that conditions are near their long-term average.

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93 Retrieved on 07.18.2021 from https://www.weather.gov/mhx/ensowhat
95 Retrieved on 07.17.2021 from https://www.climate.gov/news-features/understanding-climate/el-ni%C3%B1o-and-la-ni%C3%B1a-frequently-asked-questions
The extreme ENSO phases affect the frequency and intensity of weather events across the world, including in California. On average, areas across California experience exceptionally stormy winters with increased precipitation under El Niño conditions, but experience less stormy and drier winters under La Niña conditions. This variability in storminess and precipitation brought on by El Niño and La Niña events affects the both the frequency and intensity of severe weather conditions experienced by all CSU campuses, including CSU Dominguez Hills.

Regional Climate Influences on Severe Weather across California

Most of the weather in California is influenced by the wet-winter/ dry-summer Mediterranean climate pattern. In the summer months, Pacific storm tracks are deflected north due to the position of the Pacific High (i.e., a large-scale atmospheric circulation over the Northeast Pacific Ocean), preventing Pacific storms from reaching California. As a result, most summer storms are generated due to the incursion of moist air from the Gulf of Mexico or the Gulf of California, and occur as scattered, locally heavy showers in the desert and mountain regions of the state. In the winter months, the Pacific High decreases in intensity and moves south, permitting powerful Pacific storms to move into and across the state; these storms can produce extreme winds, heavy rains (including “atmospheric river” events), and widespread coastal and inland flooding. (Please see the Flood Hazard profile in this document for information on Floods.) As a result, storm events accompanied by precipitation in California are far more frequent in the winter months than they are in the summer months.

While the Mediterranean climate pattern influences the seasonal frequency, intensity, geographic spread, and type of some severe weather events CSU campuses experience (including CSU Dominguez Hills), other severe weather phenomena may occur in California at any time of the year. For example, near the coast and over the Central Valley, there appears to be no defined seasonality to thunderstorms, and these storms are usually light and infrequent. Thunderstorms are more intense and more frequent in the intermediate and higher elevations of the Sierra Nevada, and occur with greater frequency during the summer months.

Types of Storms in California

The 2018 California State Hazard Mitigation Plan (SHMP) defines a storm as a violent atmospheric disturbance occurring over land and/or water that is distinguished by its strength, characteristics, and the scale of the resulting damage. The SHMP also lists the
following types of storms that produce hazardous conditions and potential damage throughout the state of California.\textsuperscript{101} These storms affect (in varying degrees) all CSU campuses, including CSU Dominguez Hills.

- **Thunderstorm**: A rain-bearing cloud that also produces lightning. Thunderstorms can produce some of nature’s most destructive and deadly weather including tornadoes, hail, strong winds, lightning and flooding.\textsuperscript{102} Thunderstorms are caused by an atmospheric imbalance from warm unstable air rising rapidly into the atmosphere. Lightning, which occurs during all thunderstorms, can strike anywhere.\textsuperscript{103} Thunderstorms can produce some of nature’s most destructive and deadly weather including tornadoes, hail, strong winds, lightning and flooding.\textsuperscript{104} *Severe thunderstorms* are more intense, violent, and dangerous thunderstorms. The National Oceanic and Atmospheric Administration (NOAA) defines a severe thunderstorm as any storm that produces one or more of the following elements: Damaging winds or speeds of 58 mph (50 knots) or greater, hail 1 inch in diameter or larger, and/or a tornado.\textsuperscript{105, 106}

- **Hailstorm**: a type of storm that precipitates round chunks of ice. Hailstorms usually occur during regular thunderstorms.\textsuperscript{107}

- **Wind storm**: marked by high wind with little or no precipitation.\textsuperscript{108}

- **Winter storm**: A storm that can produce a combination of freezing rain, sleet, heavy snow, and/or strong winds.\textsuperscript{109}

- **Coastal storm**: large wind-driven waves and/or storm surge that strike the coastal zone.\textsuperscript{110}

- **Ice storm**: Ice storms are one of the most dangerous forms of winter storms. When surface temperatures are below freezing, but a thick layer of above-freezing air
remains aloft, rain can fall into the freezing layer and freeze upon impact into a glaze of ice. In general, 8 millimeters (0.31 inch) of accumulation is all that is required, especially in combination with breezy conditions, to start downing power lines as well as tree limbs. Ice storms also make unheated road surfaces too slick to drive on. Ice storms can vary in time range from hours to days and can cripple small towns and large urban centers alike.111

- **Snowstorm**: A heavy fall of snow accumulating at a rate of more than 5 centimeters (2 inches) per hour that lasts several hours. Snowstorms, especially ones with a high liquid equivalent and breezy conditions, can down tree limbs, cut off power, and paralyze travel over a large region.112

**Severe Weather Hazard Elements: Wind Hazards, Hail, and Lightning**

This hazard profile concentrates on the following types of severe weather hazards: **wind hazards (including tornadoes)**, **hail**, and **lightning**. These hazards are produced by a variety of weather phenomena, including thunderstorms, coastal storms, winter storms, and topographically-enhanced downslope winds. While storm and downslope wind hazards are responsible for severe weather events across the CSU system, only the wind, tornado, hail, and lightning elements generated by these hazards are covered in this profile. (Storm-related hazards such as flooding and extreme temperatures are covered in other sections of this document.)

**Wind Hazards**

**Wind** is the horizontal movement of air past any given point. Wind begins with differences in air pressures; pressure that is higher at one point than another sets up a force, pushing the high towards the low pressure.113 Wind gusts are defined as “rapid fluctuations in the wind speed with a variation of 10 knots or more between peaks and lulls.” 114

Wind hazards in California take several forms: High Wind, Strong Winds, Thunderstorm Winds, Mountain-Valley (Downslope) Winds, and Tornadoes. These hazards are encountered across California, and have the potential to cause harm to or loss of life and/or property throughout California and the CSU system (including CSU Dominguez Hills).

**High Winds, Strong Winds, and Thunderstorm Winds**

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The National Weather Service reports three (3) types of wind events that occur areas over land: High Winds, Strong Winds, and Thunderstorm Winds. Collectively, these reports are used to determine the frequency with which wind hazard events have affected areas across the U.S., including California.

High Winds

High winds are defined as sustained non-convective winds of 35 knots (40 mph) or greater lasting for 1 hour or longer, or gusts of 50 knots (58 mph) or greater for any duration (or otherwise locally/regionally defined). In some mountainous areas, the above numerical values are 43 knots (50 mph) and 65 knots (75 mph), respectively.\textsuperscript{115}

Strong Winds

Strong winds are defined as non-convective winds gusting less than 50 knots (58 mph), or sustained winds less than 35 knots (40 mph), resulting in a fatality, injury, or damage.\textsuperscript{116}

Thunderstorm Winds

Thunderstorm winds are winds that arise from thunderstorm convection (occurring within 30 minutes of lightning being observed or detected), with speeds of at least 50 knots (58 mph). They can also be winds of any speed (non-severe thunderstorm winds below 50 knots (58 mph)) producing a fatality, injury, or damage.\textsuperscript{117}

Please note: \textbf{Straight-line wind} is a term used to define any thunderstorm wind that is not associated with rotation. It is used mainly to differentiate from the rotational winds found in tornado-producing storms.\textsuperscript{118} However, it is not a term used in the NCEI Storm Events Database, and therefore cannot be used to determine severe weather history of or potential impacts to CSU campuses.

Tornadoes

A tornado is an extreme severe weather wind hazard. A tornado is a rapidly rotating column of air extending from a thunderstorm to the surface of the Earth.\textsuperscript{119} This column extends between cloud and the Earth’s surface. The damage from tornadoes comes from the strong winds they contain and the flying debris they create. It is generally believed that rotational wind speeds can be as high as 300 mph in the most violent tornadoes.\textsuperscript{120} On a local scale, tornadoes are the most violent and most destructive of all atmospheric phenomena.\textsuperscript{121}

\textsuperscript{115} Retrieved on 07.17.2021 from https://www.nws.noaa.gov/directives/sym/pd01016005curr.pdf
\textsuperscript{118} Retrieved on 07.15.2021 from https://www.nssl.noaa.gov/education/svrwx101/wind/types/
\textsuperscript{119} Retrieved on 07.15.2021 from https://www.earthnetworks.com/tornado/
\textsuperscript{120} Retrieved on 07.15.2021 from https://www.nssl.noaa.gov/education/svrwx101/tornadoes/faq/
\textsuperscript{121} Retrieved on 07.15.2021 from https://www.weather.gov/bgm/severedefinitions

**Santa Ana Winds.** A type of wind hazard that is peculiar to Southern California is called a *Santa Ana Wind.* Santa Ana winds are strong, topographically-enhanced, extremely dry downslope winds that originate inland and affect coastal southern California and northern Baja California (Mexico). They occur when air from a region of high pressure over the dry, desert region of the southwestern U.S. flows westward towards low pressure located off the California coast. This creates dry winds that flow east to west through the mountain passages in Southern California. These winds have a strong seasonal component; they are most common during the cooler months of the year, occurring from September through May. Santa Ana winds typically feel warm (or even hot) because as the cool desert air moves down the side of the mountain, it is compressed, which causes the temperature of the air to rise. If strong enough, Santa Ana winds can cause major property damage, and may present difficulties for airborne and seagoing transportation. They also may increase wildfire risk because of the dryness of the winds and the speed at which they can spread a flame across the landscape. (Note: The Wildfire hazard is profiled elsewhere in this document.)

Figure below illustrates the mechanisms involved in the generation of Santa Ana winds across Southern California.

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**Diablo Winds.** The Diablo wind is another type of topographically-enhanced downslope wind phenomenon that occurs in the North-Central areas of California. Diablo winds are offshore wind events that flow northeasterly over Northern California’s Coast Ranges, often creating high wind speeds downwind of major canyons and over ridges, and extreme fire danger for the San Francisco Bay Area. Diablo winds are driven by a surface pressure gradient that forms in response to an inverted pressure trough that develops over California.  

**Sundowner Winds.** Sundowner winds are significant and potentially damaging downslope wind and warming events that periodically occur along a short segment of the southern California coast in the vicinity of Santa Barbara, CA. The unique topography of this coastal region promotes the development of Sundowner wind events: over a length of about 100 km, the coastline is oriented approximately west–east, with the adjoining narrow coastal plain bounded by a steeply rising (to elevations greater than 1200 m) and
coast-parallel mountain range. Called Sundowner winds because they often begin in the late afternoon or early evening, their onset is typically associated with a rapid rise in temperature and decrease in relative humidity, and the winds tend to blow from the north from the Santa Ynez Mountains to the coast of Santa Barbara County, California. During the more intense Sundowner wind events, wind speeds can be of gale force 39-54 miles per hour) or higher, and can even reach hurricane force (≥ 74 miles per hour) in the most extreme cases. Temperatures over the coastal plain, and even at the coast itself, can rise significantly above 37.8°C (100°F). Seasonally, Sundowner winds peak in March, April, and May, with a minimum during summer and a secondary peak in winter that often corresponds with Santa Ana winds. In addition to causing a dramatic change from the more typical marine-influenced local weather conditions, Sundowner wind episodes have produced significant wind-related property and agricultural damage, as well as conditions of extreme fire danger.126 127 128

Hail

Hail is a form of precipitation consisting of solid ice that forms inside thunderstorm updrafts.129 It is roughly round in shape and at least 0.2’ in diameter. Hail develops in the upper atmosphere as ice crystals that are bounced about by high velocity updraft winds; the ice crystals accumulate frozen droplets and fall after developing enough weight. The size of hailstones varies and is a direct consequence of the severity and size of the storm that produces them – the higher the temperatures at the Earth’s surface, the greater the strength of the updrafts and the amount of time hailstones are suspended, and therefore the greater the size of the hailstone.130

Lightning

Lightning is an electrical discharge produced by a thunderstorm. Lightning rapidly heats the air in its immediate vicinity to about 50,000°F - about five times the temperature of the surface of the sun. This compresses the surrounding air and creates a supersonic shock wave, which decays to an acoustic wave that is heard as thunder.131

The discharge may occur within or between clouds, between the cloud and air, between a cloud and the ground, or between the ground and a cloud.\textsuperscript{132} Lightning that is produced from thunderstorms in which precipitation evaporates before reaching the ground is called “dry lightning.”

**Location of the Hazard**

Severe weather is a non-spatial hazard, and can occur anywhere in the CSU system, including on the CSU Dominguez Hills campus. No one area of the campus – or of the surrounding community – is subject to experiencing severe weather more than any other area.

There is geographic variability among the different types of mountain and valley wind events (as a sub-category of the severe weather hazard). Santa Ana winds occur in Southern California, Diablo winds occur in North-Central California, and Sundowner winds occur almost exclusively in Santa Barbara County, California.

**Extent of the Hazard**

Severe weather hazards are non-spatial hazards that potentially affect all CSU Dominguez Hills campus areas equally. However, the smallest geographic unit of measurement for almost all official severe weather event data is at the county level. Because the severe weather data used do not exist at the campus level, it is assumed that the same (or similar) severe weather risks to CSU Dominguez Hills reflect those of the surrounding community and County. As a result, all assets and people at CSU Dominguez Hills are at risk from the effects of severe weather and can expect to experience at least some (or the complete range of) endemic severe weather hazards. In consideration of the campus’ design, layout, and operations, the severe weather history and degree of severity in the Carson area, and the history and degree of severity of each severe weather sub-type identified by the extent scales (below), the campus planning committee ranks the overall extent of the Severe Weather hazard as **MODERATE**. See each sub-hazard below for the planning committee’s sub-type extent ranking.

**Wind Hazard: Non-Rotational**

The Beaufort Scale below is an empirical measure that relates wind speed to observed conditions at sea or on land. Its full name is the Beaufort wind force scale.\textsuperscript{133} First developed in 1805, it is still used today to estimate wind strengths.\textsuperscript{134}

\textsuperscript{133} Retrieved on 07.15.2021 from https://www.rmets.org/resource/beaufort-scale
\textsuperscript{134} Retrieved on 07.15.2021 from https://www.weather.gov/mfl/beaufort
Table 7-30: Beaufort Wind Force Scale\textsuperscript{135}

<table>
<thead>
<tr>
<th>Force</th>
<th>Speed (mph)</th>
<th>Speed (knots)</th>
<th>Description</th>
<th>Specifications for use at sea</th>
<th>Specifications for use on land</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0-1</td>
<td>0-1</td>
<td>Calm</td>
<td>Sea like a mirror.</td>
<td>Calm; smoke rises vertically.</td>
</tr>
<tr>
<td>1</td>
<td>1-3</td>
<td>1-3</td>
<td>Light Air</td>
<td>Ripples with the appearance of scales are formed, but without foam crests.</td>
<td>Direction of wind shown by smoke drift, but not by wind vanes.</td>
</tr>
<tr>
<td>2</td>
<td>4-7</td>
<td>4-6</td>
<td>Light Breeze</td>
<td>Small wavelets, still short, but more pronounced. Crests have a glassy appearance and do not break.</td>
<td>Wind felt on face; leaves rustle; ordinary vanes moved by wind.</td>
</tr>
<tr>
<td>3</td>
<td>8-12</td>
<td>7-10</td>
<td>Gentle Breeze</td>
<td>Large wavelets. Crests begin to break. Foam of glassy appearance. Perhaps scattered white horses.</td>
<td>Leaves and small twigs in constant motion; wind extends light flag.</td>
</tr>
<tr>
<td>4</td>
<td>13-18</td>
<td>11-16</td>
<td>Moderate Breeze</td>
<td>Small waves, becoming larger; fairly frequent white horses.</td>
<td>Raises dust and loose paper; small branches are moved.</td>
</tr>
<tr>
<td>5</td>
<td>19-24</td>
<td>17-21</td>
<td>Fresh Breeze</td>
<td>Moderate waves, taking a more pronounced long form; many white horses are formed.</td>
<td>Small trees in leaf begin to sway; crested wavelets form on inland waters.</td>
</tr>
<tr>
<td>6</td>
<td>25-31</td>
<td>22-27</td>
<td>Strong Breeze</td>
<td>Large waves begin to form; the white foam crests are more extensive everywhere.</td>
<td>Large branches in motion; whistling heard in telegraph wires; umbrellas used with difficulty.</td>
</tr>
<tr>
<td>7</td>
<td>32-38</td>
<td>28-33</td>
<td>Near Gale</td>
<td>Sea heaps up and white foam from breaking waves begins to be blown in streaks along the direction of the wind.</td>
<td></td>
</tr>
</tbody>
</table>

\textsuperscript{135} Retrieved on 07.15.2021 from [https://www.weather.gov/mfl/beaufort](https://www.weather.gov/mfl/beaufort)
<table>
<thead>
<tr>
<th>Level</th>
<th>Scale</th>
<th>Force</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>8</td>
<td>39-46</td>
<td>34-40</td>
<td>Gale</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Whole trees in motion; inconvenience felt when walking against the wind.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Moderately high waves of greater length; edges of crests begin to break into spindrift. The foam is blown in well-marked streaks along the direction of the wind.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Breaks twigs off trees; generally impedes progress.</td>
</tr>
<tr>
<td>9</td>
<td>47-54</td>
<td>41-47</td>
<td>Severe Gale</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>High waves. Dense streaks of foam along the direction of the wind. Crests of waves begin to topple, tumble and roll over. Spray may affect visibility</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Slight structural damage occurs (chimney-pots and slates removed)</td>
</tr>
<tr>
<td>10</td>
<td>55-63</td>
<td>48-55</td>
<td>Storm</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Very high waves with long overhanging crests. The resulting foam, in great patches, is blown in dense white streaks along the direction of the wind. On the whole the surface of the sea takes on a white appearance. The tumbling of the sea becomes heavy and shock-like. Visibility affected.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Seldom experienced inland; trees uprooted; considerable structural damage occurs.</td>
</tr>
<tr>
<td>11</td>
<td>64-72</td>
<td>56-63</td>
<td>Violent Storm</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Exceptionally high waves (small and medium-size ships might be for a time lost to view behind the waves). The sea is completely covered with long white patches of foam lying along the direction of the wind. Everywhere the edges of the wave crests are blown into froth. Visibility affected.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Very rarely experienced; accompanied by widespread damage.</td>
</tr>
<tr>
<td>12</td>
<td>73+</td>
<td>64+</td>
<td>Hurricane</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>The air is filled with foam and spray. Sea completely white with driving spray; visibility very seriously affected.</td>
</tr>
</tbody>
</table>

Based on those extent ranking factors identified (above), the planning committee ranks the extent of non-rotational wind hazards as **MODERATE**.
**Extent: Tornado**

Tornadoes have their own severity/extent scale. Until 2007, tornadoes were measured and described according to the Fujita Scale.\(^{136}\)

In February 2007, use of the Fujita Scale was discontinued. In its place, the Enhanced Fujita (EF) Scale is used. The Enhanced Fujita scale considers how most structures are designed and is thought to be a much more accurate representation of the surface wind speeds in the most violent tornadoes. Like the original Fujita scale, the Enhanced Fujita scale is a set of wind estimates (not measurements) based on damage.

It is important to note the date that a tornado occurred. Tornadoes that occurred prior to February, 2007 are classified using the original Fujita scale and will not be converted to the Enhanced Fujita Scale.

Table below illustrates the Fujita Scale in use prior to February 2007.

Table 7-31: Fujita Tornado Scale (Pre-February 2007) \(^{137}\)

<table>
<thead>
<tr>
<th>F-Scale Number</th>
<th>Intensity Phrase</th>
<th>Wind Speed</th>
<th>Type of Damage</th>
</tr>
</thead>
<tbody>
<tr>
<td>F0</td>
<td>Gale tornado</td>
<td>40-72 mph</td>
<td>Some damage to chimneys; breaks branches off trees; pushes over shallow-rooted trees; damages sign boards.</td>
</tr>
<tr>
<td>F1</td>
<td>Moderate tornado</td>
<td>73-112 mph</td>
<td>The lower limit is the beginning of hurricane wind speed; peels surface off roofs; mobile homes pushed off foundations or overturned; moving autos pushed off the roads; attached garages may be destroyed.</td>
</tr>
<tr>
<td>F2</td>
<td>Significant tornado</td>
<td>113-157 mph</td>
<td>Considerable damage. Roofs torn off frame houses; mobile homes demolished; boxcars pushed over; large trees snapped or uprooted; light object missiles generated.</td>
</tr>
<tr>
<td>F3</td>
<td>Severe tornado</td>
<td>158-206 mph</td>
<td>Roof and some walls torn off well-constructed houses; trains overturned; most trees in forest uprooted.</td>
</tr>
</tbody>
</table>

\(^{136}\) Retrieved on 07.19.2021 from \[https://www.weather.gov/tae/ef_scale\]

**F4 Devastating tornado**  
207-260 mph  
Well-constructed houses leveled; structures with weak foundations blown off some distance; cars thrown and large missiles generated.

**F5 Incredible tornado**  
261-318 mph  
Strong frame houses lifted off foundations and carried considerable distances to disintegrate; automobile sized missiles fly through the air in excess of 100 meters; trees debarked; steel reinforced concrete structures badly damaged.

**F6 Inconceivable tornado**  
319-379 mph  
These winds are very unlikely. The small area of damage they might produce would probably not be recognizable along with the mess produced by F4 and F5 wind that would surround the F6 winds. Missiles, such as cars and refrigerators would do serious secondary damage that could not be directly identified as F6 damage. If this level is ever achieved, evidence for it might only be found in some manner of ground swirl pattern, for it may never be identifiable through engineering studies.

Table below illustrates the Enhanced Fujita (EF) Scale, currently in use. Tornadoes that have occurred since February, 2007 are classified using the Enhanced Fujita Scale.
Table 7-32: Enhanced Fujita Scale (February 2007 and Later) 138

<table>
<thead>
<tr>
<th>Enhanced Fujita Category</th>
<th>Wind Speed</th>
<th>Potential Damage</th>
</tr>
</thead>
<tbody>
<tr>
<td>EF0</td>
<td>65-85 mph</td>
<td>Light damage. Peels surface off some roofs; some damage to gutters or siding; branches broken off trees; shallow-rooted trees pushed over.</td>
</tr>
<tr>
<td>EF1</td>
<td>86-110 mph</td>
<td>Moderate damage. Roofs severely stripped; mobile homes overturned or badly damaged; loss of exterior doors; windows and other glass broken.</td>
</tr>
<tr>
<td>EF2</td>
<td>111-135 mph</td>
<td>Considerable damage. Roofs torn off well-constructed houses; foundations of frame homes shifted; mobile homes completely destroyed; large trees snapped or uprooted; light-object missiles generated; cars lifted off ground.</td>
</tr>
<tr>
<td>EF3</td>
<td>136-165 mph</td>
<td>Severe damage. Entire stories of well-constructed houses destroyed; severe damage to large buildings such as shopping malls; trains overturned; trees debarked; heavy cars lifted off the ground and thrown; structures with weak foundations blown away some distance.</td>
</tr>
<tr>
<td>EF4</td>
<td>166-200 mph</td>
<td>Devastating damage. Well-constructed houses and whole frame houses completely leveled; cars thrown and small missiles generated.</td>
</tr>
<tr>
<td>EF5</td>
<td>&gt;200 mph</td>
<td>Incredible damage. Strong frame houses leveled off foundations and swept away; automobile-sized missiles fly through the air in excess of 100 m (107 yd); high-rise buildings have significant structural deformation; incredible phenomena will occur.</td>
</tr>
</tbody>
</table>

Based on the extent ranking factors identified (above), the planning committee ranks the extent of tornados as **LOW**.

**Extent: Hail**

The National Oceanic and Atmospheric Administration and the Tornado and Storm Research Organization (TORRO) have combined efforts to create the Hailstorm Intensity Scale. Table below provides details of this scale.

Table 7-33: Combined NOAA/TORRO Hailstorm Intensity Scale

<table>
<thead>
<tr>
<th>Size Code</th>
<th>Intensity Category</th>
<th>Typical Hail Diameter</th>
<th>Approximate Size</th>
<th>Typical Damage Impacts</th>
</tr>
</thead>
<tbody>
<tr>
<td>H0</td>
<td>Hard Hail</td>
<td>Up to 0.33”</td>
<td>Pea</td>
<td>No damage</td>
</tr>
<tr>
<td>H1</td>
<td>Potentially Damaging</td>
<td>0.33” – 0.60”</td>
<td>Marble or Mothball</td>
<td>Slight damage to plants and crops</td>
</tr>
<tr>
<td>H2</td>
<td>Potentially Damaging</td>
<td>0.60” – 0.80”</td>
<td>Dime or grape</td>
<td>Significant damage to fruit, crops, and vegetation</td>
</tr>
<tr>
<td>H3</td>
<td>Severe</td>
<td>0.80” – 1.20”</td>
<td>Nickel to Quarter</td>
<td>Severe damage to fruit and crops, damage to glass and plastic structures, paint and wood scored</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Extent</th>
<th>Destructive</th>
<th>Diameter</th>
<th>Damaging Effect</th>
</tr>
</thead>
<tbody>
<tr>
<td>H4</td>
<td>Severe</td>
<td>1.20” – 1.60”</td>
<td>Half Dollar to Ping Pong Ball</td>
</tr>
<tr>
<td>H5</td>
<td>Destructive</td>
<td>1.60” – 2.0”</td>
<td>Silver Dollar to Golf Ball</td>
</tr>
<tr>
<td>H6</td>
<td>Destructive</td>
<td>2.0” – 2.4”</td>
<td>Lime or Egg</td>
</tr>
<tr>
<td>H7</td>
<td>Very</td>
<td>2.4” – 3.0”</td>
<td>Tennis Ball</td>
</tr>
<tr>
<td>H8</td>
<td>Very</td>
<td>3.0” – 3.5”</td>
<td>Baseball to Orange</td>
</tr>
<tr>
<td>H9</td>
<td>Super Hailstorms</td>
<td>3.5” – 4.0”</td>
<td>Grapefruit</td>
</tr>
</tbody>
</table>

Based on those extent ranking factors identified (above), the planning committee ranks the extent of the hail hazard as **LOW**.
**Extent: Lightning**

The National Weather Service (NWS) uses a Lightning Activity Level (LAL) scale to indicate the frequency and character of cloud-to-ground (C/G) lightning. The scale uses a range of 1 – 6, with 6 being the high end of the scale. Table below provides details of the LAL scale.

Table 7-34: Lightning Activity Level (LAL) Scale

<table>
<thead>
<tr>
<th>Rank</th>
<th>Cloud and Storm Development</th>
<th>Areal Coverage</th>
<th>Counts C/G per 5 Minutes</th>
<th>Counts C/G per 15 Minutes</th>
<th>Average C/G per Minute</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>No Thunderstorms</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>2</td>
<td>Cumulus clouds are common but only a few reaches the towering stage. A single thunderstorm must be confirmed in the rating area. The clouds mostly produce virga, but light rain will occasionally reach ground. Lightning is very infrequent.</td>
<td>&lt;15%</td>
<td>1-5</td>
<td>1-8</td>
<td>&lt;1</td>
</tr>
<tr>
<td>3</td>
<td>Cumulus clouds are common. Swelling and towering cumulus cover less than 2/10 of the sky. Thunderstorms are few, but 2 to 3 occur within the observation area. Light to moderate rain will reach the ground, and lightning is infrequent.</td>
<td>15% to 24%</td>
<td>6-10</td>
<td>9-15</td>
<td>1-2</td>
</tr>
</tbody>
</table>

140 Retrieved on 07.19.2021 from [https://graphical.weather.gov/definitions/defineLAL.html](https://graphical.weather.gov/definitions/defineLAL.html)
**Lightning Activity Level Scale**

<table>
<thead>
<tr>
<th>Rank</th>
<th>Cloud and Storm Development</th>
<th>Areal Coverage</th>
<th>Counts C/G per 5 Minutes</th>
<th>Counts C/G per 15 Minutes</th>
<th>Average C/G per Minute</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>Swelling cumulus and towering cumulus cover 2-3/10 of the sky. Thunderstorms are scattered but more than three must occur within the observation area. Moderate rain is commonly produced, and lightning is frequent.</td>
<td>25% to 50%</td>
<td>11-15</td>
<td>16-25</td>
<td>2-3</td>
</tr>
<tr>
<td>5</td>
<td>Towering cumulus and thunderstorms are numerous. They cover more than 3/10 and occasionally obscure the sky. Rain is moderate to heavy, and lightning is frequent and intense.</td>
<td>&gt;50%</td>
<td>&gt;15</td>
<td>&gt;25</td>
<td>&gt;3</td>
</tr>
<tr>
<td>6</td>
<td>Dry lightning outbreak. (LAL of 3 or greater with majority of storms producing little or no rainfall.)</td>
<td>&gt;15%</td>
<td>None</td>
<td>None</td>
<td>None</td>
</tr>
</tbody>
</table>

Based on those extent ranking factors identified (above), the planning committee ranks the extent of the lightning hazard as **LOW**.

**Extent: Thunderstorms that Generate Wind, Tornado, Hail, and Lightning Hazard Events**

Thunderstorms are not explicitly identified as a severe weather category for this hazard profile. However, they are responsible for most tornado, lightning, and hail hazard events – as well as a significant number of wind hazard events – across California and the CSU system. While individual thunderstorms affect relatively small areas, there are many instances in which thunderstorms can cluster together and/or travel in a line over long distances, producing significant damage over large geographic areas.

A thunderstorm is classified as “severe” when certain meteorological parameters within the thunderstorm are reached (i.e., damaging winds or speeds of 58 mph (50 knots) or greater, hail 1 inch in diameter or larger, and/or a tornado). However, there is currently no
established, objective severity scale for thunderstorms.\textsuperscript{141, 142} That said, according to the \textit{Glossary of Meteorology} published by the American Meteorological Society (AMS), a thunderstorm is reported as \textit{light}, \textit{medium}, or \textit{heavy} according to following five (5) characteristics:

- the nature of the lightning and thunder;
- the type and intensity of the precipitation, if any;
- the speed and gustiness of the wind;
- the appearance of the clouds; and
- the effect upon surface temperature.\textsuperscript{143}

A thunderstorm may also be classified by the nature of the overall weather situation in which the thunderstorm is produced, including:

- \textbf{Airmass Thunderstorm:} A thunderstorm produced by local convection within an unstable air mass;\textsuperscript{144}
- \textbf{Frontal Thunderstorm:} An individual thunderstorm the initiation of which results from rising motion associated with a front, or a thunderstorm within a convective system generated and organized by frontal rising motion;\textsuperscript{145} or
- \textbf{Squall-line Thunderstorm:} An individual thunderstorm included within a squall line (i.e., a continuous or broken line of active deep moist convection frequently associated with thunder).\textsuperscript{146, 147}

Based on the extent ranking factors identified (above) in relation to campus layout and operations, and past event low degree of severity, the planning committee ranks the extent of the thunderstorm hazard as \textbf{LOW}.  

\textsuperscript{141} Retrieved on 07.15.2021 from \url{https://www.noaa.gov/explainers/severe-storms}
\textsuperscript{142} Retrieved on 07.15.2021 from \url{https://www.weather.gov/safety/thunderstorm}
History of the Hazard

Severe weather hazards have been an annual occurrence in Los Angeles County and on the CSU Dominguez Hills campus. Historical data for these hazards are presented below.

Historical Storm Data Collection: NCEI Storm Events Database

Historical information regarding severe weather hazards can be found using The National Centers for Environmental Information (NCEI) Storm Events Database. The Storm Events Database contains searchable, archived National Weather Service (NWS) storm data from January 1950 to April 2021, as entered by NOAA’s National Weather Service (NWS). Due to changes in the data collection and processing procedures over time, there are unique periods of record available depending on the event type. For example, from 1950 through 1954, only tornado events were recorded; from 1955 through 1995, only tornado, thunderstorm wind, and hail events were introduced into the database; from 1996 to present, 45 additional event types are recorded, including high wind, strong wind, and lightning events. To obtain the most accurate portrayal of severe weather event frequency, searches of the Storm Events Database are conducted using data collected since 01/01/1996. As a reminder, all official severe weather event data is at the county level. Severe weather data do not exist at the campus level. That said, it may be the case that the campus to some degree experiences the severe weather events reported for the surrounding community and County.

Wind Hazards (excluding Tornadoes)

Information obtained from the NCEI Storm Event Database website shows the number of events (or occurrences) of wind hazard events in Los Angeles County since 1996. Here, wind hazard events include all “High Wind,” “Strong Wind,” and “Thunderstorm Wind” storm reports.

- High Wind: at least 387 events, or approximately 15.28 events per year
- **Strong Wind**: at least 3 events, or 0.12 events per year

- **Thunderstorm Wind**: at least 43 events, or approximately 1.70 events per year

- **All Wind Hazard events** (excluding Tornadoes): at least 427 events, or approximately 16.86 events per year. (Note: This was determined by conducting a simultaneous search of the component wind hazards of high wind, strong wind and thunderstorm wind.)

Overall, in Los Angeles County, there have been at least 427 wind hazard events since 1996, excluding tornadoes. That translates to an approximate average historical frequency of occurrence of 16.86 wind hazard events per year.

Please note: Differences between the sums of individual component severe weather hazard event Database searches (i.e., 433 events) and simultaneous Database searches of all severe weather hazard events (i.e., 427 events) may be due to the following factors: (1) multiple event types are in the same record (e.g., "Thunderstorm Wind/Hail" or "Hail/Tornado;" and/or (2) severe weather hazard events such as “Thunderstorm Wind” or “Hail” that are reported for Los Angeles County have actually taken place hundreds of miles away, but are erroneously recorded as events that have occurred in the County. When such a discrepancy arises, the more conservative aggregate hazard wind event value (i.e., 427 events) is used to determine the historical frequency of occurrence for the severe weather hazard. The origin of this discrepancy is unknown at this time.

**Historical Wind Hazard Losses for Los Angeles County since 1996**

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153 National Climatic Data Center. Storm Events Database. Retrieved 07.29.2021 from [https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28Z%29+Strong+Wind&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=LOS%2BANGELES%3A37&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA](https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28Z%29+Strong+Wind&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=LOS%2BANGELES%3A37&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA)

154 National Climatic Data Center. Storm Events Database. Retrieved 07.29.2021 from [https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Thunderstorm+Wind&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=LOS%2BANGELES%3A37&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA](https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Thunderstorm+Wind&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=LOS%2BANGELES%3A37&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA)

155 National Climatic Data Center. Storm Events Database. Retrieved 07.29.2021 from [https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28Z%29+High+Wind&eventType=%28Z%29+Strong+Wind&eventType=%28C%29+Thunderstorm+Wind&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=LOS%2BANGELES%3A37&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA](https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28Z%29+High+Wind&eventType=%28Z%29+Strong+Wind&eventType=%28C%29+Thunderstorm+Wind&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=LOS%2BANGELES%3A37&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA)

156 National Climatic Data Center. Storm Events Database. Retrieved 07.29.2021 from [https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28Z%29+High+Wind&eventType=%28Z%29+Strong+Wind&eventType=%28C%29+Thunderstorm+Wind&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=LOS%2BANGELES%3A37&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA](https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28Z%29+High+Wind&eventType=%28Z%29+Strong+Wind&eventType=%28C%29+Thunderstorm+Wind&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=LOS%2BANGELES%3A37&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA)

According to the NCEI Storm Events Database, the wind hazard events that Los Angeles County has experienced since 1996 have been costly. There have been 2 deaths and 4 injuries reported from wind hazard events (excluding tornadoes) in Los Angeles County; no property or crop damage has been reported.158

**Tornado Wind Hazards**

Information from the NCEI Storm Events Database indicates that since 1996, there have been 12 reported events of tornadoes in Los Angeles County, which translates to approximately 0.47 tornado events per year.159

The vast majority of tornado reports in Los Angeles County since 1996 have been of tornadoes with a severity rating of F0/EF0. Only one (1) or 12 of the tornadoes reported in has been rated F1/EF1 or higher (it was an F1 tornado that occurred in 1998); that translates to approximately 0.04 events of F1/EF1 tornadoes have occurred per year in Los Angeles County.160

**Historical Tornado Hazard Losses for Los Angeles County since 1996**

According to the NCEI Storm Events Database, the tornado hazard events that Los Angeles County has experienced since 1996 have been minimal. There have been no deaths, or property or crop damage reported; however, 1 injury has been reported.161 (Note: The F1/EF1 tornado that occurred in Los Angeles County in 1998 caused the one (1) reported injury.)

**Hail**

Information from the NCEI Storm Events Database indicates that since 1996, there have been 18 reported events of hail in Los Angeles County, which translates to approximately 0.71 hail events per year.162 (Note: The NCEI Storm Event Database search results for hail

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158 National Climatic Data Center. Storm Events Database. Retrieved 07.29.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28Z%29+High+Wind&eventType=%28Z%29+Strong+Wind&eventType=%28C%29+Thunderstorm+Wind&beginDate_mm=01&beginDate_dd=01&begin Date_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=LOS%2BANGELES%3A37 &hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA

159 National Climatic Data Center. Storm Events Database. Retrieved 07.29.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Tornado&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=LOS%2BANGELES%3A37&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA

160 National Climatic Data Center. Storm Events Database. Retrieved 07.29.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Tornado&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=LOS%2BANGELES%3A37&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA

161 National Climatic Data Center. Storm Events Database. Retrieved 07.29.2021 from

162 National Climatic Data Center. Storm Events Database. Retrieved 07.29.2021 from
indicate that there has been a total of 19 reports of hail since 1996. However, one (1) entry is for a hail event in San Diego County, over 100 miles away from Los Angeles County. The origin of this discrepancy is unknown at this time.

**Historical Hail Hazard Losses for Los Angeles County since 1996**

According to the NCEI Storm Events Database, the hail hazard events that Los Angeles County has experienced since 1996 have been costly. While there have been no deaths, injuries, or crop damages reported, property damage estimates have totaled approximately $3,500,000; the property damage estimate is from one (1) hail hazard event that occurred in 2003.¹⁶³ (Note: The San Diego County hail event that was included erroneously in the search results for hail events in Los Angeles County accounted for all reported injuries (i.e., 5) and crop damage estimates (i.e., $300,000) presented in the search results.)

**Lightning**

Information from the NCEI Storm Events Database indicates that since 1996, there have been 9 reported events of lightning in Los Angeles County, which translates to approximately **0.36** lightning events per year.¹⁶⁴

**Historical Lightning Hazard Losses for Los Angeles County since 1996**

According to the NCEI Storm Events Database, the lightning hazard events that Los Angeles County has experienced since 1996 have been costly. While no property or crop damages have been reported, there have been 2 deaths and 13 injuries attributed to lightning hazard events.¹⁶⁵

**All Severe Weather Hazard Events Recorded by the NCEI Storm Events Database**

¹⁶³ National Climatic Data Center. Storm Events Database. Retrieved 07.29.2021 from [https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Hail&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=LOS%2BANGELES%3A37&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA](https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Hail&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=LOS%2BANGELES%3A37&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA)

¹⁶⁴ National Climatic Data Center. Storm Events Database. Retrieved 07.29.2021 from [https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Lightning&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=LOS%2BANGELES%3A37&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA](https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Lightning&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=LOS%2BANGELES%3A37&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA)

¹⁶⁵ National Climatic Data Center. Storm Events Database. Retrieved 07.29.2021 from [https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Lightning&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=LOS%2BANGELES%3A37&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA](https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Lightning&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=LOS%2BANGELES%3A37&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA)
Information obtained from the NCEI Storm Events Database indicates that there have been 466 occurrences of the severe weather hazard in Los Angeles County. This translates to 18.39 severe weather hazard occurrences per year.¹⁶⁶

Please note: Differences between the sums of individual component severe weather hazard event Database searches (i.e., 472 events) and simultaneous Database searches of all severe weather hazard events (i.e., 466 events) may be due to the following factors: (1) multiple event types are in the same record (e.g., "Thunderstorm Wind/Hail" or "Hail/Tornado;" and/or (2) severe weather hazard events such as “Thunderstorm Wind” or “Hail” that are reported for Los Angeles County have actually taken place hundreds of miles away, but are erroneously recorded as events that have occurred in the County.¹⁶⁷ When such a discrepancy arises, the more conservative aggregate hazard wind event value (i.e., 466 events) is used to determine the historical frequency of occurrence for the severe weather hazard. The origin of this discrepancy is unknown at this time.

**Historical, Aggregated Severe Hazard Losses for Los Angeles County since 1996**

According to the NCEI Storm Events Database, the severe weather events that Los Angeles County has experienced since 1996 have been costly. There have been 4 deaths and 18 injuries, and property damage estimates have totaled approximately $3,500,000; no crop damage has been reported. *It is important to note that for all Los Angeles County severe weather hazard events recorded on the Storm Events Database, lightning has accounted for half of the deaths, and 13 out of 14 (92.9%) injuries reported. However, hail has accounted for all reported estimates of property damage.*

**Wind Hazards Not Included in the NCEI Storm Events Database**

*Santa Ana Winds*

Santa Ana wind events occur at least twice per month from October through April.¹⁶⁸ From 1948 to 2012, total of 2056 events on the 65-year record were recorded in the Southern California region, yielding an average of 32 occurrences per year. Typical Santa Ana wind events last 1–2 days and represent 27% of the occurrences, with events lasting

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¹⁶⁶ National Climatic Data Center. Storm Events Database. Retrieved 07.29.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Hail&eventType=%28Z%29+High+Wind&eventType=%28C%29+Lightning&eventType=%28Z%29+Strong+Wind&eventType=%28C%29+Thunderstorm+Wind&eventType=%28C%29+Tornado&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=LOS%2BANGELES%3A37&hailfilter=0.0&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA


up to 6 days accounting for 90% of all occurrences. The remaining 10% are made up almost entirely of events lasting between 7 and 12 days.169 170

Figure below shows the mean monthly frequency per season of Santa Ana Wind events detected from 1948 to 2012. Extreme Santa Ana wind events are shown in dark red, and are defined as those events that are above the 90th percentile of all events on record.

Figure 7-17: Mean Annual Frequency of Santa Ana Wind events (1948-2012)171 172

**Diablo Winds**

Diablo wind events occur approximately **2.5 events per year**. These events are most frequent during the fall and early winter seasons, with the highest frequency of events occurring in October. As a result, the highest risk of Diablo-wind-related damage is in the fall and early winter.\(^{173}\)

Figure below shows the monthly frequency of Diablo winds (along with average live fuel moisture content). The Diablo Wind data are derived from a 17-year climatology of San Francisco Bay Area regional surface weather stations.\(^{174}\)

Figure 7-18: Monthly Frequency of Diablo Winds and Average Live Fuel Moisture Content (Dashed Line)\(^{175}\)

**Sundowner Winds**

Strong sundowner wind events occur approximately **2-3 times per year**. These events can create sharp temperature rises, local gale force winds, and significant weather-related problems. Rare, “explosive” types of sundowner wind events occur about 6 times per century that present dangerous weather situations, generating extremely strong and hot winds that can reach gale force or higher speeds.\(^{176}\)

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\(^{174}\) Retrieved on 07.15.2021 from [https://www.fireweather.org/diablo-winds](https://www.fireweather.org/diablo-winds)

\(^{175}\) Retrieved on 07.13.2021 from [https://www.fireweather.org/diablo-winds](https://www.fireweather.org/diablo-winds)

Historical Frequency of All Severe Weather Hazards

Table below shows the average historical frequency of severe weather hazard events for Los Angeles County since 1996.

Table 7-35: Severe Weather Hazard Event

Frequencies for Los Angeles County since 1996.

<table>
<thead>
<tr>
<th>Severe Weather Hazard Category</th>
<th>Average Number of Hazard Events Per Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wind (Includes High, Strong and Thunderstorm Winds ONLY)</td>
<td>16.86</td>
</tr>
<tr>
<td>Tornado</td>
<td>0.47</td>
</tr>
<tr>
<td>Hail</td>
<td>0.71</td>
</tr>
<tr>
<td>Lightning</td>
<td>0.36</td>
</tr>
<tr>
<td>Diablo Wind*</td>
<td>2.5</td>
</tr>
<tr>
<td>Santa Ana Wind</td>
<td>32</td>
</tr>
<tr>
<td>Sundowner Wind*</td>
<td>2 to 3</td>
</tr>
</tbody>
</table>

* Note: The Diablo and Sundowner wind hazards are not present in Los Angeles County. They are included here for information purposes only.

Potential Impacts of the Hazard

The significance (or priority) of a hazard’s potential impacts is based primarily on the frequency and resulting damage caused by the hazard, including deaths/injuries and property, crop, and economic damage. All assets and people within CSU Dominguez Hills campus areas are at risk from the effects of severe weather.

Wind Hazards (Including Tornadoes)

Wind hazard events have the potential to impact people, property, and operations on campuses across the CSU system. People caught in the open during an extreme wind event are exposed to high winds and debris, and could be injured or killed.

The habitability of buildings can be compromised (by damaging roofs, windows, or other weak points in the building envelope), leading to long-term operational issues for the campus. As with most university campuses, space is always at a premium at the CSU
Dominguez Hills campus, and the loss of any currently utilized space due to building or structural damage would likely disrupt operations and the University’s mission.

Extreme wind events can result in power failure, which would impact the operation of the campus. Fallen tree limbs and other potential transportation hazards may also cause disruption to the surrounding community and limit ingress/egress to the campus.

According to the 2013 City of Carson Natural Hazards Mitigation Plan (NHMP), wind storms (including wind hazards and tornadoes) are considered to be significant, and therefore to have a significant potential impact on both the City of Carson and (by extension) the CSU Dominguez Hills campus.177 However, the 2019 County of Los Angeles All-Hazards Mitigation Plan is climate-change-focused, and does not include explicitly any severe weather hazards in its hazard identification profiles and risk assessments.178 To accommodate both hazard mitigation plans’ wind hazard assessments, as well as NCEI Storm Events Database historical frequencies, wind hazards (excluding tornadoes) are identified here as having medium significance for and moderate impact on both the City of Carson and (by extension) the CSU Dominguez Hills campus. However, tornado hazards are considered to have low significance for and minimal potential impact on the city and on the campus area.

**Hail**

Hail typically impacts property by damaging structures, cars, and utilities as it falls. Dents in cars, broken glass, and holes in roofs are common impacts of hail. Injuries to people from hail are less common, though they can happen, as hail is a hard object falling in an unpredictable manner at a fairly high rate of speed.

According to both the 2013 City of Carson Natural Hazards Mitigation Plan (NHMP) and the 2019 County of Los Angeles All-Hazards Mitigation Plan, hail hazards are not explicitly identified to be significant hazards. Therefore, the hail hazard is considered to be of low significance and therefore to have minimal potential impact on the City of Carson and (by extension) the CSU Dominguez Hills campus.179 180

**Lightning**

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Lightning strikes the United States about 20-25 million times a year.\textsuperscript{181} Although most lightning occurs in the summer months, people can be struck at any time of year. Since 1990, lightning has killed an average of 39 people each year in the United States, and hundreds more have been injured.\textsuperscript{182} Property losses due to lightning have been very costly across the U.S. For example, from 2005 through 2020, U.S. homeowner’s insurance claim payouts for lightning losses totaled approximately $15,334,600,000, or $958,412,500 worth of payouts per year.\textsuperscript{183} (Commercial claim payouts for lightning losses for the U.S. were not available.)

According to both the 2013 City of Carson Natural Hazards Mitigation Plan (NHMP) and the 2019 County of Los Angeles All-Hazards Mitigation Plan, lightning hazards are not considered to be significant enough to include as a profiled hazard. Therefore, the hail hazard is considered to be of low significance and therefore to have minimal potential impact on the City of Carson and (by extension) the CSU Dominguez Hills campus.\textsuperscript{184} 185

**Probability of Future Occurrence of the Hazard**

Areas throughout California, including all California State University (CSU) campuses, experience severe weather events every year, and future occurrences of such events are projected to increase in both their frequency and intensity. Unfortunately, neither the 2013 City of Carson Natural Hazards Mitigation Plan (NHMP) nor the 2019 County of Los Angeles All-Hazards Mitigation Plan has much (if any) explicit quantitative assessment on probability of future occurrence of severe weather hazards.\textsuperscript{186} 187 However, according to the NCEI Storm Events Database, some of the severe weather hazards have occurred in Los Angeles County at least once per year. Furthermore, while the severe weather hazard is a non-spatial hazard that affects all areas of the CSU Dominguez Hills campus equally, the smallest geographic unit of measurement for almost all official severe weather event data is at the county level. Because the severe weather data used in this assessment do not exist at the campus level, it is assumed that the severe weather probabilities for the

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\textsuperscript{183} Retrieved on 07.21.2021 from https://www.iii.org/table-archive/20504
CSU Dominguez Hills campus reflect those of the surrounding community and County identified in the Table below.

Based on the data available the NCEI Storm Events Database, the severe weather hazard is expected to occur on (or otherwise impact) the CSU Dominguez Hills campus at least once on an annual basis. Therefore, the probability of future occurrence of the severe weather hazard for CSU Dominguez Hills is HIGHLY LIKELY. See Table below for probabilities of future occurrence for component severe weather hazards for the City/County and the campus.

Table 7-36: Severe Weather Hazard Probabilities of Future Occurrence for Los Angeles County and CSU Dominguez Hills

<table>
<thead>
<tr>
<th>Severe Weather Hazard Category</th>
<th>Average Number of Hazard Events Per Year</th>
<th>Probability of Future Occurrence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wind (Includes High, Strong and Thunderstorm Winds ONLY)</td>
<td>16.86</td>
<td>Highly Likely</td>
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<tr>
<td>Tornado</td>
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<tr>
<td>Lightning</td>
<td>0.36</td>
<td>Possible</td>
</tr>
<tr>
<td>Diablo Wind**</td>
<td>2.5</td>
<td>Not Rated</td>
</tr>
<tr>
<td>Santa Ana Wind</td>
<td>32</td>
<td>Highly Likely</td>
</tr>
<tr>
<td>Sundowner Wind**</td>
<td>2 to 3</td>
<td>Not Rated</td>
</tr>
</tbody>
</table>

** Note: The Diablo and Sundowner wind hazards are not present in Los Angeles County, and therefore are not rated for probability of future occurrence. They are included here for information purposes only.

Vulnerability to the Hazard

People, structures, and assets on the CSU Dominguez Hills campus are all vulnerable to the impacts associated with severe weather. Infrastructure can be damaged or destroyed by hail, wind, tornadoes, thunderstorms, and lightning, which can result in service interruptions and outages. Structures can be damaged or destroyed by hail, wind, tornadoes, thunderstorms, and lightning. People can be injured or killed by lightning, flying debris, hail, or extreme wind events. The CSU Dominguez Hills campus also has vehicles, as well as off-campus conference and recreational facilities, that are all vulnerable to a severe weather event.
Estimate of Potential Losses

Severe weather is a non-spatial hazard that affects the entire CSU Dominguez Hills campus. Each of the hazards associated with severe weather can result in losses throughout the planning area.

All structures within the CSU Dominguez Hills campus are at risk from severe weather. There are approximately 54 buildings on the main campus that could be damaged by wind, hail, and/or lightning. If even a fraction of these assets were to be damaged, the resulting estimated losses would still be in the millions of dollars. The total replacement costs due to severe weather hazard are $142,163,477 for 37 buildings, and are unknown for the remaining 17 buildings. An analysis of projected dollar losses to campus buildings from severe weather as a percentage of building replacement costs is not currently available, though CSU leadership may pursue such data in the future.

The population at the CSU Dominguez Hills campus varies throughout the day. As of Fall, 2019, CSU Dominguez Hills had 17,027 students and 1,761 faculty and staff; all are at risk from severe weather events, with 18,788 being directly vulnerable in this scenario.188 189

Vulnerability Assessment Conclusions

Severe weather presents a variety of hazards to the CSU Dominguez Hills campus. People, assets, infrastructure, and vehicles can all be damaged by this hazard, and losses can quickly begin to rise. In the aggregate, severe weather is a frequently occurring hazard (mostly in the form of wind hazard events) that presents a variety of risks to CSU Dominguez Hills.

It is evident that the CSU Dominguez Hills campus has vulnerabilities to and risks from severe weather hazard incidents, and that pre-event planning, communication, and mitigation efforts should be implemented. Public education and outreach regarding areas of shelter that could be used by campus populations during severe weather events is considered by campus leadership to be one viable mitigation option. The campus planning committee will continue to look for feasible and cost-effective options for the mitigation of severe weather risks going forward.

Identified Data Limitations

Numerous federal agencies maintain a variety of records regarding losses associated with hazards. Unfortunately, no single source is considered to offer a definitive accounting of all losses. The Federal Emergency Management Agency (FEMA) maintains records on federal expenditures associated with declared major disasters. The US Army Corps of Engineers (USACE) and the Natural Resources Conservation Service (NRCS) collect data on losses during the course of some of their ongoing projects and studies.

188 Retrieved on 07.19.2021 from https://www2.calstate.edu/csusystem/about-the-csu/facts-about-the-csu/enrollment/Pages/default.aspx
Additionally, the National Oceanic and Atmospheric Administration’s (NOAA) National Centers for Environmental Information (NCEI) collects and maintains data about natural hazards in summary format, as well as occurrences, dates, injuries, deaths, and estimated costs for individual storm events. Many of these databases and other data collection services, including the NCEI, have inherent data limitations when searching for information at a scale as small as a single campus.

The best available data and records have been used throughout this section. Where no data or records exist or could be located, that deficiency is noted.
7.4 Social Resilience Assessment

Overview

While every person is vulnerable to risk, individuals from diverse populations such as those with access and functional needs are disproportionately more vulnerable and may be at a higher risk to harm in a disaster event. In addition to physical vulnerabilities, the intersectionality between physical hazard risks and population social vulnerabilities must be considered to holistically address overall campus risk.

As inclusivity is a high priority for CSU, addressing campus risk and resilience must be done through the lens of inclusion and equity. Addressing social vulnerability is an increasingly critical requirement of state and national doctrines and described in Section 4.4 of the HVRA Base Plan. Every individual of the campus’s richly diverse population group needs to have the capacity, skills, and knowledge in order to understand, access, and participate in risk reduction and disaster response in ways that are meaningful to their own unique situation. In a campus community, having strong social support networks and active involvement in community disaster responses may negatively or positively impact these opportunities and reduce the resilience-building process. This section offers a glimpse into the CSU Dominguez Hills campus’s unique social construct, population demographics, strengths and concerns and presents a high-level assessment of the resilience, coping capacities and potential social vulnerabilities of students, staff and faculty. The research variables that were asked are often considered sensitive subjects, and few are traditionally included in emergency management/hazard mitigation planning.

This social resilience assessment of college campuses is the first of its kind in the nation. The research methodology unfolded as the interviews with campuses progressed. The assessment data presented are not definitive or authoritative. The answers, analysis, and suggested trends are strictly indicators for potential social risk. They do not represent an accurate data capture as limitations on the data gathering process influenced an ability to provide accuracy. This assessment provides indications of increased risk, not accuracy of response or a true reflection of the situation of the campus. The information presented is to be considered in the context of the more detailed system-wide CSU social vulnerability assessment that is included in the baseline HVRA.

Campus-Identified Populations of Concern

During the campus interview, the following responses were provided when asked, “In considering the diverse population group(s) amongst student body, faculty and staff, which are of the most concern in your emergency management planning?”
Table 7-37: High level summary of campus populations of concern.

<table>
<thead>
<tr>
<th>Question</th>
<th>Campus Response</th>
</tr>
</thead>
</table>
| Which population groups amongst the student body, faculty, and staff, are of the most concern for physical and social vulnerabilities in emergency management planning? | • First generation students  
• Populations with disabilities                                    |
| Which population groups are most difficult to reach in an event?        | Non-English-speaking students and employees           |
| Which population groups have little/limited support networks if impacted by an event? | Students who rely on university housing               |

Resilience Variables Related to Campus Emergency Management

The interviewees were asked to reflect on a set of 12 variables for the campus populations of student, faculty and staff: homelessness (*housing insecurity*), food security, health and wellness, disability/access and functional needs (*AFN*), racial equity, digital equity, communications, international students, immigrants/immigration status issues (*undocumented, DACA, etc.*), LGBTQI (Lesbian Gay Bisexual Transgender Questioning (or queer) Intersex), and transportation dependency. They were also offered an opportunity to add any other factor they wanted to include. The following two questions were asked:

- Is this factor a particular issue of concern for emergency management on your campus? Responses were summarized as **Very High, High, Medium, Low**
- Is this factor reflected in the emergency plans and processes for your campus? Responses were summarized as **Yes, No, In Progress, NA**

In order to provide a high-level qualitative response for the answers, the approach of averaging response was taken. If conflicting answers were expressed by the interviewees,
the answer (code) was averaged out. A detailed explanation of the response averaging approach is included in the base HVRA.

Table 7-38: campus-specific emergency management issues of concern and inclusion in emergency management plans and processes.

<table>
<thead>
<tr>
<th>Issue of Concern</th>
<th>Plans &amp; Processes</th>
<th>Plans &amp; Processes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Homelessness (Housing Insecurity)</td>
<td>Very High</td>
<td>No</td>
</tr>
<tr>
<td>Food Security</td>
<td>Very High</td>
<td>No</td>
</tr>
<tr>
<td>Health &amp; Wellness</td>
<td>Very High</td>
<td>In Progress</td>
</tr>
<tr>
<td>AFN</td>
<td>Medium</td>
<td>No</td>
</tr>
<tr>
<td>Racial Equity</td>
<td>Low</td>
<td>No</td>
</tr>
<tr>
<td>Digital Equity</td>
<td>High</td>
<td>No</td>
</tr>
<tr>
<td>Comms.</td>
<td>Very High</td>
<td>No</td>
</tr>
<tr>
<td>International Students</td>
<td>Medium</td>
<td>No</td>
</tr>
<tr>
<td>Immigrants / Immigration Status</td>
<td>Very High</td>
<td>No</td>
</tr>
<tr>
<td>LGBTQI</td>
<td>Low</td>
<td>No</td>
</tr>
<tr>
<td>Transportation Dependency</td>
<td>Low</td>
<td>No</td>
</tr>
</tbody>
</table>

Qualitative Narrative: Campus Overview of Potential Resilience Vulnerabilities

The following are interview notes of interest:

- Nora Garcia is an experienced emergency management lead and understands the issues related to social vulnerability.
- Community approach and inclusion in the emergency management planning process and review has not happened there for the campus plans. Now working with the unions because they represent the areas of individuals in the front end. The whole community approach is biggest – with a newsletter tailored to specific groups.
- May need to start looking for translation services for emergency notification for the non-English speaking populations because have such a diverse pop with students and staff—it is a currently disconnect.
The housed population have basic needs folks who don’t have access to nutrition or technology, and nowhere else to go. Need a Plan B for housing. Many students are facing some type of homelessness.

Campus is located in a poor neighborhood, many low income; many African American and Hispanic make up the student base. Hispanics are number one student population and black is second.

Very high concerns regarding food security. Student affairs has a food drive; used to have a food pantry.

Health and wellness are definitely issues of concern. Developed six “Toro team” for employee success and wellness; has a chair to set up online platforms and opened up to expand to students; never been done (unclear meaning). Operates like a branch. Have “Nora’s Plan” – this sits in the campus COVID safety and response plan, and at some point, the plan will need to transition to the EOP. The group reports up to the EOC.

“EOC structure has been a lifesaver.”

Not sure they are doing enough for AFN.

Not sure if “they” are resourced enough, as the emergency manager is concerned.

Communications in COVID is only in English. Very concerned they are not doing enough to address non-English speaking populations. While not in the current plans, she has plans, including a marketing campaign.

The international students are aware of emergency management practices and resources.

Very concerned about immigrants/immigration status issues, different expectations, how a potential civil unrest related to the President’s order before revoked would have impacted the emergency management program. Concerned about fallout from issues related to the police chief sending messages to the community about ICE. Need to look at the fallout of the problems.

Campus High Hazards and Potentially Vulnerable Populations

This section provides a brief introduction to the link between socially vulnerable populations and a particular hazard type. While extensive research has been conducted on the impacts of hazards, not all linkages have been documented or published, and detail for finding them are beyond the scope of this assessment. It’s important to note, the intersectional nature of what makes an individual’s personal experience and resilience to an event is played out by unique factors for that individual or population. The nuanced social vulnerabilities often come from the social and physical environment in which a person is embedded.

In order to aid in further assessing campus resilience, below is a general description of the known impacts. From some hazards, the descriptions are robust, while others are only brief introductions.
Table 7-39: CSU Channel Islands *Highly Likely, Likely and Possible* Hazards

<table>
<thead>
<tr>
<th>Hazard</th>
<th>Future Occurrence Probability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Communicable Disease</td>
<td>Highly Likely</td>
</tr>
<tr>
<td>Drought</td>
<td>Highly Likely</td>
</tr>
<tr>
<td>Earthquake</td>
<td>Possible</td>
</tr>
<tr>
<td>Erosion</td>
<td>Highly Likely</td>
</tr>
<tr>
<td>Landslide</td>
<td>Possible</td>
</tr>
<tr>
<td>Power Outage</td>
<td>Likely</td>
</tr>
<tr>
<td>Wildfire</td>
<td>Unlikely (Fire); Likely (Smoke)</td>
</tr>
</tbody>
</table>

**Communicable Diseases**

*TBD*

**Drought**

The 2012-2016 drought had severe effects on two vulnerable sectors of our population: those in low-income brackets, and those, especially Native Americans, who rely on subsistence fishing for their livelihoods. Water bills increased throughout the state. Due to rising water prices, for the working poor, many have paid four to five percent of their income for water. Since many CSU students are commuters, and many living with families, future drought impacts may potentially affect a percentage of non-resident students. NASA’s modeling shows that future droughts are likely to last longer and be more intense, even leading to “megadroughts” in the western states. Fresh water supplies are predicted to be full of extremes, with both droughts and extreme precipitation events being more severe. The interrelationship between drought and other hazard conditions may lead to a set of secondary impacts. Drought conditions lead to water quality issues due to loss of drinking water, increased fire danger that leads to drought-induced fires and elevated AQI levels, as well as extreme heat or prolonged heat events.

---


**Earthquake**

Impacts on populations from earthquakes are complex, with long-term implications on social stability for all populations. In addition to the physical impact exposure during a no-notice earthquake event and the social and logistical challenges of a recovering community, an earthquake can have lasting impacts long afterwards due to post traumatic stress disorder (PTSD).

Socioeconomic vulnerabilities of populations at risk were analyzed in the hypothetical yet scientifically realistic earthquake sequence that is being used to better understand hazards for the San Francisco Bay region during and after a magnitude-7 earthquake (mainshock) on the Hayward Fault and its aftershocks. In this study, the at-risk populations located in areas of concentrated damage are anticipated to experience longer recovery trajectories, increased long term housing displacement, and transportation impacts due to dependencies on transit dependencies. When neighborhood schools close, families with school age children may move to other areas to keep their children in schools. Persons with access and functions needs are likely to be more dependent on access to functioning medical, social and personal health care services that would be overwhelmed by the event and therefore increasing their vulnerabilities. For the homeless populations, the loss of social community services and damages to shelters could add to protracted relocations. For the young and mobile populations who rent, the major disruption to housing, jobs and transit will also drive relocation. Widespread housing damage and preexisting housing market constraints will make it “extremely challenging” for the socially and economically vulnerable populations to find alternative housing near their home communities. Those who utilize interim and irregular housing for months and years after a disaster are more vulnerable to physical, social, and mental disorders, including suicide, substance abuse, and physical and verbal abuse. Aftershocks and post disaster conditions delay population return and increase outmigration.¹⁹²

**Erosion**

Risk from erosion relates to earthen and infrastructural losses. The degree of vulnerability to these events and their impacts depends on human behavior and the traditional social factors such as situational awareness, prior knowledge of hazards, social capital and decision-making capabilities, as well as increased vulnerability due to social factors, such as racial and economic disparities.

**Landslides**

Although infrastructural losses are of secondary importance to the risk to humans themselves, research investigating the vulnerability of people to landslides is rare. The many reasons for this lack of data are related to the fact that the collapse of occupied buildings which makes it a function of structural vulnerability and therefore, indirect. The degree of vulnerability to landslides by an individual considered at high risk, or even the general populations, also depends on human behavior, including many of the traditional social factors that are difficult to measure such as situational awareness, prior knowledge of hazards, and decision-making capabilities.\(^{193}\)

Landslides can result in primary lifeline failures through the loss of roads or power and communication lines. Transportation routes are often expensive to clean up, and prolonged obstruction can disrupt the movement of people and goods. Risk from landslide relates to earthen and infrastructural losses. The degree of vulnerability to these events and their impacts depends on human behavior and the traditional social factors such as situational awareness, prior knowledge of hazards, social capital and decision-making capabilities, as well as increased vulnerability due to social factors, such as racial and economic disparities.

**Power Outage/Public Safety Power Shutdowns (PSPS)**

Loss of power creates economic hardship to a region experiencing regular PSPS events, such as those experienced throughout the state over the recent years. Many businesses close, including gas stations, grocery stores, and local retail establishments. These impacts may deeply impact students dependent on support jobs, as well impacting family members of campus staff and faculty. PSPS increases risks to the public due to inability to use medical devices, spoilage of food and medicines, and disruption to infrastructure, such as supply of clean water and electricity used to run home medical equipment, such as lift chairs and ventilators.

**Wildfire**

Increased wildfire threat occurs especially in the end of fall, when conditions are driest, but before the winter rains have come; an east-to-west wind gusts exacerbate fire risk. Wildfire threats have the concomitant threat of Public Safety Power Shutoffs (PSPS). And, in the case of an actual wildfire, danger exists both from fire and from the smoke. Recent wildfires have demonstrated that some demographics are disproportionately affected. Native Americans are six times more likely to be affected than white people. Blacks and Hispanic people are 50 percent more vulnerable. These values take into account the likelihood of a community being affected and the greater difficulty of that community to recover. These statistics reflect the lack of access to resources to pay for insurance, to

rebuild and recover, to implement fire safety measures, and to access other resources. Price gouging after a fire (such as documented in Sonoma County after the 2017 Tubbs Fire) further exacerbates the disparity. Furthermore, the disabled and the elderly are at particular risk from extreme wildfire conditions, as they are often not as able to effectively evacuate. Of the 85 people who died in the Camp Fire in Butte in 2018, 62 of them were at least 65 years old.

Smoke from wildfires creates a significant public health threat. Especially vulnerable are individuals who have heart or lung issues, such heart disease, lung disease or asthma. Those most vulnerable include the medically fragile, elderly and children. Air Quality Indexes track the level of the following: particulate matter, surface levels of ozone, carbon monoxide, sulfur dioxide, and nitrogen dioxide. All of these can cause respiratory distress and harm lungs.

The California Department of Public Health reports the increased public health risks, and risk indicators that include: heat-related ED visits, populations living in wildfire areas, adults with multiple chronic conditions, populations living in poverty, race/ethnicity, outdoor workers, public transit access, air conditioner ownership and tree canopy.

Hazard Mitigation and Emergency Management Planning

exploring campus social risks and vulnerabilities, as well as to inform and to enhance holistic emergency management and hazard mitigation decision making, planning processes and future adaptive risk management strategies. By including the social resilience factors, mitigation investments may move beyond standardized planning and regulations, structure and infrastructure projects, and natural systems protections to embrace a more expanded, customized emergency operations plan and an education and outreach program unique to the campus.

A more robust social resilience inquiry is strongly encouraged to develop an accurate picture, based on methodical and scientific research-based data. Such an effort would be envisioned through both nuanced discussions with a variety of campus stakeholders and the invitation of nontraditional stakeholders to join in a collaborative resilience


partnership. Such a forward-leaning effort would be directly in keeping with CSU’s commitment to inclusion and equity in risk reduction.
**Section 08**  
California State University, East Bay

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8.1 University Profile

University History

California State University, East Bay (CSU East Bay) was founded in 1959 as Alameda State College. The school underwent several name changes until, in 1972, it earned university status and became CSU, Hayward. Its final name change came in 2005 after the school implemented a broader mission to serve the eastern San Francisco Bay Area. Today, the school includes four colleges and is classed as a Master's College and University by the Carnegie Institute. It is a federally recognized Hispanic-Serving Institution and from 2015-2017 was recognized by the Chronicle of Higher Education’s Almanac as the most diverse university in the mainland United States. CSU East Bay is designated as both a Hispanic-Serving Institution (HSI and an Asian American and Native American Pacific Islander-Serving Institution (AANAPISI).

University Governance

The campus president is the chief executive officer who oversees the administration of the entire university. The president manages campus operations and fundraising, sets campus priorities, and oversees the hiring and support of staff and faculty. The president also maintains a close working relationship with the CSU’s systemwide office, reporting to the chancellor and participating in the systemwide Executive Council.

The provost is the chief academic officer of the university, overseeing all academic affairs and programs of the university. The provost reports directly to the president.

The Academic Senate is made up of elected faculty members, administrators, staff members, and students who work together to determine policies and the Academic Calendar. The President and Provost are ex officio members. Six committees are included in the Senate, including three focused on academics, instruction, and research; one diversity and equity committee; one faculty affairs committee, and one budget and allocation committee.

University Mission

“Cal State East Bay welcomes and supports a diverse student body with academically rich, culturally relevant learning experiences which prepare students to apply their education to meaningful lifework, and to be socially responsible contributors to society. Through its educational programs and activities, the university strives to meet the educational needs and to contribute to the vitality of the East Bay, the state, the nation, and global communities.”

In addition to an academic plan, adopted in 2008 to highlight educational needs, priorities, and goals, the university has also implemented a diversity plan. The actions outlined in both plans are consistent with the university’s strategic goals around academic quality, inclusivity, community engagement, transparency, sustainability, social responsibility, and innovation.
University Location

CSU East Bay consists of three campuses: Hayward Hills, Concord, and Oakland Professional Development and Conference Center. The main campus is situated in the city of Hayward, a city of 159,000, just east of the Hayward fault. Located fewer than 20 miles south of Oakland, the area is characterized by a large number of manufacturing companies, including corporate headquarters, plants, and high-tech companies.

The city of Concord, 22 miles east of Oakland, is home to 122,000 people. It is largely a bedroom community for San Francisco and Oakland.

University Population

CSU East Bay typically enrolls approximately 15,000 students per semester. In fall 2019, the 14,705-student population was overwhelmingly made up of undergraduate degree seekers and female students. Latinx students made up 37.1% of all students, with Asian students making up the second most populous group at 22.6%.

In addition to the student population, the University is home to 1,763 faculty and staff.

8.2 Interim Final Rule for Hazard Vulnerability and Risk Assessment

Requirement §201.6(c)(2): The plan shall include a risk assessment that provides the factual basis for activities proposed in the strategy to reduce losses from identified hazards. Local risk assessments must provide sufficient information to enable the jurisdiction to identify and prioritize appropriate mitigation actions to reduce losses from identified hazards.

Requirement §201.6(c)(2)(i): [The risk assessment shall include a] description of the type...location and extent of all natural hazards that can affect the jurisdiction. The plan shall include information on previous occurrences of hazard events and on the probability of future hazard events.

Requirement §201.6(c)(2)(ii): [The risk assessment shall include a] description of the jurisdiction’s vulnerability to the hazards described in paragraph (c)(2)(i) of this section. This description shall include an overall summary of each hazard and its impact on the community.

Requirement §201.6(c)(2)(ii): [The risk assessment] must also address National Flood Insurance Program (NFIP) insured structures that have been repetitively damaged floods.

Requirement §201.6(c)(2)(ii)(A): The plan should describe vulnerability in terms of the types and numbers of existing and future buildings, infrastructure, and critical facilities located in the identified hazard area.

Requirement §201.6(c)(2)(ii)(B): [The plan should describe vulnerability in terms of an] estimate of the potential dollar losses to vulnerable structures identified in paragraph (c)(2)(ii)(A) of this section and a description of the methodology used to prepare the
estimating ..

**Requirement §201.6(c)(2)(ii)(C):** [The plan should describe vulnerability in terms of] providing a general description of land uses and development trends within the community so that mitigation options can be considered in future land use decisions.

**Requirement §201.6(c)(2)(iii):** For multi-jurisdictional plans, the risk assessment must assess each jurisdiction's risks where they vary from the risks facing the entire planning area.

### 8.3 Hazard Identification and Risk Assessment

#### Overview of California State University, East Bay History of Hazards

Numerous federal agencies maintain a variety of records regarding losses associated with hazards. Unfortunately, no single source is considered to offer a definitive accounting of all losses. The Federal Emergency Management Agency (FEMA) maintains records on federal expenditures associated with declared major disasters. The US Army Corps of Engineers (USACE) and the Natural Resources Conservation Service (NRCS) collect data on losses during the course of some of their ongoing projects and studies. Additionally, the National Oceanic and Atmospheric Administration’s (NOAA) National Centers for Environmental Information (NCEI) database collects and maintains data about natural hazards in summary format. The data includes occurrences, dates, injuries, deaths, and estimated costs. Many of these databases and other data collection services, including the NCEI, have inherent data limitations when searching for information at a university scale.

The best available data and records were used throughout this assessment.

#### Hazard Identification

As part of the initial hazard identification process, the Campus Assessment Team considered potential hazards with the most chance to significantly affect the planning area. The hazards include those that have occurred in the past and may occur in the future. A variety of sources were used to develop the list of hazards considered including national, regional, and local sources such as emergency operations plans, FEMA’s *How-To Series*, websites, published documents, databases, and maps, as well as discussion among the Campus Assessment Team members.

In the initial phase of the planning process, the Campus Assessment Team considered XX hazards and the risks they create for the University and its material assets, population, and operations. The hazards initially considered, and the determinations as to the treatment of those hazards, are shown in Table 8-1 (following).

### Table 8-1: Hazard Identification Determinations
<table>
<thead>
<tr>
<th>Hazard</th>
<th>Determination (Yes/No)</th>
<th>Reason for Determination</th>
<th>Future Occurrence Probability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Communicable Disease</td>
<td>Yes</td>
<td>Hazard of concern for campus</td>
<td>Highly Likely</td>
</tr>
<tr>
<td>Dam and Levee Failure</td>
<td>Yes</td>
<td>Hazard of concern for campus</td>
<td>Unlikely</td>
</tr>
<tr>
<td>Drought</td>
<td>Yes</td>
<td>Hazard of concern for campus</td>
<td>Highly Likely</td>
</tr>
<tr>
<td>Earthquake</td>
<td>Yes</td>
<td>Hazard of concern for campus</td>
<td>Possible</td>
</tr>
<tr>
<td>Erosion</td>
<td>Yes</td>
<td>Hazard of concern for campus</td>
<td>Highly Likely</td>
</tr>
<tr>
<td>Extreme Temperature</td>
<td>No</td>
<td>Not a hazard of concern for campus</td>
<td>N/A</td>
</tr>
<tr>
<td>Flood</td>
<td>Yes</td>
<td>Hazard of concern for campus</td>
<td>Unlikely</td>
</tr>
<tr>
<td>Hazardous Materials</td>
<td>Yes</td>
<td>Hazard of concern for campus</td>
<td>Unlikely</td>
</tr>
<tr>
<td>Landslide</td>
<td>Yes</td>
<td>Hazard of concern for campus</td>
<td>Possible</td>
</tr>
<tr>
<td>Power Outage</td>
<td>Yes</td>
<td>Hazard of concern for campus</td>
<td>Likely</td>
</tr>
<tr>
<td>Sea Level Rise</td>
<td>No</td>
<td>Not a hazard of concern for campus</td>
<td>N/A</td>
</tr>
<tr>
<td>Tsunami</td>
<td>No</td>
<td>Not a hazard of concern for campus</td>
<td>N/A</td>
</tr>
<tr>
<td>Volcano</td>
<td>Yes</td>
<td>Hazard of concern for campus</td>
<td>Unlikely</td>
</tr>
<tr>
<td>Wildfire</td>
<td>Yes</td>
<td>Hazard of concern for campus</td>
<td>Possible (Fire); Possible (Smoke)</td>
</tr>
</tbody>
</table>

**Future Occurrence Probability**

In order to determine the probability of future occurrences of each hazard profiled, the following scale was developed:

Highly Likely- 76%-100% that the hazard would occur annually.
Likely- 50%-75% that the hazard would occur annually.
Possible- 11%-49% that the hazard would occur each annually.
Unlikely- 0%-10% that the hazard would occur each annually.
Communicable Disease

Description of the Hazard

Communicable diseases are illnesses that occur due to infectious agents or their toxic products and are infectious due to their potential of transmission from one person or species to another by a replicating agent.¹ They may be transmitted from a reservoir to a susceptible host either directly as from an infected person or animal or indirectly through the agency of an intermediate plant or animal host, vector, or the inanimate environment. Communicable diseases are clinically evident illness resulting from the presence of pathogenic microbial agents, including pathogenic viruses, pathogenic bacteria, fungi, protozoa, multi-cellular parasites, and aberrant proteins known as prions.² The degree of spread of a communicable disease depends on both the ability of an organism to enter, survive and multiply in the host and the comparative ease with which the disease is transmitted to other hosts.³

Some ways in which communicable diseases spread are by:

- travel through the air, such as tuberculosis, measles, or COVID-19;
- physical contact with an infected person, such as through touch (staphylococcus), sexual intercourse (gonorrhea, HIV), fecal/oral transmission (hepatitis A), or droplets (influenza, TB, COVID-19);
- contact with a contaminated surface or object (Norwalk virus), food (salmonella, E. coli), blood (HIV, hepatitis B), or water (cholera); and,
- bites from insects or animals capable of transmitting the disease (mosquito: malaria and yellow fever; flea: plague).⁴

Collectively, the twenty-three (23) campuses and Chancellor’s Office of the California State University (CSU) system have identified nine (9) communicable disease hazards that have had significant impacts on their respective student, faculty, and staff populations. Of these communicable diseases, COVID-19 is considered to be the most prominent and widespread agent across all CSU campuses. (See Table 8-2 below.)

¹ California Legislative Information. Health and Safety Code – HSC. Print. Retrieved 03.22.2021 from: https://leginfo.legislature.ca.gov/faces/codes_displaySection.xhtml?lawCode=HSC&sectionNum=120290.&text=(2)%20%E2%80%9CInfectious%20or%20communicable,has%20significant%20public%20health%20implications
Table 8-2: Communicable Diseases at Identified CSU Campuses

<table>
<thead>
<tr>
<th>Collective List of Communicable Diseases Identified by All CSU Campuses</th>
<th>Number of CSU Campuses (Including Chancellor’s Office) Identifying Communicable Disease Having Significant Impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>COVID-19 (SARS-CoV-2)</td>
<td>24</td>
</tr>
<tr>
<td>Meningitis</td>
<td>7</td>
</tr>
<tr>
<td>Measles</td>
<td>6</td>
</tr>
<tr>
<td>Influenza (Including H1N1/Swine Flu)</td>
<td>6</td>
</tr>
<tr>
<td>Tuberculosis</td>
<td>5</td>
</tr>
<tr>
<td>Norovirus</td>
<td>4</td>
</tr>
<tr>
<td>Mumps</td>
<td>2</td>
</tr>
<tr>
<td>E. Coli</td>
<td>2</td>
</tr>
<tr>
<td>Sexually Transmitted Diseases (STDs)</td>
<td>2</td>
</tr>
</tbody>
</table>

(Source: Interviews with CSU campus staff at CSU campuses and at CSU Chancellor’s Office.)

With the exception of COVID-19, there is variability among CSU campuses regarding which communicable diseases have had the greatest impact on individual campus communities. Table 8-3 shows the communicable disease hazards that have had the greatest impact on each CSU campus.

Table 8-3: Communicable Disease Hazards at CSU Campuses with Greatest Impact

<table>
<thead>
<tr>
<th>CSU Campus</th>
<th>Identified Communicable Disease Hazards with the Greatest Impact on CSU Campus</th>
</tr>
</thead>
<tbody>
<tr>
<td>CSU Bakersfield</td>
<td>COVID-19, Meningitis</td>
</tr>
<tr>
<td>CSU Channel Islands</td>
<td>COVID-19, Measles</td>
</tr>
<tr>
<td>Chico State</td>
<td>COVID-19, Tuberculosis</td>
</tr>
<tr>
<td>CSU Dominguez Hills</td>
<td>COVID-19</td>
</tr>
<tr>
<td>Cal State East Bay</td>
<td><strong>COVID-19, Meningitis</strong></td>
</tr>
<tr>
<td>Fresno State</td>
<td>COVID-19, Meningitis, Tuberculosis</td>
</tr>
<tr>
<td>Cal State Fullerton</td>
<td>COVID-19, Influenza</td>
</tr>
<tr>
<td>Humboldt State</td>
<td>COVID-19, Measles, Norovirus, Influenza, STDs</td>
</tr>
</tbody>
</table>
Cal State Long Beach   COVID-19
Cal State LA          COVID-19, E. coli, Measles
Cal Maritime          COVID-19
CSU Monterey Bay      COVID-19
CSUN (Northridge)     COVID-19, Measles
Cal Poly Pomona       COVID-19, Influenza (Swine Flu - H1N1)
Sacramento State      COVID-19
Cal State San Bernardino COVID-19, Tuberculosis
San Diego State       COVID-19, Meningitis, Mumps
San Francisco State   COVID-19
San José State        COVID-19, H1N1
Cal Poly San Luis Obispo  COVID-19, Meningitis, Norovirus
CSU San Marcos        COVID-19
Sonoma State          COVID-19, H1N1, Norovirus
Stanislaus State      COVID-19, Tuberculosis
Office of the Chancellor  COVID-19
CSU System-Wide       COVID-19, Meningitis, Measles, Tuberculosis, Influenza-Swine Flu-H1N1, Mumps, Norovirus, E. coli, STDs

(Source: Interviews with CSU campus staff at CSU campuses and at CSU Chancellor’s Office.)

Descriptions of Identified Communicable Disease Hazards at CSU East Bay

CSU East Bay has identified two (2) communicable disease hazards that have had the greatest impact on campus – COVID-19 and Meningitis. The following are brief descriptions of the communicable disease hazards at CSU East Bay.

COVID-19 (SARS-CoV-2)

Coronaviruses are a family of viruses that can cause illnesses such as the common cold, severe acute respiratory syndrome (SARS) and Middle East respiratory syndrome (MERS). In 2019, a new coronavirus was identified as the cause of a disease outbreak that originated in China. This virus is now known as the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2). The disease it causes is called Coronavirus Disease 2019 (COVID-19). In March 2020, the World Health Organization (WHO) declared the COVID-19 outbreak a pandemic.
Signs and symptoms of coronavirus disease 2019 (i.e., COVID-19) may appear two to 14 days after exposure. Common signs and symptoms can include fever, cough, and tiredness. Early symptoms of COVID-19 may also include a loss of taste or smell.

The virus that causes COVID-19 spreads easily among people, and more continues to be discovered over time about how it spreads. Data has shown that the COVID-19 virus spreads mainly from person to person among those in close contact (within about 6 feet, or 2 meters). The virus is transmitted by respiratory droplets being released when someone with the virus coughs, sneezes, breathes, sings or talks. These droplets can be inhaled or land in the mouth, nose or eyes of a person nearby. In some situations, the COVID-19 virus can spread by a person being exposed to small droplets or aerosols that stay in the air for several minutes or hours (i.e., airborne transmission). It's not yet known how common it is for the virus to spread this way. The COVID-19 virus can also spread if a person touches a surface or object with the virus on it and then touches his or her mouth, nose or eyes; however, this is not considered to be a main way it spreads.

The severity of COVID-19 symptoms can range from very mild to severe. Some people may have only a few symptoms, and some people may have no symptoms at all. However, some people may experience worsened symptoms, such as worsened shortness of breath and pneumonia. People who are older have a higher risk of serious illness from COVID-19, and the risk increases with age. People who have existing medical conditions also may have a higher risk of serious illness from COVID-19. In some cases, the disease can cause severe medical complications and may even lead to death.⁵

**Meningitis**

Meningitis is an inflammation of the fluid and membranes (meninges) surrounding the brain and spinal cord. The swelling from meningitis typically triggers signs and symptoms such as headache, fever and a stiff neck. Early meningitis symptoms may mimic the flu (influenza). Symptoms may develop over several hours or over a few days.

Most cases of meningitis in the United States are caused by a viral infection, but bacterial, parasitic and fungal infections are other causes. Some cases of meningitis improve without treatment in a few weeks. Others can be life-threatening and require emergency antibiotic treatment. Bacterial meningitis is particularly serious and can be fatal within days without prompt antibiotic treatment. Delayed treatment also increases the risk of permanent brain damage or death.⁶

**Location of the Hazard**

Communicable diseases have the potential to affect the entire CSU East Bay planning area equally. As a result, the communicable disease hazard can be found at the CSU East Bay (CSUEB) main campus located in Hayward, CA (Alameda County), at the CSUEB

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satellite campus in Concord, CA (Contra Costa County) and at the CSUEB Oakland Professional Development and Conference Center. Because of the ubiquitous nature of many communicable diseases, students, faculty, staff at (and visitors to) all three (3) CSUEB locations are at risk of exposure to the communicable disease hazard.\(^7\)

**CSU Student Housing Locations and Populations**

Although CSU-campus-owned student housing opportunities have been severely limited due to the COVID-19 pandemic, this situation is temporary. Eventually, students will be allowed back on campus at full capacity, and many of these students will be living in campus-owned housing. When this occurs, over 53,000 students (i.e., just over 11\% of the CSU total enrollment) will be at increased risk of exposure to communicable disease hazards, owing to the “close-quarters” living arrangements in student housing. For CSU – East Bay, approximately 15\% of its 14,705 enrolled students or 2,206 students reside in student housing. Table 8-4 shows the number of students that were living in CSU-campus-owned housing in Fall 2019, prior to the COVID-19 pandemic.\(^8\),\(^9\)

Table 8-4: CSU Campus Student Housing Populations

<table>
<thead>
<tr>
<th>CSU Campus</th>
<th>Approximate Enrollment Population (Fall 2019)</th>
<th>Approximate Proportion of Students Living in School Housing</th>
<th>Approximate School Housing Population (Fall 2019)</th>
</tr>
</thead>
<tbody>
<tr>
<td>CSU Bakersfield</td>
<td>11,199</td>
<td>5%</td>
<td>560</td>
</tr>
<tr>
<td>CSU Channel Islands(^10)</td>
<td>7,093</td>
<td>6%</td>
<td>432</td>
</tr>
<tr>
<td>Chico State</td>
<td>17,019</td>
<td>2%</td>
<td>340</td>
</tr>
<tr>
<td>CSU Dominguez Hills</td>
<td>17,027</td>
<td>5%</td>
<td>851</td>
</tr>
<tr>
<td><strong>Cal State East Bay</strong></td>
<td><strong>14,705</strong></td>
<td><strong>15%</strong></td>
<td><strong>2,206</strong></td>
</tr>
<tr>
<td>Fresno State</td>
<td>24,139</td>
<td>5%</td>
<td>1,207</td>
</tr>
<tr>
<td>Cal State Fullerton</td>
<td>39,868</td>
<td>6%</td>
<td>2,392</td>
</tr>
<tr>
<td>Humboldt State</td>
<td>6,983</td>
<td>9%</td>
<td>628</td>
</tr>
<tr>
<td>Cal State Long Beach</td>
<td>38,074</td>
<td>9%</td>
<td>3,427</td>
</tr>
<tr>
<td>Cal State LA</td>
<td>26,361</td>
<td>4%</td>
<td>1,054</td>
</tr>
</tbody>
</table>


### Extent of the Hazard

Various communicable diseases are categorized by the Center for Disease Control and Prevention (CDC) by levels of containment called Biosafety Levels (or BSLs). The higher the BSL, the greater the level of containment and level of effort necessary to prevent transmission of the disease, and therefore the greater the hazard.

Biosafety Levels prescribe procedures and levels of containment for a particular microorganism or material (including research involving recombinant or synthetic nucleic acid molecules) and procedures associated with that containment. BSLs also consider primary barriers (e.g., biosafety cabinets), secondary barriers, facility design, air handling, laboratory security, etc. BSLs are graded from 1 to 4; as the BSL increases so does the relative risk of the agent/procedures as well the stringency of procedures and facility design.

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Figure 8-1 describes the different BSLs and provides examples of communicable diseases that would typically fall into these classifications, as well as the typical protections that would be necessary to prevent transmission of each of the diseases.

Figure 8-1: Biosafety Levels (BSLs)\textsuperscript{13}

The Extent of CSU East Bay Communicable Disease Hazards Except COVID-19:
Before the COVID-19 pandemic, there were cases of Meningitis at CSU East Bay. Meningitis would be classified at the BSL-2 containment level.\textsuperscript{14}

The Extent of CSU East Bay COVID-19 Communicable Disease Hazard:
As a microorganism, the SARS-CoV-2 (COVID-19) virus requires a high level of containment. It is therefore classified at BSL-3.\textsuperscript{15}

History of the Hazard
Over an approximately one-year period, from mid-March 2020 to March 23, 2021, there were a reported 29 cases of COVID-19 at CSU East Bay. CSU-campus-specific COVID-19 case data for CSU East Bay can be found in the “History of the Hazard” section below.

Each CSU campus is an integral part of the surrounding community. Any event that occurs on a CSU campus has an effect on both the adjacent areas of campus and on the community-at-large – and vice-versa. Communicable disease hazard events are no exception. Most communicable disease data are maintained by at the state and at the county levels and are not generally available at the municipal or campus levels, unless (a) the CSU campus falls under the jurisdiction of a city-level health department, or (b) a geographically specific outbreak occurs on campus or in the local community. The exception to this is the current COVID-19 pandemic, where both campus and County-level case data have been collected. As a result, it is important to provide COVID-19 case statistics for both CSU campuses and the counties where CSU campus assets are located.

Tables 8-5 and 8-6 show county-level COVID-19 Case data for CSU East Bay. These case data are updated on at least a weekly basis. (Please note that the COVID-19 case numbers here may not reflect the most recent updates.)

Table 8-5: Campus-Level COVID-19 Case Data for CSU East Bay (as of 03.17.2021)\(^\text{16}\)

<table>
<thead>
<tr>
<th>Campus</th>
<th>Students</th>
<th>Faculty/Staff</th>
<th>TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hayward</td>
<td>13</td>
<td>15</td>
<td>28</td>
</tr>
<tr>
<td>Concord</td>
<td>1</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Oakland Center</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>14</strong></td>
<td><strong>15</strong></td>
<td><strong>29</strong></td>
</tr>
</tbody>
</table>

\(^*\)Based on last contact on campus where 1) a public health agency has confirmed via a COVID-19 test that a member of the university community has the virus AND 2) the individual was recently on campus or at another university-related instructional site.

\(^**\)Note, however, that between March 2020 and August 16, 2020, Cal State East Bay was notified of sixteen (16) students, faculty or staff members that reported a confirmed COVID-19 test. CSUEB is in contact with local health officials and are following national guidelines related to COVID-19.

Table 8-6: County-Level COVID-19 Case Data for Alameda and Contra Costa Counties and the City of Berkeley (as of 03.18.2021)\(^\text{17,18}\)

<table>
<thead>
<tr>
<th>County</th>
<th>Total Cases</th>
<th>Total Deaths</th>
<th>TOTALS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alameda County (incl. City of Berkeley)</td>
<td>82,593</td>
<td>1,369</td>
<td>83,962</td>
</tr>
</tbody>
</table>


Potential Impacts of the Hazard

Communicable disease outbreaks and pandemics potentially have (and will continue to have) direct impact on life, health, and safety across the CSU system (including the CSU – East Bay campus). The extent of this impact is contingent on the type of infection or contagion, the severity of the outbreak, and the speed at which it is transmitted. Property and infrastructure integrity may be affected if large portions of the campus population contract communicable diseases at the same time and are therefore unable to perform maintenance, operations, and educational tasks. This would be particularly disruptive if those impacted are first responders or other essential personnel. Long-term outbreaks affecting large numbers of CSU – East Bay students could result in cancelled classes, delayed matriculation, or other disruptions to the CSU System’s mission. This has already occurred with the current COVID-19 pandemic, and could occur again with more virulent strains of communicable diseases, including COVID-19.

Communicable disease hazards found across the CSU system (including CSU – East Bay) vary both by level of containment (BSL) (described previously) and by level of individual/public health risk, or Risk Group (RG) level. While BSLs describe the procedures and required levels of containment in a laboratory setting, Risk Groups (RGs) reflect the potential effects of disease exposure on humans or animals. Like BSLs, RGs range from Level 1 (RG1) to Level 4 (RG4), with Level 1 (RG1) posing minimal risk to healthy individuals and public health and Level 4 (RG4) posing a very serious or extreme risks to individuals and public. BSLs generally correlate with Risk Group (RG) Levels (e.g., a RG2 agent is worked with at BSL-2), but there are exceptions (e.g., production volumes, high-risk procedures, etc.).

The World Health Organization’s (WHO) Laboratory Biosafety Manual, 3rd ed., NIH Guidelines, categorizes Risk Groups (RGs) in the following way:

Table 8-7: WHO Risk Group Categorization

<table>
<thead>
<tr>
<th>Risk Group (RG)</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>RG1</td>
<td>Rarely associated with disease in healthy adult humans or animals and pose no-to-little public health risk (e.g.,</td>
</tr>
</tbody>
</table>

---


Saccharomyces cerevisiae, E. coli K-12 strain derivatives often used for recombinant/molecular biology, many environmental organisms

<table>
<thead>
<tr>
<th>Level</th>
<th>Examples</th>
<th>Typical Protection to Prevent Transmission</th>
</tr>
</thead>
<tbody>
<tr>
<td>RG2</td>
<td>Associated with mild to moderate disease for which preventative measures or post exposure treatments are often available; public health impact is limited (e.g., Streptococcus pyogenes, Salmonella, hepatitis B virus)</td>
<td></td>
</tr>
<tr>
<td>RG3</td>
<td>Associated with serious to lethal human disease for which preventative vaccines or post-exposure therapies may be scarce. Public health impact is limited-to-moderate (e.g., Mycobacterium tuberculosis, hantaviruses, West Nile virus, SARS)</td>
<td></td>
</tr>
<tr>
<td>RG4</td>
<td>Associated with serious to lethal human disease for which preventative vaccines or post exposure therapies are not usually available. Public health impact is high (e.g., Ebola virus, Marburg virus, smallpox virus, etc.)</td>
<td></td>
</tr>
</tbody>
</table>

Table 6-7 describes the four (4) Risk Group Levels (RGs), and provides examples of communicable diseases that would typically fall in to these classifications, and the typical protections that would be necessary to prevent transmission of the disease. It is important to note that all but two (2) communicable disease hazards identified by CSU campuses fall under either the lower-risk RG1 or RG2 categories. COVID-19 and tuberculosis are the two (2) communicable diseases fall under the higher-risk RG3 category. However, with the advent of the recently-developed COVID-19 vaccine, and with the expectation of an increasingly robust vaccine supply, it is possible that the RG level for COVID-19 could be lowered in the future, thereby reducing both the extent and the potential impact of COVID-19.

Table 8-8: Risk Group Levels (RGs) with Example Diseases and Recommended Precautions

<table>
<thead>
<tr>
<th>Level</th>
<th>Examples</th>
<th>Typical Protection to Prevent Transmission</th>
</tr>
</thead>
<tbody>
<tr>
<td>Risk Group Level I</td>
<td>E. Coli</td>
<td>Precautions are minimal, most likely involving gloves and some sort of facial protection. Usually, contaminated materials are left in open (but separately indicated) waste receptacles. Decontamination procedures for this level are similar in most respects to modern precautions against everyday viruses (i.e.: washing one’s hands</td>
</tr>
</tbody>
</table>

Risk Group Level II

<table>
<thead>
<tr>
<th>Chicken Pox</th>
<th>Hepatitis A, B, C</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lyme disease</td>
<td>Salmonella</td>
</tr>
<tr>
<td>Mumps</td>
<td>Measles</td>
</tr>
<tr>
<td>Malaria</td>
<td>Scrapie</td>
</tr>
<tr>
<td>Dengue Fever</td>
<td>HIV</td>
</tr>
</tbody>
</table>

These bacteria and viruses cause mild disease in humans or are difficult to contract via aerosol. Routine diagnostic work with clinical specimens can be done safely at BSL-2, using BSL-2 practices and procedures.

Risk Group Level III

<table>
<thead>
<tr>
<th>Anthrax</th>
<th>West Nile Virus</th>
</tr>
</thead>
<tbody>
<tr>
<td>SARS Virus (Including COVID-19)</td>
<td>Tuberculosis</td>
</tr>
<tr>
<td>Typhus</td>
<td>Yellow Fever</td>
</tr>
<tr>
<td>Hantaviruses</td>
<td>Avian Flu</td>
</tr>
</tbody>
</table>

These bacteria and viruses cause severe to fatal disease in human, but vaccines or other treatments do exist to combat them. Laboratory personnel have specific training in handling pathogenic and potentially lethal agents and are supervised by competent scientists who are experienced in working with these agents. This is considered a neutral or warm zone.

Risk Group Level IV

<table>
<thead>
<tr>
<th>H5N1 (Bird Flu)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dengue Hemorrhagic Fever</td>
</tr>
<tr>
<td>Marburg Virus</td>
</tr>
<tr>
<td>Ebola Virus</td>
</tr>
<tr>
<td>Smallpox</td>
</tr>
</tbody>
</table>

These viruses and bacteria cause severe to fatal disease in humans, for which vaccines or other treatments are not available. When dealing with biological hazards at this level the use of a Hazmat suit and a self-contained oxygen supply is mandatory. The entrance and exit of a BSL-4 lab will contain multiple showers, a vacuum room, an ultraviolet light room, autonomous detection system, and...
other safety precautions designed to destroy all traces of the biohazard. Multiple airlocks are employed and are electronically secured to prevent both doors opening at the same time. All air and water service going to and coming from a BSL- 4 lab will undergo similar decontamination procedures to eliminate the possibility of an accidental release.

Probability of Future Occurrence of the Hazard

There are significant data limitations regarding non-COVID-19 communicable disease cases, as the information thereof is outdated, anecdotal, and/or inadequate. As a result, it is not feasible to provide quantitative probabilities of future occurrence for non-COVID-19 communicable disease hazards. However, based on the limited data, it is feasible to present qualitative probabilities of future occurrence based on ranges of communicable disease frequency.

Table 8-9 shows a probability scale of future occurrence for the nine (9) communicable disease hazards profiled in this assessment. This scale is divided into four (4) levels of probability:

Table 8-9: Likelihood of Future Hazard Occurrence

<table>
<thead>
<tr>
<th>Likelihood</th>
<th>Parameters for Determining Likelihood</th>
</tr>
</thead>
<tbody>
<tr>
<td>Highly Likely</td>
<td>76 – 100% probability that hazard will occur annually (high to very high frequency)</td>
</tr>
<tr>
<td>Likely</td>
<td>50 – 75% probability that hazard will occur annually (moderate to high frequency)</td>
</tr>
<tr>
<td>Possible</td>
<td>11 – 49% probability that hazard will occur annually (low to moderate frequency)</td>
</tr>
<tr>
<td>Unlikely</td>
<td>0 – 10% probability that hazard will occur annually (very low to low frequency)</td>
</tr>
</tbody>
</table>

Due to significant data limitations surrounding non-COVID communicable diseases, the probability of future occurrence of CSU-system-wide communicable disease is measured by the proportion of campuses that have identified a particular communicable disease as having an impact on the campus community. In this measure, the more frequent a communicable disease is seen as impactful CSU-wide, the greater the probability of future occurrence.

Note: Each communicable disease’s system-wide probability ranking (below) reflects the ranking at the individual CSU campus level unless noted otherwise.
Table 8-10: Probability of Future Occurrence of Communicable Disease Hazard for CSU System

<table>
<thead>
<tr>
<th>Collective List of Communicable Diseases Identified by All CSU Campuses</th>
<th>Number of CSU Campuses (Including Chancellor’s Office) Identifying Communicable Disease Having Significant Impact</th>
<th>Proportion of CSU Campuses Identifying Communicable Disease as Having Significant Impact System-Wide</th>
<th>CSU System-Wide Probability Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>COVID-19 (SARS-CoV-2)</td>
<td>24</td>
<td>1.00</td>
<td>Highly Likely</td>
</tr>
<tr>
<td>Meningitis</td>
<td>7</td>
<td>0.29</td>
<td>Possible</td>
</tr>
<tr>
<td>Measles</td>
<td>6</td>
<td>0.25</td>
<td>Possible</td>
</tr>
<tr>
<td>Influenza (Including H1N1/Swine Flu)</td>
<td>6</td>
<td>0.25</td>
<td>Possible</td>
</tr>
<tr>
<td>Tuberculosis</td>
<td>5</td>
<td>0.21</td>
<td>Possible</td>
</tr>
<tr>
<td>Norovirus</td>
<td>4</td>
<td>0.17</td>
<td>Possible</td>
</tr>
<tr>
<td>Mumps</td>
<td>2</td>
<td>0.08</td>
<td>Unlikely</td>
</tr>
<tr>
<td>E. Coli</td>
<td>2</td>
<td>0.08</td>
<td>Unlikely</td>
</tr>
<tr>
<td>Sexually Transmitted Diseases (STDs)</td>
<td>2</td>
<td>0.08</td>
<td>Unlikely</td>
</tr>
</tbody>
</table>

(Source: Interviews with staff at CSU campuses and at the CSU Chancellor’s Office.)

Vulnerability to the Hazard

Vulnerability to a communicable diseases hazard resides in the population of a given area – both human and animal – not in the infrastructure or physical assets. While CSU assets and infrastructure could be impacted indirectly by the communicable disease hazard, these impacts would be secondary to the impact that the communicable disease hazard would have on students, faculty, staff, and visitors at the CSU – East Bay campus.

CSU campus settings are geographically diverse, with locations ranging from small towns to medium-sized cities to densely populated urban areas. Hundreds of thousands of people work, study, and/or pass through CSU campuses on any given day. (As of Fall
2019, the CSU System had 480,541 students and 53,763 faculty and staff. Each of these persons is vulnerable to communicable disease, particularly if it is a pathogen that individual has not been immunized against, or for which no immunization exists. Prolonged outbreaks could result in a loss of services, failure of infrastructure (from lack of operators or maintenance), and closure of facilities. This exact scenario has played out to some degree in the current COVID-19 pandemic on the CSU – East Bay campus.

Estimate of Potential Losses

COVID-19 Pandemic Health Impact on CSU Campuses and Surrounding Communities

The most prescient metric for estimating losses from COVID-19 is loss of life. The nationwide campus-related COVID-19 death rate of 0.02% remains well below the average COVID-19 death rate in the U.S. However, due to data limitations, there is no information on CSU-campus-specific deaths by COVID-19 or by any other communicable diseases. In fact, COVID-19 is the only communicable disease for which case reports have been readily available for CSU campuses.

At some point in the future, CSU campuses will return to full capacity. Without adequate surveillance regarding campus access and student and employee interaction, CSU campuses (including CSU – East Bay) are at risk of developing an extreme incidence of COVID-19, and may become “super-spreaders” for adjacent communities. The emergence of more virulent COVID-19 variants would only add to the potential for high negative impacts on life safety, operations, and service delivery across the CSU system. (Other communicable diseases would also re-emerge, but with low to moderate negative impacts on life safety, operations, and service delivery.)

Economic Impact of COVID-19 Pandemic on CSU Financial Health

During the first few months of the COVID-19 pandemic in 2020, the CSU system suffered tremendous negative fiscal impacts. From March through July of 2020 alone, over $146 million worth of revenue losses were sustained across the CSU system due to refunds to students for parking, housing and dining service fees during Spring Semester, 2020. See Table 8-11 below for the economic impact to CSU – East Bay.

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22 The California State University. Enrollment. Retrieved 05.03.2021 from: https://www2.calstate.edu/csu-system/about-the-csu/facts-about-the-csu/enrollment/Pages/default.aspx

23 The California State University. Employee Head Count by Campus. Retrieved 05.03.2021 from: https://www2.calstate.edu/csu-system/faculty-staff/employee-profile/csu-workforce/Pages/employee-headcount-by-campus.aspx

Mitigative Relief from Federal Assistance

The $1.5 billion in total federal assistance sent to the CSU system will help relieve the losses of revenues from services like dorms, parking and dining services during a year of mainly empty campuses. (See Table 8-12) However, because of staggering COVID-related revenue losses, the CSU system is planning for three (3) years of fiscal duress.

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Table 8-11: CSU COVID-19 Cost Tracking Showing Revenue Refund Losses and Increased Costs

<table>
<thead>
<tr>
<th>Campus</th>
<th>State Agency Code</th>
<th>Absorbable</th>
<th>Non-Absorbable</th>
<th>Total Costs (within department operations)</th>
<th>Refunds</th>
<th>Grand Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bakersfield</td>
<td>6650</td>
<td>-</td>
<td>1,377</td>
<td>1,377</td>
<td>-</td>
<td>2,752</td>
</tr>
<tr>
<td>Chancellor’s Office</td>
<td>6620</td>
<td>27</td>
<td>745</td>
<td>772</td>
<td>-</td>
<td>772</td>
</tr>
<tr>
<td>Channel Islands</td>
<td>6850</td>
<td>-</td>
<td>1,138</td>
<td>1,318</td>
<td>6,670</td>
<td>8,088</td>
</tr>
<tr>
<td>Chico</td>
<td>6880</td>
<td>-</td>
<td>1,374</td>
<td>5,127</td>
<td>6,501</td>
<td>8,021</td>
</tr>
<tr>
<td>Dominguez Hills</td>
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<td>1</td>
<td>568</td>
<td>1,580</td>
<td>2,147</td>
<td>3,728</td>
</tr>
<tr>
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<td>6720</td>
<td>1,217</td>
<td>8</td>
<td>1,225</td>
<td>2,845</td>
<td>4,070</td>
</tr>
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<td>1,607</td>
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<td>Humboldt</td>
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<tr>
<td>Los Angeles</td>
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<td>1,480</td>
<td>-</td>
<td>1,480</td>
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<td>4,301</td>
</tr>
<tr>
<td>Maritime Academy</td>
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<td>264</td>
<td>264</td>
<td>542</td>
<td>806</td>
<td></td>
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<tr>
<td>Monterey Bay</td>
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<td>-</td>
<td>1,426</td>
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<td>6,932</td>
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<td>-</td>
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<td>1,213</td>
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<td>766</td>
<td>1,066</td>
<td>3,602</td>
<td>4,668</td>
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<td>San Diego</td>
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<td>89</td>
<td>5,861</td>
<td>9,560</td>
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<td>27,016</td>
</tr>
<tr>
<td>San Francisco</td>
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<td>5</td>
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<td>3,287</td>
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<td>16,532</td>
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<td>3,615</td>
<td>9,883</td>
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<td>San Luis Obispo</td>
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<td>7</td>
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<td>522</td>
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<td>Sonoma</td>
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<td>470</td>
<td>640</td>
<td>4,126</td>
<td>4,766</td>
<td></td>
</tr>
<tr>
<td>Stanislaus</td>
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<td>1,020</td>
<td>1,087</td>
<td>2,266</td>
<td></td>
</tr>
</tbody>
</table>

---

Table 8-12: Total Federal Assistance to CSU for COVID-19 Related Losses, 2020 – 202126,27,28

<table>
<thead>
<tr>
<th>Institution</th>
<th>December, 2020 Stimulus</th>
<th>CARES Act</th>
<th>APLU Projection of HEERF Total ARP Act Funding Allocation</th>
<th>Total Estimated Federal COVID Relief Funding</th>
</tr>
</thead>
<tbody>
<tr>
<td>California Polytechnic State University</td>
<td>$20,752,799</td>
<td>$14,725,000</td>
<td>$37,000,928</td>
<td>$72,478,727</td>
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<tr>
<td>California State Polytechnic University, Pomona</td>
<td>$48,614,353</td>
<td>$31,102,000</td>
<td>$86,044,649</td>
<td>$165,761,002</td>
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<tr>
<td>California State University Channel Islands</td>
<td>$14,288,099</td>
<td>$8,512,000</td>
<td>$24,915,170</td>
<td>$47,715,269</td>
</tr>
<tr>
<td>California State University Maritime Academy</td>
<td>$1,381,700</td>
<td>$1,204,000</td>
<td>$2,472,622</td>
<td>$5,058,322</td>
</tr>
<tr>
<td>California State University - Sacramento</td>
<td>$59,891,260</td>
<td>$35,643,000</td>
<td>$104,900,133</td>
<td>$200,434,393</td>
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<tr>
<td>California State University, Bakersfield</td>
<td>$22,855,632</td>
<td>$12,483,000</td>
<td>$40,285,565</td>
<td>$75,624,197</td>
</tr>
<tr>
<td>California State University, Chico</td>
<td>$31,603,856</td>
<td>$20,019,000</td>
<td>$55,754,538</td>
<td>$107,377,394</td>
</tr>
<tr>
<td>California State University, Dominguez Hills</td>
<td>$31,843,563</td>
<td>$18,312,000</td>
<td>$55,915,410</td>
<td>$106,070,973</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>University</th>
<th>2018-19</th>
<th>2019-20</th>
<th>2020-21</th>
<th>2021-22</th>
</tr>
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<tbody>
<tr>
<td>California State University, East Bay</td>
<td>$24,243,652</td>
<td>$14,394,000</td>
<td>$42,929,208</td>
<td>$81,566,860</td>
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<tr>
<td>California State University, Fresno</td>
<td>$52,725,317</td>
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<td>California State University, Fullerton</td>
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<td>$41,088,000</td>
<td>$120,859,884</td>
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<tr>
<td>California State University, Long Beach</td>
<td>$67,421,424</td>
<td>$41,202,000</td>
<td>$119,508,329</td>
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<td>California State University, Los Angeles</td>
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<td>$40,067,000</td>
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<td>California State University, Monterey Bay</td>
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<td>$8,705,000</td>
<td>$23,922,768</td>
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<tr>
<td>California State University, Northridge</td>
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<td>$47,458,000</td>
<td>$131,021,450</td>
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<td>California State University, San Bernardino</td>
<td>$42,438,131</td>
<td>$27,924,000</td>
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<td>California State University, San Marcos</td>
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<td>$15,542,000</td>
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<td>California State University, Stanislaus</td>
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<td>$16,130,016</td>
<td>$11,146,000</td>
<td>$28,831,619</td>
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<tr>
<td>San Diego State University</td>
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<td>$30,394,000</td>
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<td>San Francisco State University</td>
<td>$47,404,409</td>
<td>$30,000,000</td>
<td>$83,075,470</td>
<td>$160,479,879</td>
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<tr>
<td>San Jose State University</td>
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<td>$30,977,000</td>
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<tr>
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<td>$9,153,000</td>
<td>$24,732,994</td>
<td>$47,866,789</td>
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</tbody>
</table>

8-22
Vulnerability Assessment Conclusions

Before the COVID-19 pandemic, populations at all CSU campuses and CSU-affiliated facilities were substantial. Collectively, as of Fall 2019, CSU campuses had 480,541 students and 53,763 faculty and staff. All were at risk from the communicable disease events, with 534,304 people being directly vulnerable. The COVID-19 pandemic has caused campus population numbers to plummet to a small fraction of full capacity.

At some point in the future, campus population numbers will return to their pre-pandemic levels, and students, faculty, and staff will again be vulnerable to the communicable disease hazard. If just 10% of the total CSU population were to become ill with a highly infective communicable disease like influenza or another strain of SARS, this would mean that approximately 53,430 people would be sick at the same time. This scenario would likely overwhelm available on-campus medical services could even overwhelm portions of the larger community’s medical resources – especially if there were large numbers of infected people with immune system compromises or other underlying health problems. See Table 8-13 below for the “10% outbreak scenario” projections for the CSU – East Bay campus and for the entire CSU system.

Table 8-13: Scenario of Communicable Disease Hazard Affecting 10% of the CSU Population

<table>
<thead>
<tr>
<th>CSU Campus</th>
<th>Approximate Enrollment Population (Fall 2019)</th>
<th>Approximate Total FT/PT Faculty/Staff Population (Fall 2019)</th>
<th>Total Combined Approximate Student and Faculty/Staff Population</th>
<th>10% Outbreak Scenario (Students and Faculty/Staff Combined)</th>
</tr>
</thead>
<tbody>
<tr>
<td>CSU Bakersfield</td>
<td>11,199</td>
<td>1,277</td>
<td>12,476</td>
<td>1,248</td>
</tr>
<tr>
<td>CSU Channel Islands</td>
<td>7,093</td>
<td>994</td>
<td>8,087</td>
<td>809</td>
</tr>
<tr>
<td>CSU Chico (Chico State)</td>
<td>17,019</td>
<td>1,969</td>
<td>18,988</td>
<td>1,899</td>
</tr>
<tr>
<td>CSU Dominguez Hills</td>
<td>17,027</td>
<td>1,761</td>
<td>18,788</td>
<td>1,879</td>
</tr>
<tr>
<td>CSU East Bay</td>
<td>14,705</td>
<td>1,764</td>
<td>16,469</td>
<td>1,647</td>
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</table>


<table>
<thead>
<tr>
<th>Institution</th>
<th>Undergraduate</th>
<th>Graduate</th>
<th>Total Enrollment</th>
<th>Full-Time Equivalent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fresno State</td>
<td>24,139</td>
<td>2,534</td>
<td>26,673</td>
<td>2,667</td>
</tr>
<tr>
<td>Cal State Fullerton</td>
<td>39,868</td>
<td>3,736</td>
<td>43,604</td>
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</tr>
<tr>
<td>Humboldt State</td>
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<td>815</td>
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<tr>
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<td>38,074</td>
<td>4,004</td>
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<td>4,208</td>
</tr>
<tr>
<td>Cal State LA</td>
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</tr>
<tr>
<td>Cal Maritime</td>
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<td>329</td>
<td>1,240</td>
<td>124</td>
</tr>
<tr>
<td>CSU Monterey Bay</td>
<td>7,123</td>
<td>1,059</td>
<td>8,182</td>
<td>818</td>
</tr>
<tr>
<td>CSUN (Northridge)</td>
<td>38,391</td>
<td>3,832</td>
<td>42,223</td>
<td>4,222</td>
</tr>
<tr>
<td>Cal Poly Pomona</td>
<td>27,914</td>
<td>2,650</td>
<td>30,564</td>
<td>3,056</td>
</tr>
<tr>
<td>Sacramento State</td>
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<td>3,228</td>
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<tr>
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<tr>
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<td>21,242</td>
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<td>2,411</td>
</tr>
<tr>
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<td>14,519</td>
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<td>16,206</td>
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</tr>
<tr>
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<td>9,987</td>
<td>999</td>
</tr>
<tr>
<td>Stanislaus State</td>
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<td>1,276</td>
<td>11,890</td>
<td>1,189</td>
</tr>
<tr>
<td>Office of the Chancellor</td>
<td>0</td>
<td>673</td>
<td>673</td>
<td>67</td>
</tr>
<tr>
<td>CSU System-Wide</td>
<td>480,541</td>
<td>53,763</td>
<td>534,304</td>
<td>53,430</td>
</tr>
</tbody>
</table>

Note: Enrollment figures do not include non-specific CSU campus International Programs (455 students) or CALStateTEACH Program (933 students).

While the case numbers of COVID-19 have been significantly lower (about 1% of the total CSU population) than those in the 10% scenario, the degree of virulence and resultant morbidity and mortality caused by COVID-19 have led to widespread campus shutdowns, educational disruption, and economic harm to the CSU system. In short, the real-time COVID-19 communicable disease outbreak scenario has proven far more devastating than the 10% simulated scenario.
Identified Data Limitations

There is a wealth of technical information available for communicable disease. However, there is also limited non-COVID-19 communicable disease data available regarding risk or vulnerability of specific populations throughout the CSU. Much of the data that does exist is protected by privacy policies, and therefore cannot be obtained for more specific populations. As a result, performing a detailed quantitative assessment for this hazard is difficult.

Data that could be collected prior to the next update in order to improve this methodology includes:

Data regarding infection rates at the campus level and for specific populations;
Data regarding communicable disease case numbers and outcomes, by CSU campus;
Data regarding projected population changes;
Data regarding absenteeism; and
Data regarding increased operating costs as a result of absenteeism (i.e., temporary shifting of duties resulting in business interruption).
**Dam and Levee Failure**

**Description of the Hazard**

A dam failure represents the structural collapse of a dam that stores water in a reservoir behind the dam. These failures are typically the result of structural age, damage to the structure caused by earthquake or flooding, inadequate discharge or spillway capacity, inadequate maintenance, improper construction materials, or extreme inflow of water into the reservoir. Prolonged precipitation may result in overtopping of the dam resulting in structural compromise. The tremendous energy generated by a sudden breach of the dam will have significant downstream effects. Flood damage resulting from dam failures potentially will result in economic losses, environmental damage, destruction of agriculture, and human casualties. This type of incident is extremely dangerous as it can occur rapidly, with no warning resulting in an inability to effectively evacuate threatened communities.

A levee failure is similar to dam failures as the result will be a breach causing flooding on the dry side of the levee. Levees are embankments whose primary purpose is to furnish flood protection from seasonal high water or divert the flow of water. Most levees in California are intended to withstand peak water levels generated by heavy precipitation or rapid snowmelt in a watershed. Other levees are designed to withstand fluctuating water levels on a continuous basis such as those in the California Delta exposed to tidal influences. Levees routinely extend for lengthy distances immediately protecting communities. Levees can be found throughout the state but are most prominent in the Sacramento and San Joaquin Valleys.

Levee failures can vary from overtopping to small uncontrolled discharge to catastrophic failure. Areas downstream of the failure will be subject to inundation dependent on the volume of water released. These levee failures are also typically the result of structural age, damage to the structure caused by earthquake or flooding, slumping, seepage underneath the levee, high velocity flows eroding the levee, inadequate capacity, inadequate maintenance, improper construction materials, or extreme inflow of water into the system. Flood damage resulting from levee failures potentially will result in economic losses, environmental damage, destruction of agriculture, and human casualties.

A Dam or levee failure flooding will vary depending on a number of factors including the extent of the collapse or breach, the volume of water behind the structure, and the nature of the exposed downstream features. This unpredictable flooding presents a threat to life and property in addition to critical infrastructure. Lifelines and supply routes will likely be damaged or made impassible by flood erosion or standing water. Water quality and health concerns would likely be cascading effects of dam or levee failures.

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Location of the Hazard

Alameda County is home to a variety of flood control facilities and levee systems mostly throughout the Oakland and Hayward Hills and along the San Francisco Bay. Dams are located in various valleys throughout the hills and along the base of the hills where drainage meets populated areas. Levees have been constructed along various flood control channels and in protection against tidal influences providing community protection.

The closest dam facility in proximity to CSU East Bay is the Ward Creek dam. This facility is an earthen dam that has a capacity of holding 117af of water. The dam sits in a valley ¾ mile north of the campus. The height of the dam is lower in elevation than the campus and discharges its water to the west away from the campus. There are no other dam facilities that are in proximity to the campus.

There are other Alameda County dams that may have indirect effects to the CSU East Bay campus. The James H Turner Dam holding the San Antonio Reservoir is 13 miles to the southeast of the campus. The Calaveras Dam and Reservoir is 17 miles southeast of the campus. A failure of these dams would likely cause significant disruptions across multiple transportation routes in Hayward, Fremont, and Union City. Interstates 680 and 880 in addition to surface streets in these cities reside within the inundation zone.

The Alameda Creek drains the hills of the East Bay and the San Antonio Reservoir. The length of the Alameda Creek from the base of the hills in Fremont to the outlet into the San Francisco Bay is a levee protected flood control channel. The channel is located almost 4.5 miles south of the CSU East Bay campus and is lower in elevation than the campus. However, the creek crosses into populated communities that would support transportation access to the campus from the south and support resources within these communities.

Additional levees are found along the San Francisco Bay providing protection against tidal influences. These levees serve a direct protection role to parts of Hayward, Fremont, and Union City but are not providing a direct role in protecting the campus. The campus is situated in the hills elevated from tidal influences. However, the campus transportation access, access to affected support services, and impacts to the campus community residing or working in these areas may be threatened.
Extent of the Hazard

Dams are classified according to the hazard that they pose to life and property in the event of failure, rather than the likelihood of that failure.

**High hazard potential dams** may result in loss of human life, and will likely result in economic, environmental, or lifeline losses.

**Significant hazard potential dams** are not expected to result in loss of life, but are expected to cause economic, environmental, and lifeline losses.

**Low hazard potential dams** are not expected to result in loss of life, and there is a low expectation of economic, environmental, or lifeline losses. What losses do occur are generally limited to the dam owner.

Dams classified as high hazard are required to have Emergency Action Plans (EAP). EAPS are formal documents that identify potential emergency conditions at the dam and
specify preplanned actions to be followed in case of failure. An EAP is required for all high hazard dams and is recommended for all significant hazard dams.

Table 8-15: Alameda County Dams in Proximity to CSU East Bay

<table>
<thead>
<tr>
<th>River</th>
<th>Dam</th>
<th>Storage</th>
<th>Hazard Severity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Calaveras</td>
<td>New Calaveras</td>
<td>96,850af</td>
<td>High Hazard</td>
</tr>
<tr>
<td>San Antonio Creek</td>
<td>James H Turner</td>
<td>50,500af</td>
<td>High Hazard</td>
</tr>
<tr>
<td>Ward Creek</td>
<td>Ward Creek</td>
<td>130af</td>
<td>High Hazard</td>
</tr>
</tbody>
</table>

The CSU East Bay campus lies outside of the inundation zone of the dams listed above. In the event of a catastrophic failure of the identified dams, the CSU East Bay campus is expected to remain out of the inundation area. The inundation area is expected to spread water in areas below the elevation of the campus. However, there are multiple transportation corridors that lie within the dam inundation zones that could compromise transportation routes and areas the campus community reside or work. Based on these conditions, the planning committee ranks the extent of the dam failure hazard as **Low**.

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Figure 8-2: Ward Creek Dam Breach Inundation Map

33 California Department of Water Resources, *Dam Breach Inundation Map Publisher*. Retrieved 04.08.2021 from: https://fmds.water.ca.gov/webgis/?appid=dam_prototype_v2
Figure 8-3: New Calaveras Dam Breach Inundation Map

Extent – Levee Failure

Levees are used along numerous flood control channels and other waterways including the Los Angeles River, Dominguez Channel, and Compton Creek. The CSU East Bay campus lies outside of the levee flood protected areas for these levees. As such, it is not at risk to direct levee failure impacts. In the event that any of these channels were flowing at elevated levels and a failure of a levee were to occur, the communities lying within the protection zone of the failed levee would likely experience flood related damages. Based on these factors, the planning committee ranks the extent of the hazard as Low.

History of the Hazard

34 California Department of Water Resources. *Dam Breach Inundation Map Publisher*. Retrieved 04.08.2021 from: https://fmds.water.ca.gov/webgis/?appid=dam_prototype_v2
There are no records of dam or levee failures in areas that present a threat to the CSU East Bay campus. Alameda County has experienced the following dam failures:

Table 8-16: Alameda County Dam Failures

<table>
<thead>
<tr>
<th>Date</th>
<th>Dam</th>
<th>Release</th>
<th>Damage</th>
</tr>
</thead>
<tbody>
<tr>
<td>1918</td>
<td>Calaveras</td>
<td>Unknown</td>
<td>Damage to dam facilities</td>
</tr>
<tr>
<td>2015</td>
<td>Alameda Creek (Inflatable)</td>
<td>Unknown</td>
<td>Loss of water supply</td>
</tr>
</tbody>
</table>

Potential Impacts of the Hazard

**Dam Failure Impacts**

Water that is released due to a dam that has failed generates tremendous energy and force causing a flood that will be catastrophic to life and property. Water levels from the failed dam could be significantly higher than those experienced in worst case scenario flood events. Areas closer to the failed dam will be more likely to experience complete devastation while other areas within the inundation zone will see varying levels of flood waters. The extent of the impacts of a failed dam would vary based on a number of factors such as the volume of water released, the base flow of the river, the time of the failure, the amount of warning provided, and the distance from the dam. Impacts resulting from a dam failure include:

- Loss of life
- Property destruction or damage
- Loss of property contents
- Infrastructure damage
- Flooded or destroyed lifelines/supply routes
- Damaged or destroyed utilities
- Loss of community economic base
- Employment losses
- Agricultural (crops and livestock) damages or destruction
- Environmental damage
- Floods generating threats to public health
- Flood generated debris
- Damage or destruction of academic materials, fine arts, and research

Levee Failure Impacts

A levee failure may result in substantial amounts of water to enter into developed areas protected by the levee. The force and volume of water that is generated by a levee failure may cause extensive structural damage in close proximity to the breach and effects of flooding spreading well beyond the point of the failure. The extent of the impacts would vary based on a number of factors such as the volume of water released, the time of the failure, the amount of warning provided, the location of the breach, elevation, and distance from the breach. Potential impacts resulting from a levee failure include:

- Loss of life
- Property destruction or damage
- Loss of property contents
- Infrastructure damage
- Public health hazards resulting from mold, mildew, and disease due to flood water
- Flooded or destroyed lifelines/supply routes
- Damaged or destroyed utilities
- Loss of community economic base
- Employment losses
- Agricultural (crops and livestock) damages or destruction
- Environmental damage
- Prolonged periods of necessary dewatering
- Disruptions to education delivery to community
- Damage or destruction of academic materials, fine arts, and research
- Damage or destruction of university computer systems and networks
- Damaged university infrastructure
- Reduced or eliminated student engagement with academic programs
- Reductions in campus revenues

Probability of Future Occurrence of the Hazard
Alameda County is determined to be at risk from dam and levee failure. However, the location of the CSU East Bay campus elevated in the hills east of Hayward minimizes exposure to Alameda County dams or levees. The campus is located outside of identified dam or levee inundation zones. There are no official recurrence intervals that have been calculated for dam or levee failures. However, based on no historical occurrences, the likelihood of this hazard is low.

The probability of future occurrence for both dam and levee failures is Unlikely.

Vulnerability to the Hazard

The CSU East Bay campus is subject indirectly to the effects of flooding resulting from compromised dams and levees. The effects would likely be mostly affecting members of the campus community and regional transportation networks and services. The flood control channels are lined by levees intended to protect the surrounding areas from rises in water level. In the case of dam failure, the amount of time to respond to the needs of the campus community will be limited.

Any breach along a levee is impossible to predict where a failure may occur. It is likely that response action will not be fully implemented until the incident situational intelligence provides adequate information as to compromised locations. These variables place all those working and living within the dam inundation and flood protection zones in vulnerable locations.

The distributed placement of levees, most near development may expose significant vulnerabilities to other areas of the region even if the campus is unaffected. There is potential the campus community will be affected as a breach may cause flooding and damages to the homes of students, faculty, and staff or to access/supply routes, utilities, or other critical services. The potential for flood damaged structures being left uninhabitable including campus residence halls will result in the vulnerability of numerous displaced individuals and households. The lack of flood insurance will cause additional extreme financial burdens on those affected.

Vulnerability to the secondary or indirect effects of a dam or levee failure on the CSU East Bay campus will vary depending on the extent of the breach or structural failure and when the failure were to occur, and will be lessened during periods when classes are not in session or during periods of breaks. Conversely, during the days and hours that classes are in session and staff are at their workplaces, the vulnerability increases. However, in region-wide events this vulnerability may be shared with the homes and workplaces of members of the campus community and their families.

Certain campus populations will experience greater challenges to a post-flood / failure environment. Vulnerable populations will likely need to navigate through flood generated debris, face extreme health safety issues from flood waters, experience extreme stresses of a disaster, an inability to communicate to or gain access to support networks, and find difficulty in accessing equipment or supplies to aid in a specific need.

Estimate of Potential Losses
Estimates of potential losses will be influenced by a variety of factors. The volume and force of the water will determine the scale of damages affecting campus infrastructure, equipment, and other impacted features. The proximity to the failure and elevation above flood waters will affect the level of damage and individuals exposed. The time of the academic year, the day of week, and hour in which the failure was to occur will influence the number of people on campus and potential casualties. Losses will be generated by the physical damages, the loss of revenue, loss of academic research, loss of building contents, and community wide economic reductions.

Based on estimate replacement costs of facilities and structures on campus, the total replacement costs due to earthquake are $164,768,550. However, it is unlikely for a dam or levee failure event to cause catastrophic destruction at CSU East Bay.

Vulnerability Assessment Conclusions

While the occurrence of dam and levee failures have not been historically relevant near the CSU East Bay campus, the potential for hazards related to the region’s levees and dams still exist. This hazard is associated with support systems and transportation corridors servicing the campus and effects to the campus community rather than a direct exposure to the campus locations. Additionally, the presence of earthquake faults in proximity to the existing dam and levee structures presents a valid danger to downstream locations in the event of an earthquake. In the unlikely event of a catastrophic dam failure, the consequences to downstream communities would be severe. The potential for dam or levee failure further generates the added potential for a number of cascading effects such as disruptions to the local economy, utility failures, disruptions to providing for the needs of the community, and development of public health hazards. These effects would be exacerbated by effects of seasonal flooding, ongoing heavy precipitation, or excessive run-off from the watershed contributing to the river system. The potential for widespread flooding and damage of structures due to the force of water has exponentially powerful impacts on particular populations among the campus community including those with access or functional needs, international students, the homeless, and students residing in the residence halls.

Identified Data Limitations

Missing campus structural replacement costs and complete inventory of building construction features or mitigation efforts to lessen the impact due to flood inundation. Missing facility information of satellite campuses and locations.
**Drought**

**Description of the Hazard**

Drought is defined as a condition where moisture levels fall significantly below normal for an extended period of time over a large area that adversely affects plants, animal life, and humans. Drought is a gradual phenomenon. Although droughts are sometimes characterized as emergencies, they differ from typical emergency events. Most natural disasters, such as floods or forest fires, occur relatively rapidly and afford little time for preparing for disaster response. Droughts occur slowly, over a multi-year period, and it is often not obvious or easy to quantify when a drought begins and ends.

Throughout California, one dry year does not normally constitute a drought. California’s extensive system of water supply infrastructure (reservoirs, groundwater basins, and conveyance assets) mitigates the effect of short-term dry periods for most water users. Defining when a drought begins is a function of drought impacts to water users. Drought in one location may not constitute a drought for all water users, as some users in relative proximity may have a different water supply. For example, individual water suppliers may use a combination of sources such as rainfall/runoff, water in storage, or expected supply from a water wholesaler to define their water supply conditions.

Drought can be characterized as one or more of the four following types:

**Meteorological drought** is defined on the basis of the degree of dryness (in comparison to some “normal” or average amount) and the duration of the dry period. A meteorological drought must be considered as region-specific since the atmospheric conditions that result in deficiencies of precipitation are highly variable from region to region.

**Hydrological drought** is associated with the effects of periods of precipitation (including snowfall) shortfalls on surface or subsurface water supply (e.g., streamflow, reservoir and lake levels, ground water). The frequency and severity of hydrological drought is often defined on a watershed or river basin scale. Although all droughts originate with a deficiency of precipitation, hydrologists are more concerned with how this deficiency plays out through the hydrologic system. Hydrological droughts are usually out of phase with or lag the occurrence of meteorological and agricultural droughts. It takes longer for precipitation deficiencies to show up in components of the hydrological system such as soil moisture, streamflow, and ground water and reservoir levels. As a result, these impacts are out of phase with impacts in other economic sectors.

**Agricultural drought** focus is on soil moisture deficiencies, differences between actual and potential evaporation, reduced ground water or reservoir levels, and so forth. Plant water demand depends on prevailing weather conditions, biological characteristics of the specific plant, its stage of growth, and the physical and biological properties of the soil.

**Socioeconomic drought** refers to when physical water shortage begins to affect health, well-being, and quality of life of people, or when the drought starts to affect the supply and demand of an economic product that relies on water.
The drought issue in California is further compounded by water rights. The central challenge is how to prioritize water usage among a broad variety of contexts. It is for this reason that water is a commodity possessed and utilized under a variety of legal doctrines. As such, many competing sets of interests create a dynamic prioritization process between, for example, farming and federally protected fish habitats and water supply for municipal/public use (including usage for CSU - East Bay) versus water usage for wildfire abatement or natural resource protection.

Location of the Hazard

Drought conditions have been identified in Alameda County and Contra Costa County where CSU - East Bay is located. Drought is not a location-specific hazard and affects the entire planning area equally. Drought location is not isolated to each campus footprint but occurs as a geographic sub-set of drought conditions occurring at larger scales. From 2000-2020, drought conditions existed continuously somewhere in the state, with 80-100% of the state impacted for 12 of the last 20 years.36

Extent of the Hazard

Given the historical occurrence of severe drought impacts throughout the CSU system-wide planning area and across the state and the potential future impact exacerbated by climate change, the CSU Planning Committee recognizes that drought will continue to pose a high degree of risk, potentially impacting crops, livestock, water resources, the natural environment at large, buildings and infrastructure (from land subsidence), and local economies. That said, although drought affects the entire planning area, the potential impacts may be variable and specific to each campus/jurisdiction, depending on contextual factors such as the degree of assets and activities historically impacted by drought within each jurisdiction. In addition, land subsidence has occurred state-wide and will continue in areas where the groundwater basin has been subject to overdraft and long-term recharge is inadequate to maintain the water table elevation, leaving underground voids. Subsidence levels have been measured up to 30-feet in California with subsidence bowls covering hundreds of square miles. As such, drought-related subsidence may result in serious structural damage to buildings, roads, irrigation ditches, underground utilities, and pipelines. Such effects, while not reported for the campus up to this point, are applicable concerns for the East Bay campus over the long term.37

The U.S. Drought Monitor developed tables of impacts reported during past droughts in California in order to depict the extent of drought risk for each level of drought on the U.S. These possible extent conditions for California complement the general impacts column of the U.S. Drought Monitor Classification Scheme.

Table 8-17: Impacts of Drought Levels as Determined by US Drought Monitor

<table>
<thead>
<tr>
<th>Category</th>
<th>Impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>D0</td>
<td>Soil is dry; irrigation delivery begins early</td>
</tr>
<tr>
<td></td>
<td>Dryland crop germination is stunted</td>
</tr>
<tr>
<td></td>
<td>Active fire season begins</td>
</tr>
<tr>
<td></td>
<td>Winter resort visitation is low; snowpack is minimal</td>
</tr>
<tr>
<td>D1</td>
<td>Dryland pasture growth is stunted; producers give supplemental feed to cattle</td>
</tr>
<tr>
<td></td>
<td>Landscaping and gardens need irrigation earlier; wildlife patterns begin to change</td>
</tr>
<tr>
<td></td>
<td>Stock ponds and creeks are lower than usual</td>
</tr>
<tr>
<td></td>
<td>Grazing land is inadequate</td>
</tr>
<tr>
<td></td>
<td>Producers increase water efficiency methods and drought-resistant crops</td>
</tr>
<tr>
<td></td>
<td>Fire season is longer, with high burn intensity, dry fuels, and large fire spatial extent; more fire crews are on staff</td>
</tr>
<tr>
<td>D2</td>
<td>Wine country tourism increases; lake- and river-based tourism declines; boat ramps close</td>
</tr>
<tr>
<td></td>
<td>Trees are stressed; plants increase reproductive mechanisms; wildlife diseases increase</td>
</tr>
<tr>
<td></td>
<td>Water temperature increases; programs to divert water to protect fish begin</td>
</tr>
<tr>
<td></td>
<td>River flows decrease; reservoir levels are low and banks are exposed</td>
</tr>
<tr>
<td>D3</td>
<td>Livestock need expensive supplemental feed, cattle and horses are sold; little pasture remains, producers find it difficult to maintain organic meat requirements</td>
</tr>
<tr>
<td></td>
<td>Fruit trees bud early; producers begin irrigating in the winter</td>
</tr>
<tr>
<td></td>
<td>Federal water is not adequate to meet irrigation contracts; extracting supplemental groundwater is expensive</td>
</tr>
<tr>
<td></td>
<td>Dairy operations close</td>
</tr>
<tr>
<td></td>
<td>Marijuana growers illegally tap water out of rivers</td>
</tr>
<tr>
<td></td>
<td>Fire season lasts year-round; fires occur in typically wet parts of state; burn bans are implemented</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Ski and rafting business is low, mountain communities suffer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Orchard removal and well drilling company business increase; panning for gold increases</td>
</tr>
<tr>
<td>Low river levels impede fish migration and cause lower survival rates</td>
</tr>
<tr>
<td>Wildlife encroach on developed areas; little native food and water is available for bears, which hibernate less</td>
</tr>
<tr>
<td>Water sanitation is a concern, reservoir levels drop significantly, surface water is nearly dry, flows are very low; water theft occurs</td>
</tr>
<tr>
<td>Wells and aquifer levels decrease; homeowners drill new wells</td>
</tr>
<tr>
<td>Water conservation rebate programs increase; water use restrictions are implemented; water transfers increase</td>
</tr>
<tr>
<td>Water is inadequate for agriculture, wildlife, and urban needs; reservoirs are extremely low; hydropower is restricted</td>
</tr>
<tr>
<td>Fields are left fallow; orchards are removed; vegetable yields are low; honey harvest is small</td>
</tr>
<tr>
<td>Fire season is very costly; number of fires and area burned are extensive</td>
</tr>
<tr>
<td>Many recreational activities are affected</td>
</tr>
<tr>
<td>Fish rescue and relocation begins; pine beetle infestation occurs; forest mortality is high; wetlands dry up; survival of native plants and animals is low; fewer wildflowers bloom; wildlife death is widespread; algae blooms appear</td>
</tr>
<tr>
<td>Policy change; agriculture unemployment is high, food aid is needed</td>
</tr>
<tr>
<td>Poor air quality affects health; greenhouse gas emissions increase as hydropower production decreases; West Nile Virus outbreaks rise</td>
</tr>
<tr>
<td>Water shortages are widespread; surface water is depleted; federal irrigation water deliveries are extremely low; junior water rights are curtailed; water prices are extremely high; wells are dry, more and deeper wells are drilled; water quality is poor;</td>
</tr>
</tbody>
</table>

**History of the Hazard**

Historically, drought has been so prevalent in California that its presence is almost continuous, including Alameda County which surrounds the CSU - East Bay footprint. According to the US Drought Monitor Time Series data, Alameda County has experienced eight (8) periods of drought covering 12 years from 2000-2021.
Although no data is available on campus-level drought occurrences, according to the National Drought Mitigation Center, over 3,500 reports and publications covering 370 drought-related events took place across the state (many of which were statewide events) between 2000-2020. In addition, the National Center for Environmental Information (NCEI) reports more than 500 events statewide during this same time period. These events produced a comprehensive range of impacts to water supply, regulations and allocations to businesses and municipalities, budgets and resources for firefighting, water law and policy, and physical impacts to built and natural environments. As such, data records of previous occurrences can be viewed as separate time and event demarcations for a hazard almost continuously in effect across the state with cascading impact potential.

According to the Department of Water Resources, droughts exceeding three years are relatively common in Southern California, but relatively rare in Northern California - the region is the geographic source of much of the state’s developed water supply. The 1929-34 drought established the criteria commonly used in designing storage capacity and yield of large Northern California reservoirs.

According to the US Drought Monitor’s time series data, from 2000-2021 (with the exception of a 2–3-month period in 2000 and 2011), some degree of drought conditions have been continuously in effect somewhere in California. In fact, 80% - 100% of the state has been subjected to drought conditions for 12 of the last 20 years, with the most severe drought being the 100% state-wide event from 2012-2017.

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40 National Oceanic and Atmospheric Administration (NOAA), National Centers for Environmental Information. Storm Events Database. Retrieved 05.05.2021 from: https://www.ncdc.noaa.gov/stormevents/
41 National Drought Mitigation Center, University of Nebraska. Drought Impact Reporter. Retrieved 05.01.2021 from: https://droughtreporter.unl.edu/map/
Given the extent of the drought risk in California, the following drought event was selected as an exemplar due to its broad and significant impacts on the state and on the region surrounding the CSU - East Bay campus planning area:

2012 – 2017 – Drought produced severe impacts to water wells throughout the state of California, with a high number of wells running dry. Land subsidence due to increased groundwater pumping also occurred in numerous areas of the state such as the San Joaquin and Central Valleys. Crop damage was widespread as well. Water allotments were drastically reduced in many towns and water agencies, with extremely high costs for procuring water. In addition, job loss occurred with many families requiring food supply assistance, and water supply assistance provided to home-owners with dry wells. According to a report released by UC Davis Center for Watershed Sciences, the 2014-2017 period of the California drought cost the state’s agriculture industry about $1 billion in lost revenue, with a total statewide economic cost of the drought calculated to be $2.2 billion.44 The report says, “it is responsible for the greatest water loss ever seen in California agriculture - about one third less than normal.” The report calls the groundwater situation in California "a slow-moving train wreck." Spring snowpack at Donner Summit reached record low levels in 2014, exceeded in 2015 by a remarkable April 1 snow-water-equivalent value of only 5% of average. Decreased precipitation since contributed to near-record low levels in the Shasta Reservoir. The ongoing drought has contributed to declines in crop values across the state. For example, crops including cotton, corn silage and barley (the field crop category) fell by 42 percent.45

Potential Impacts of the Hazard

Drought impacts are wide-reaching and may be economic, environmental, and/or societal. This assessment of its impact recognizes that historic occurrences of drought throughout the planning area are a sub-set of larger and inter-connected local and

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regional droughts, and that the (related) historic impacts provide a sound basis for understanding potential (future) impacts.

Though no historic impacts are recorded for drought on campus, the most significant potential impact associated with drought across the CSU - East Bay campus planning area is the historic and potential reduction in water availability for the municipal area tied to each campus. Other impacts include crop loss and damage to trees and other natural resources (See Tree Mortality below). The footprint of CSU - East Bay to some extent includes these vulnerable resources based on the campus landscape (trees) and the presence (and footprint size) of agricultural research crops and field stations.

As a secondary impact of drought, wildfire is directly attributable to dry atmospheric conditions. Wildfires almost always coincide with drought in California, though not limited to such. However, the wildfire hazard is analyzed separately in this plan. See wildfire section towards the end of this section.

In reviewing the occurrences of drought for CSU - East Bay (in municipality and county), the US Drought Monitor and the National Drought Mitigation Center report that tens of millions of trees died during the (2014-2017) state-wide drought disaster. Though data sources do not provide data for tree mortality specific to CSU - East Bay, the broad geographic extent of the impact makes it likely that tree mortality occurred to some degree on the CSU campus system. Due to the lasting and ongoing effects of drought on the landscape, trees will continue to be impacted within the municipalities, counties and regions wherein lies the CSU campus system as long as drought conditions continue to occur in the future.

Given the absence of data, in order for the CSU Committee to assess the impact of tree mortality, it is useful to view it as a risk sub-set to the probability, location, extent, severity and duration of the drought hazard within each campus-located municipality, county and region. Regarding potential impacts, standing dead trees could fall, posing a risk to people, buildings, power lines, roads and other infrastructure. In addition, drought-impacted trees become susceptible to diseases and insect infestations (bark beetle) further adding to the risk of tree mortality and related potential impacts. No data is currently available for tree mortality on campus, however, the CSU Planning Team will pursue data on this issue in the future.

As a potential tertiary impact, prolonged and repeated drought conditions over time can produce land subsidence and the risk of damage to building foundations and infrastructure on campus resulting from ground instability and collapse. Land subsidence is defined as the vertical sinking of the land over manmade or natural underground voids. Subsidence is often the direct result of groundwater over-extraction in response to drought conditions, as well as oil and gas extraction. Weight can accelerate the process of subsidence resulting from surface development and infrastructure such as roads and buildings, vibrations from construction blasting and heavy truck or train traffic. For

example, the State Water Project’s 444-mile-long California Aqueduct has required repairs such as the raising of canal linings, bridges, and water control structures on the Aqueduct – in the Central Valley a five-mile reach of the Eastside Bypass was impacted by subsidence, and the Department of Water Resources estimated that it may cost in the range of $250 million to acquire flowage easements and levee improvements to restore the design capacity of the subsided area.47

At present, drought related damage to campus buildings and infrastructure at CSU - East Bay has not been reported, but the potential for such impacts is possible. With regard to overall potential impact, water supply/availability for CSU - East Bay is ultimately tied to broader inter-dependent, and more intensive modes of water use at local and regional scales such as agriculture and ranching, wildfire protection, larger metropolitan/municipal usage, manufacturing and commerce, tourism, recreation, and wildlife preservation. During drought periods, the State of California’s regulated water allocations are modified and often reduced, which can result in reduced water availability for all usage contexts, including CSU - East Bay. A reduction of electric power generation and water quality deterioration are also potential impact factors.

Table 8-18: Summary of Drought Impacts on Water Resources48

<table>
<thead>
<tr>
<th>Resource</th>
<th>Type of Impact</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sea Level</td>
<td>Direct</td>
<td>Sea level is rising and will likely impact coastal areas</td>
</tr>
<tr>
<td>Soil Moisture</td>
<td>Direct</td>
<td>Prolonged dry seasons can lead to decreases in soil moisture; drier vegetation</td>
</tr>
<tr>
<td>Vegetation</td>
<td>Indirect</td>
<td>Longer and more intense fire season with increased extent of area burned</td>
</tr>
<tr>
<td>Stream Conditions</td>
<td>Direct</td>
<td>Increases in water temperature; potential effects on fish</td>
</tr>
<tr>
<td>Snowpack</td>
<td>Indirect</td>
<td>Increases in temperature will lead to decreases in snowpack</td>
</tr>
<tr>
<td>Runoff</td>
<td>Direct</td>
<td>Warmer temperatures are likely to lead to a shift in peak runoff from spring to winter and a likely decrease in summer base flow</td>
</tr>
<tr>
<td>Hydropower</td>
<td>Indirect</td>
<td>Decreased summer flows resulting from earlier snowmelt and a shift in peak runoff could affect hydropower generation during summer months</td>
</tr>
</tbody>
</table>


**Precipitation**

<table>
<thead>
<tr>
<th>Direct</th>
<th>Warmer winter temperatures will result in a greater percentage of precipitation falling as rain rather than as snow</th>
</tr>
</thead>
</table>

**Groundwater**

<table>
<thead>
<tr>
<th>Indirect</th>
<th>Reduction in snowpack and extended periods of drought are likely to increase dependency on groundwater</th>
</tr>
</thead>
</table>

**Probability of Future Occurrence of the Hazard**

**Highly Likely** — The US Drought Monitor’s time series data (2000-2020) indicates that some degree of drought has nearly a 100% probability of occurrence in the state in any given year. Given that CSU - East Bay lies within a drought impacted region, it is prudent to extend this likelihood of occurrence to the planning area.

**Vulnerability to the Hazard**

In California, rising temperatures are projected to increase the average lowest elevation at which snow falls, reducing water storage in the snowpack, particularly at those lower mountain elevations which are now on the margins of reliable snowpack accumulation. Higher spring temperatures will also result in earlier melting of the snowpack. The shift in snow melt to earlier in the season is critical for California’s water supply because flood control rules require that water be allowed to flow downstream and that water cannot be stored in reservoirs for use in the dry season. As such, state-level drought risk factors that have led to drought’s state-wide severity and extent, and potential impacts also create drought vulnerabilities at the level of the CSU - East Bay campus.

Moreover, climate change will likely adversely impact the vulnerability of watersheds and ecosystems in their ability to deliver important ecosystem services. These changes may limit the natural capacity of healthy forests to capture water and regulate stream flows. Sierra Nevada mountain winters and springs are warming, and on average, precipitation as snowfall relative to rain is decreasing. A warming climate with reduced snowpack will result in earlier snowmelt and will subsequently reduce downstream water availability during summer and early fall.

As such, the state and the CSU - East Bay planning area stakeholders potentially have less capacity to address future drought risks due to projected temperature increases and shortages in water; ground-water withdrawals have been occurring at a deficit rate of 1 – 2 million acre feet per year, where the impacts of drought include decreased availability of water for agriculture and environmental uses.\(^49\) In forested and other vegetated areas, prolonged drought decreases the moisture content of forest fuels and increases the risk of high severity wildfires.

It should be pointed out that California is the single most productive agricultural state and its agricultural industry relies heavily on reservoir water supplied by snowmelt and rainfall runoff. Yearly variations in snowpack depths have implications for water availability as snowmelt from the winter snowpack feeds a network of reservoirs. Spring snowpack at Donner Summit reached record low levels in 2014, exceeded in 2015 by a remarkable April 1 snow-water-equivalent value of only 5% of average. Decreased precipitation since 2011 has contributed to near-record low levels in the Shasta Reservoir.50

Vulnerability of Populations

The historical and potential impacts of drought on California’s population include agricultural sector job loss, secondary economic losses to local businesses and public recreational resources, increased cost to local and state government for large-scale water acquisition and delivery, and water rationing and water wells running dry for individuals and families. As drought is often accompanied by prolonged periods of extreme heat, negative health impacts such as dehydration can also occur, where children and elderly are most susceptible. Air quality often declines in times of drought which can affect those with respiratory ailments. These same vulnerabilities apply to the students, faculty and staff of the CSU – East Bay campus.

Property Vulnerability

The historical and potential impacts of drought on property include crop loss, injury and death of livestock and pets, and damage to infrastructure, homes and other buildings resulting from the secondary drought impact of land subsidence. The related drought impacts of tree mortality and land subsidence pose risks to vulnerable critical infrastructure and property. These same vulnerabilities apply to the properties of the CSU - East Bay campus.

Natural Environment Vulnerability

The historical and potential vulnerabilities of drought in the natural environment are widespread throughout public and private lands within the state, including tree mortality, impacts to all flora and fauna, and destabilization (subsidence) of land along streams and rivers, and within watersheds.

The core issue shaping drought vulnerabilities throughout California (including the East Bay campus) s water supply and demand. Several factors play into the issue including groundwater basins, surface water run-off, public and agricultural demand, and surface water storage water sheds. A USGS led analysis was first conducted in 2010 through the Forest and Rangeland Assessment and ongoing through the USGS Forest and Rangeland Ecosystem Science Center to identify threats and assets where water supply would

benefit from environmental management designed to protect or enhance water resources, the key effort which, in part, both defines and mitigates the severity of drought risk and vulnerabilities.

With regard to overall threat and asset findings shaping the potential severity of drought, the watersheds in the Sierra region contribute most greatly to the state’s water supply, but are under threat from climate change, wildfire and development. In addition, groundwater basins in the San Joaquin Valley and Sacramento Valley bioregions are an abundant resource that is heavily threatened by over pumping.

**Critical Facilities Vulnerabilities**

Drought vulnerabilities for CSU - East Bay’s critical facilities include water shortfalls for facility operations and critical functions, and potential structural destabilization and damage resulting from land subsidence.

**Estimate of Potential Losses**

An estimate of potential losses from drought has not been calculated for the campus or the CSU system as a whole. However, drought related losses to the City of Hayward and Alameda County, and the surrounding region such as crop loss and cost increases for water resources have re-occurred over time. Please consult city and county level government, and/or state agricultural agencies for data on the financial impacts from drought.

**Vulnerability Assessment Conclusions**

The CSU Planning Committee understands that the high degree of vulnerability posed by drought will be exacerbated by greater climate variation in the future and therefore greater variation and uncertainty regarding the availability of water supplies which are already under tremendous stress. In response to such vulnerability, state legislation passed in 2014 requires local governments to regulate pumping and recharge to better manage groundwater supplies, and groundwater-dependent regions are required to halt overdraft and bring basins into sustainable levels of pumping and recharge by the early 2040s. That said, the Committee will continue to work with local, regional and state partners and stakeholders to explore solutions for mitigating the drought hazard on its campuses by accessing the best available data and resources on climate change and its relationship to drought.

**Identified Data Limitations**

Data is limited concerning campus-related agricultural assets as well as data on campus tree mortality.

**Earthquake**

**Description of the Hazard**

An earthquake is a sudden motion or shaking caused by the release of pressure accumulated along the edge of tectonic plates covering the earth. These huge plates are
constantly moving and move ever so slowly under, over, or by passing one another. This movement is gradual however the plates may lock together accumulating enormous amounts of energy. When this energy builds, stress develops, and the adjoining plates will eventually break free and result in ground shaking – an earthquake.

Large earthquakes may result in fissuring, ground settlement, and/or vertical or horizontal displacement. Earthquakes occur without warning and can result in extensive damages and human casualties. Damages associated to earthquake generated ground shaking is normally confined to a narrow area along fault trend from the earthquake epicenter. However, seismic waves may generate ground shaking resulting in damages in areas outside of the fault trend.

**Fault Rupture** – The rupture of faults is the differential movement of the two sides of the earth’s plates at the point of the fault. Horizontal or vertical displacement may be significant and occur over great distances. The movement and energy that occurs along a fault is released in waves resulting in ground shaking. The intensity of ground shaking varies based on the magnitude of the earthquake, the proximity to the earthquake epicenter, the composition of the ground sediment or rock the waves travel through, and the depth of the earthquake.

**Liquefaction** – In addition to the primary fault rupture that occurs right along a fault during an earthquake, the ground many miles away can also fail during intense shaking. As seismic waves travel through saturated granular soil; the soil begins to liquefy and act as a fluid. Soil strength and stability is lost causing the effects of ground shaking to intensify and for ground deformation to occur. These water saturated soils when shaken quickly lose the ability to support buildings, bridges, utilities, and other structures. Areas susceptible to liquefaction include places where sandy sediments have been deposited by rivers along their course or by wave action along beaches. The greater the magnitude of an earthquake and longer duration of strong ground shaking will result in an enhanced potential for liquefaction to occur. Settlement can cause damage when the amount settlement varies significantly across the length of a structure. Lateral spreading occurs when liquefaction occurs on gently sloping ground and the liquefied material at depth allows the area to slide, often toward a vertical discontinuity or “free face” such as a creek or stream channel. Liquefaction can occur in susceptible soils below bodies of water, and settlement and lateral spreading can damage structures built on or adjacent to these areas. Transportation bridges across water bodies, wharves, piers and other structures at ports and harbors, and underwater utility lines can be severely damaged by this hidden hazard.

**Subsidence** - Changes in the local environment that cause subsidence or sinkholes are called triggering mechanisms. Water is the primary factor that affects the local environment and causes subsidence. Water level decline, changes in groundwater flow, increased loading, and deterioration (such as abandoned mines) are all triggering mechanisms. Water level decline may occur naturally, or it may be the result of human action. Factors that lead to water decline are pumping (from wells), localized drainage (for construction activities), dewatering, or drought. Changes in groundwater flow can result
from an increase in the velocity of groundwater movement, and increase in the frequency of water table fluctuations, and changes in discharge (either increase or decrease). Increased loading can cause pressure in the soil, leading to the failure of underground cavities and space, such as caves. Vibrations from earthquakes, heavy machinery, and blasting may result in structural collapse, followed by surface resettlement.

**Location of the Hazard**

The State of California is particularly vulnerable to earthquake activity due to California’s location residing between two large tectonic plates. CSU East Bay is located in the East Bay area of the San Francisco Bay region at the base of the Hayward Hills. In general, fault systems surround and traverse throughout the Bay Area and Alameda County including the area of CSU East Bay. Throughout the populated areas of Hayward and surrounding cities, the ground is saturated with sediment eroded from the hills by means of multiple stream channels. Liquefaction zones rated at moderate susceptibility exist in the majority of Hayward west of Huntwood Ave.

The Pacific Plate and the North American Plate come together at the San Andreas Fault 19 miles west of the CSU East Bay campus. In addition to the San Andreas Fault, Alameda County is home to or near additional fault systems with the potential to generate strong ground shaking. The campus is additionally in close proximity to two powerful fault systems. The Hayward Fault traverses south to north along the western base of the Hayward and Oakland Hills less than ½ mile west of the CSU East Bay campus. The Calaveras Fault extends south to north 120 miles in length from San Benito County to Contra Costa County 7 miles east of the CSU East Bay campus. The 17-mile-long Mission Fault connects the Calaveras Fault with the Hayward Fault 2 miles south of the campus. The entire San Francisco Bay Area is saturated with numerous additional faults mostly paralleling the San Andreas Fault to the northwest. These fault systems are located on each side of the campus.
Figure 8-6A: Fault Lines Through CSU East Bay

Figure 8-7B: Liquification Zone CSU East Bay
Extent of the Hazard

The extent or severity of earthquake damage is expressed in terms of magnitude, intensity and duration. The amount of energy released during an earthquake is normally conveyed as a magnitude measured from a seismogram. Magnitude is expressed in numbers and decimals representing the physical size of the earthquake. The strength and effect of the shaking on the surface of the earth is classified as the intensity. Intensity is further defined from the effects the earthquake has on people, structures, and the natural environment. The intensity of an earthquake in terms of measuring magnitude and evaluating its effects is generally expressed using the Modified Mercalli (MM) Intensity Scale. Duration is the length of time the earthquake’s energy is released.

The Richter magnitude scale (Table 8-19 below) was developed in 1935 by Charles F. Richter of the California Institute of Technology as a mathematical device to compare the size of earthquakes. The Richter Scale is the best-known scale for measuring the magnitude of earthquakes. The magnitude value is proportional to the logarithm of the amplitude of the strongest wave during an earthquake. A recording of 7, for example, indicates a disturbance with ground motion 10 times as large as a recording of 6. The energy released by an earthquake increases by a factor of 31 for every unit increase in the Richter scale.
Table 8-19: Earthquake Intensity and Frequency Comparisons

<table>
<thead>
<tr>
<th>Magnitude</th>
<th>Mercalli Intensity</th>
<th>Potential Damage</th>
<th>Global Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 2.0</td>
<td>I</td>
<td>None</td>
<td>Continually</td>
</tr>
<tr>
<td>2.0 - 2.9</td>
<td>I to II</td>
<td>None</td>
<td>&gt; IM per year</td>
</tr>
<tr>
<td>3.0 - 3.9</td>
<td>II to IV</td>
<td>Light</td>
<td>&gt; 100,000 per year</td>
</tr>
<tr>
<td>4.0 - 4.9</td>
<td>IV to VII</td>
<td>Light</td>
<td>10K to 15 K per year</td>
</tr>
<tr>
<td>5.0 - 5.9</td>
<td>VI to VII</td>
<td>Moderate</td>
<td>1K to 1,500 per year</td>
</tr>
<tr>
<td>6.0 - 6.9</td>
<td>VII to X</td>
<td>Heavy</td>
<td>100 to 150 per year</td>
</tr>
<tr>
<td>7.0 - 7.9</td>
<td>VII &lt;</td>
<td>Very Heavy</td>
<td>10 - 20 per year</td>
</tr>
<tr>
<td>8.0 - 8.9</td>
<td>VII &lt;</td>
<td></td>
<td>1 per year</td>
</tr>
<tr>
<td>&gt; 9.0</td>
<td>VII &lt;</td>
<td></td>
<td>1 per 10-50 years</td>
</tr>
</tbody>
</table>

The Modified Mercalli Intensity Scale provides descriptive values of earthquake intensity that may provide greater meaning to the broader population as the description of intensity refers to the effects actually experienced. This scale uses an arbitrary ranking based on observed earthquake effects. The scale is composed of increasing levels of intensity ranging from shaking that is not recognizable to intense shaking resulting in catastrophic damages and casualties. The Modified Mercalli Intensity Scale is demonstrated below:

Table 8-20: Modified Mercalli Intensity Scale51

<table>
<thead>
<tr>
<th>Intensity</th>
<th>Shaking</th>
<th>Description / Damage</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Not felt</td>
<td>Not felt except by a very few under especially favorable conditions.</td>
</tr>
<tr>
<td>II</td>
<td>Weak</td>
<td>Felt only by a few persons at rest, especially on upper floors of buildings.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Level</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>III</td>
<td>Weak</td>
</tr>
<tr>
<td>IV</td>
<td>Light</td>
</tr>
<tr>
<td>V</td>
<td>Moderate</td>
</tr>
<tr>
<td>VI</td>
<td>Strong</td>
</tr>
<tr>
<td>VII</td>
<td>Very strong</td>
</tr>
<tr>
<td>VIII</td>
<td>Severe</td>
</tr>
<tr>
<td>IX</td>
<td>Violent</td>
</tr>
<tr>
<td>X</td>
<td>Extreme</td>
</tr>
</tbody>
</table>

The graph below illustrates the increasing intensity of energy that is released and as the measured magnitude increases. While each whole number increases in magnitude represents a tenfold increase in the measured amplitude, it represents an increasing rate of 32 times more energy released in the same increase in magnitude. As the magnitude of an earthquake is measured higher, the intensity of the earthquake worsens progressively from one category to the next.
Based on the earthquake shaking potential in the Alameda County area, the campus residing along numerous fault-lines, and the fairly extensive history of earthquakes in the county and surrounding area, (including the catastrophic Loma Prieta event in 1989) the extent of the earthquake risk is considered **Moderate**.

**History of the Hazard**

The State of California has a long history of chronic and destructive earthquakes throughout the state. On average, earthquakes strong enough to result in structural damages occur three to four times a year in California, while earthquakes Magnitude 6.0 to 6.9 occur once every two to three years. Likewise, Alameda County also has a long history of earthquake activity. The entire area of Alameda County is at risk to seismic activity and has a history of significant earthquakes resulting in damages.

Table 8-21: Historic Earthquakes Near Hayward, CA

<table>
<thead>
<tr>
<th>Date</th>
<th>Location</th>
<th>Magnitude</th>
<th>Damages</th>
</tr>
</thead>
<tbody>
<tr>
<td>10/21/1868</td>
<td>Hayward</td>
<td>6.8</td>
<td>Extensive destruction; 20-mile rupture</td>
</tr>
</tbody>
</table>

---


<table>
<thead>
<tr>
<th>Date</th>
<th>Location</th>
<th>Magnitude</th>
<th>Damage Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>4/18/1906</td>
<td>San Francisco</td>
<td>7.9</td>
<td>Extensive destruction; 3000 fatalities</td>
</tr>
<tr>
<td>3/22/1957</td>
<td>Daly City</td>
<td>5.3</td>
<td>$1 million, 1 fatality</td>
</tr>
<tr>
<td>8/6/1979</td>
<td>Gilroy</td>
<td>5.7</td>
<td>Minor</td>
</tr>
<tr>
<td>4/24/1984</td>
<td>Morgan Hill</td>
<td>6.2</td>
<td>$8 million</td>
</tr>
<tr>
<td>10/17/1989</td>
<td>Loma Prieta</td>
<td>6.9</td>
<td>$5.9 billion, 63 fatalities</td>
</tr>
<tr>
<td>9/3/2000</td>
<td>Yountville</td>
<td>5.0</td>
<td>Minor</td>
</tr>
<tr>
<td>10/30/2007</td>
<td>Alum Rock</td>
<td>5.6</td>
<td>Minor</td>
</tr>
<tr>
<td>8/24/2014</td>
<td>American Canyon</td>
<td>6.0</td>
<td>$400 million</td>
</tr>
</tbody>
</table>

The April 18, 1906 San Francisco Earthquake became one of the most well-known earthquakes in California history. The earthquake caused extensive damage to buildings, bridges, water systems, and critical facilities. Damage was experienced well beyond San Francisco including areas such as Monterey and Santa Cruz. 3,000 people were killed and thousands more injured. The San Francisco Earthquake was found to shift the course of northern California rivers. The shaking was felt from Oregon to Los Angeles.

The October 17, 1989 Loma Prieta Earthquake shook a large part of northern California, especially the San Francisco Bay Area. The earthquake caused $5.9 billion in damages, most extensively in San Francisco, the East Bay, and South Bay areas. The earthquake resulted in extensive infrastructure damages, 12,000 displaced, 3,757 injuries, and 63 fatalities. The earthquake was provided a federal disaster declaration (DR-845).

**Potential Impacts of the Hazard**

The shaking of the ground from earthquakes can result in building collapse, bridge failure, utility disruptions and other structural collapse. Large earthquakes can additionally cause natural gas lines to break resulting in structure fires. The proximity to the unstable soils surrounding the campus presents a potential for liquefaction creating greater ground instability during seismic events. A major earthquake in the San Francisco Bay Area would likely result in region-wide social disruptions in addition to structural damages. The region-wide structural damages may disrupt lifelines and supply chain routes limiting the campus from effective evacuation routes and receiving necessary supplies or equipment.

Most injuries resulting from earthquakes are from collapsing walls, flying glass, or other objects moved by ground shaking. The lack of warning allows individuals minimal time to react and find areas of safety. A moderate earthquake occurring near Hayward could cause injuries or fatalities to members of the campus community or support networks the campus relies on. These earthquake effects might be aggravated by collateral incidents such as fire, flooding, hazardous material spills, dam/levee compromises, and other cascading events. A catastrophic earthquake near Hayward could result in extensive casualties, expansive structural damages, panic, widespread utility outages,
communication failures, and secondary emergencies such as fire. A catastrophic earthquake would certainly affect the broader Alameda County and East Bay region limiting immediate assistance that the campus may normally expect.

Local impacts to CSU East Bay campus caused by an earthquake could include:
- Damage and secondary fires to industrial facilities on west side of Hayward
- Potential hazardous material releases on and off campus
- Infrastructure damage to freeway system
- Structural damage to bridges over waterways and flood control channels
- Potential isolation of campus from community
- Potential isolation among on-campus residents
- Structural damage to Alameda Creek levees and levees along San Francisco Bay
- Potential landslide and roadway damage to Carlos Bee Blvd and Harder Rd limiting access to campus
- Potential liquefaction-based effects to isolated sections of the campus and large areas of the surrounding cities
- Structural damage to campus academic and support buildings
- Structural damage to residence halls resulting in displaced student populations
- Structural damage to nearby residences
- Community members arriving on campus for refuge from damaged homes
- Damaged university communications, computer systems, and networks
- Considerable stress and fear among community
- Closure or reduction of service to campus operations
- Reduction of campus revenue

Probability of Future Occurrence of the Hazard

The Working Group on California Earthquake Probabilities (WGCEP), a collaboration between the United States Geological Survey (USGS), the Southern California Earthquake Center (SCEC), and the California Geological Survey (CGS) develops Uniform California Earthquake Forecasts (UCERFs) using the best currently available science and technology. The UCERF version 3 provides a three-dimensional view of the likelihood a region in California will experience a Magnitude 6.7 or greater earthquake in the next 30 years. The likelihood for the Alameda County fault systems surrounding the East Bay region is included in the following table.
Table 8-22: Major Potentially Active Faults in Proximity to CSU East Bay

<table>
<thead>
<tr>
<th>Fault Zone</th>
<th>Recurrence</th>
<th>Maximum Magnitude</th>
<th>UCERF3 Likelihood</th>
</tr>
</thead>
<tbody>
<tr>
<td>Calaveras</td>
<td>Historic: 150-200 years</td>
<td>6.5 to 7.1</td>
<td>7%</td>
</tr>
<tr>
<td>Hayward</td>
<td>Varies: 20-300 years</td>
<td>6.8 to 7.0</td>
<td>14-21%</td>
</tr>
<tr>
<td>Mission</td>
<td>Historic: Unknown</td>
<td>6.0 to 6.5</td>
<td>1-2%</td>
</tr>
<tr>
<td>Monte Vista</td>
<td>Historic: Unknown</td>
<td>6.0 to 6.5</td>
<td>1%</td>
</tr>
<tr>
<td>San Andreas</td>
<td>Historic: 150-200 years</td>
<td>7.8</td>
<td>7%</td>
</tr>
</tbody>
</table>

There is a 76% probability of one or more magnitude 7.0 earthquakes striking Northern California within 30 years beginning in 2014. Based on the earthquake shaking potential in the Hayward area, the proximity to the Calaveras, Hayward, and San Andreas Fault Systems, the probability of seismic ground shaking that would generate damage is considered Possible.

Vulnerability to the Hazard

A considerable challenge regarding earthquakes is they generally occur without warning. The fault systems surrounding the region all cross major transportation routes potentially reducing the availability of access and the supply chain. The geographic location of CSU East Bay places the campus in an urban/suburban community near residential, commercial, and industrial areas that is moderately populated. Earthquake effects experienced in the neighboring local community will likely spill over onto the campus.

The known fault systems generating the threat to the San Francisco Bay region generally surround the area and some cross near the CSU East Bay campus. The campus resides in a region that is exposed to fault systems on all sides. The proximity and potential for large earthquake development from these surrounding systems expose significant vulnerabilities. The potential for earthquake damaged structures being left uninhabitable including campus residence halls will result in numerous displaced individuals and households. The lack of earthquake insurance will cause extreme financial burdens on those affected.

Elements of the vulnerability to a major earthquake on the CSU East Bay campus will vary depending on when the earthquake were to strike. The risk to the campus population will be lessened during periods when classes are not in session or during periods of breaks.

Conversely, during the days and hours that classes are in session and staff are at their workplaces, the human vulnerability increases. Generally, people are safer when at home in wood frame structures as earthquakes tend to generate less structural damage to wood construction than in commercial or industrial facilities. The greater number of people on campus at the time of an earthquake will result in more people being exposed to effects from damaged campus facilities or equipment and require greater evacuation assistance. However, in region-wide events this vulnerability may simply shift to the homes and workplaces of members of the campus community and their families.

The aftermath of a major earthquake will likely result in widespread search and rescue operations for trapped and injured individuals. The demand on emergency services will be great, potentially requiring the campus community to be prepared for these scenarios and initiate response actions as needed. There will be needs for emergency medical care, shelter, water, and food for individuals who have been displaced by the earthquake. In earthquakes causing significant damages, there may be a necessity to provide assistance with identification and support to local agencies in mass fatality management.

There may be a need to evacuate members of the campus community from the campus and to other locations that are deemed to be safer locations. This may be heightened in the southwestern portions of the campus as this area has been identified as being within a liquefaction zone. As access routes to and from the CSU East Bay campus is exposed by dam facilities, the decision to evacuate will need to take into account whether flood control facilities are filled with water and the actual threat to the dam or levees.

The San Francisco Bay Area and both Hayward and Concord in particular are moderately populated and attract commuter employees to the commercial cores. The road and freeway network becomes easily congested in normal situations. A major earthquake has the potential for rendering these critical lifelines and supply routes inoperable and forcing the campus community to be self-reliant for a period of time.

Certain campus populations will experience greater challenges to a post-earthquake environment. Vulnerable populations including those that rely on specific services, require electrical power, homeless students, experience disabilities, non-English speakers, those whose age make evacuating difficult, and others will be most affected. These individuals will likely need to navigate through earthquake generated debris, extreme stresses of a disaster, an inability to communicate to or gain access to support networks, and find difficulty in accessing equipment or supplies to aid in a specific need.

**Estimate of Potential Losses**

Estimates of potential losses will be influenced by a variety of factors. The intensity of the earthquake will determine what scale of damages affecting campus infrastructure, equipment, and other impacted features. Losses will be generated by the physical damages, the loss of revenue, loss of academic research, loss of building contents, and community wide economic reductions.

Based on estimate replacement costs of facilities and structures on campus, the maximum total replacement costs due to earthquake are $164,768,550.
Table 8-23: HAZUS Peak Ground Acceleration Zone (PGA) Estimated Losses

<table>
<thead>
<tr>
<th>PGA Zone Designation</th>
<th>Intensity</th>
<th>No. of Buildings</th>
<th>Maximum Replacement Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Extreme</td>
<td>X+</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Violent</td>
<td>IX</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Severe</td>
<td>VIII</td>
<td>30</td>
<td>$164,768,550</td>
</tr>
<tr>
<td>Very Strong</td>
<td>VII</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Strong</td>
<td>VI</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Moderate</td>
<td>V</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Light</td>
<td>IV</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Weak</td>
<td>II-III</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Not Felt</td>
<td>I</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>NA</td>
<td>NA</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>No Building Value Data Provided*</td>
<td>NA</td>
<td>9</td>
<td>Unknown</td>
</tr>
</tbody>
</table>

*Buildings with no value defined are also included in the respective Zones they are found in.

Vulnerability Assessment Conclusions

It is difficult to predict the severity of casualties, property, and cascading impacts generated by future seismic events affecting the greater San Francisco Bay region, the East Bay, and the CSU East Bay campus. Each of the earthquake generated effects will vary widely based on the intensity of the earthquake, location of the epicenter, proximity to people and development, time of day and year, the soil composition under the impacted structures, building construction, among others. In any case, the potential for a major earthquake exists affecting the campus and causing extensive challenges to the CSU East Bay campus and community.

In the event that a major earthquake was to strike along the many fault systems surrounding Hayward, the effects could be significant to the campus community and campus operations. The widespread impacts generated by a major earthquake would extend the effects of casualties, damages, and other impacts to the broader San Francisco Bay region creating large-scale regionwide needs for critical assistance and a heavy demand on limited emergency resources. The threat and impacts presented to the campus will be shared with the campus community from their homes and places of work. The campus will likely be required to address critical needs independently during early phases of the disaster.

The campus population are additionally vulnerable to the effects of major ground shaking that are far reaching. The psychological and social impacts a major earthquake will give
rise to will potentially harm individuals and cause tremendous fear. The willingness to return indoors may be hampered especially as after-shock continue. These effects are magnified for populations having specific vulnerabilities or access limitations.

Identified Data Limitations

Missing campus structural replacement costs and an inventory of building construction types to include status of earthquake retrofitting. HAZUS generated analysis is focused on the broader community level versus finetuning the analysis to the micro-level for facilities such as a university campus.
Erosion

Description of the Hazard

The US Geological Survey (USGS) defines erosion as “the process whereby materials of the earth’s crust are loosened, dissolved, or worn away and simultaneously moved from one place to another.”\textsuperscript{57} Erosion may occur in areas of streams and rivers, along bluffs, around immovable objects (such as buildings or bridge abutments), or as a cascading result of other natural hazards, such as earthquakes or wildfires. When erosion occurs along bodies of water, the removal of material causes the shore to move further landward.

Forces such as sea level rise and changes in sediment supply impact erosion gradually and can be difficult to recognize. In contrast, the impacts of short-term events, such as storms and flooding, can be severe and are immediately recognizable. Along the Pacific coast, rain, wind, and waves can induce significant short-term erosion.

Location of the Hazard

Erosion is a severe hazard in coastal communities, where sea level rise and storms contribute to de-sedimentation and the retreat of coastal cliffs, bluffs, and beaches. While coastal erosion can happen in any storm, it is more likely during El Niño events, which occur every 5-7 years. As such, for the purpose of this campus-level analysis, the erosion hazard poses a consistent risk across the terrain of the CSU-East Bay campus with erosion-prone characteristics. While it is understood that such conditions exist generally, no specific locations under threat of erosion or erosion-in-process have been identified. Such an assessment may be conducted by campus leadership at some point in the future.

Other incidents of erosion, such as occurs around buildings, are relatively non-spatial and can occur in any locations with conducive soil structure and a source of movement, such as water or wind. An area’s potential for erosion is determined by several factors, including rainfall, topography, soil characteristics, and vegetative cover.

Extent of the Hazard

There is no published scale of severity or extent for this geologic hazard. If conditions are favorable, erosion is likely to occur. Given no historical occurrence of erosion on campus, the planning committee ranks the extent of this hazard as Low.

History of the Hazard

While there have been incidents of riverine erosion in other parts of Hayward County, no incidents have been recorded on the CSU East Bay campus.

Potential Impacts of the Hazard

Coastal erosion can result in severe impacts to infrastructure, including the undermining of foundations, exposure of underground infrastructure, and breaches of natural or constructed protections. The latter can expose communities to the destructive forces of floodwaters, surge, and debris impacts. On campus, areas of erosion can create pedestrian and transportation hazards, and structures may become unsafe if erosion is not controlled. Public health and safety, structures, and infrastructure can all be negatively impacted, damaged, or destroyed by the erosion hazard.

**Probability of Future Occurrence of the Hazard**

Erosion is an on-going and dynamic process that occurs regularly. As climate change induces more frequent and intense weather events, coastal and other erosion may generally become more widespread or severe. These events can cause erosion or exacerbate areas already experiencing erosion. As a result, and in consideration of the potential extent of erosion, the probability of future occurrence is high over the long term.

**Vulnerability to the Hazard**

Topography, soil structure, land use, and precipitation are all factors of erosion. CSU East Bay infrastructure and buildings located on steep slopes, in areas with little vegetation, or in areas with conducive soil types are more vulnerable to erosion.

In the wider Hayward community, erosion vulnerabilities include agricultural sector job loss, degradation of riverine ecosystems and coastlines, and loss of water quality.

**Estimate of Potential Losses**

The historic and potential impacts of erosion on property statewide include reduced agricultural productivity, lower surface water quality, and damaged drainage networks. Current modeling is not precise enough to allow for an assessment of potential losses to buildings and infrastructure on campus.

**Vulnerability Assessment Conclusions**

While the ability to predict future erosion on the CSU East Bay campus is limited, the core issues shaping erosion vulnerability on campus are flora and landscaping. If left unchecked, erosion can cause significant damage to campus infrastructure and the surrounding environment.

**Identified Data Limitations**

The complex interactions between soil erosion factors make predictive modeling, determination of hazard areas, and quantification of loss difficult. Localized data on this hazard is also limited, resulting in more generalized findings.
Description of the Hazard

The incredible geographic diversity in California presents tremendous challenges for flood planning and response. The state is home to extensive mountain ranges such as the Sierra Nevada, Cascades, Klamath, Coastal Ranges, and the Southern California Transverse Range all creating tremendous watersheds. Large river systems drain the mountains traveling through populated communities including the Sacramento and San Joaquin Rivers draining into the California Delta. The state has a complex system of reservoirs, dams, and levees providing water storage and flood protection. Finally, California’s 840-mile coastline exposes the coastal regions to tidal influences.

Floods are characterized by the rising and overflowing of excess water from a water source such as a stream, river, lake, canal, or coastal body onto an area of normally dry floodplain. A floodplain is a lowland area downstream and adjacent to water bodies that are subject to flood events. Flooding is a naturally occurring event that become hazardous when populations and property are affected.

Flooding can result from excessive precipitation from weather systems generating prolonged rainfall, excessive snowmelt from watersheds upstream from the floodplain, infrastructure failure, exceeding the capacity of dams or levees, tidal influences, or a combination from any of the previous factors.

Floods represent one of the costliest and most frequent natural disasters that influence human suffering and economic impact in the United States. Flooding will likely result in significant damage to structures, infrastructure, utilities, landscapes, and the environment. Erosion of stream banks, roadways, other features may result from the movement of flood waters. The saturated ground resulting from standing flood waters may cause ground instability, collapse, erosion, or other damages. Further, floods will often generate substantial debris that will accumulate and be deposited throughout the flooded areas.

Flooding can be either slow-rise or rapid onset floods. With slow rise floods, there is often warning preceding water rise by hours or days before dangerous conditions present themselves. Slow rise floods that are expected to enter into populated areas generally allow for some time to initiate evacuation and sand bagging efforts. Flooding that occurs rapidly conversely are water events that present with extremely limited warning times and a limited ability to take response actions until flooding has already begun to occur.

Flooding may take on different forms:

**Flash Flooding** – Flash flooding is typically characterized by a rapid rise, short duration, and large volume of water in a localized area. Heavy rainfall in areas that have limited drainage capacities often contribute to flash flooding conditions. These flooding events frequently occur with limited notice requiring immediate evacuation or rapid response efforts such as sand bagging. Flash flooding may arrive with fast moving water creating added hazardous conditions.
Riverine Flooding – Riverine flooding is usually caused by prolonged rainfall or rainfall combined with heavy snowmelt. When soils are already saturated, the ability for the ground to absorb water is minimized. In a riverine flood, the water way exceeds channel capacity and extends into areas outside of the channel, often in developed communities. In California, riverine flooding is most likely to occur from November through April. The duration of riverine floods may vary from a period of hours to weeks.

Localized Flooding – Localized flooding is commonly the result of stormwater drainage systems being overwhelmed by unusually heavy rainfall. These flooding events frequently occur in areas that are urbanized or developed with greater amounts of impervious surfaces not allowing ground absorption. This generates added runoff into the drainage systems and onto roadways creating backups.

Infrastructure Failure – Failures of dams or levees presents a serious flooding concern for areas downstream from the compromised structure. This situation may result in a catastrophic flood with limited warning time and widespread areas affected.

Coastal Flooding – Coastal flooding can occur in multiple areas along the California coastline. Flooding may result from intense storms coming from the Pacific Ocean that generate elevated water levels or storm surge. The size, duration, winds generated, and intensity of the storm will influence the effect the waves will have on the shoreline. Periods of high tide can aggravate the conditions allowing greater wave impingement into coastal areas.

Atmospheric River

California, including the location of this campus, is subject to the effects of a phenomenon referred to as atmospheric rivers. These weather events consist of long, narrow regions in the atmosphere transporting tremendous amounts of water vapor from the tropics. These weather regions behave like rivers in the sky. They can carry heavy volumes of water vapor compared to the amount of water flow at the mouth of the Mississippi River. As these atmospheric rivers arrive into California they tend to generate significant rain and snow.

Atmospheric rivers can arrive in many different shapes and sizes. The larger events are able to generate extreme rainfall amounts resulting in flooding. They can stall over watersheds vulnerable to flooding, often saturated with heavy snow amounts. The atmospheric rivers known as a “Pineapple Express” coming from the tropics and arriving with warmer air may produce heavy rains that will melt ground snow adding to the water volume that will be added in the flood runoff.

These events can produce heavy amounts of precipitation creating extensive damages. However, these events may present as weaker systems that produce precipitation that is enough to be beneficial for the local water supply. At the higher elevations in the California mountains, these events have the potential to generate a tremendous snowpack providing a source of water during the dry summer months.
Location of the Hazard

Hayward is located in Alameda County on the east side of the southern San Francisco Bay. Alameda County can experience flooding from overflowing streams and heavy precipitation events in low lying areas such as Castro Valley, San Leandro, and Hayward. These areas often experience shallow flooding impacting roadways and other areas where drainage is inadequate. The western side of Alameda County is a coastal plain adjacent to the San Francisco Bay that gradually rises to the east at the Hayward Hills. The communities in western Alameda County are densely populated with extensive residential neighborhoods. Within 2 miles of the campus are large industrial zones containing a variety of land uses including chemical facilities and distribution centers shipping different materials.

The CSU East Bay campus is located elevated on the hills limiting the flooding potential that exists in the low-lying areas. The campus is situated on a topography of rolling hills 300-400 feet higher than the coastal basin located 0.5 miles away. Creek beds that have been carved into valleys among the hills surround the campus with Ward Creek ¼ mile to the north and Ziele Creek 0.25 miles to the south. The entire CSU East Bay campus sits within a Special Flood Hazard Area (SFHA) Zone X: Area of Minimal Flood Risk designation on the Flood Insurance Rate Map. The CSU East Bay, Concord Campus, located 20 miles to the north in Contra Costa County also resides in a Zone X: Area of Minimal Flood Risk.

**Extent of the Hazard**

The CSU East Bay campus is located entirely in a designated Zone X: Area of Minimal Flood Hazard. The access routes into and out of the campus servicing locations to the north and west are found in areas primarily designated as Zone X: Area of Minimal Flood Hazard, access routes to and from the south and east are primarily located in Zone X:
Area with Reduced Flood Risk Due to Levee. The CSU East Bay, Concord campus is also located entirely in a designated Zone X: Area of Minimal Flood Hazard as are the access routes into and out of the facility. Based on these factors, the planning committee ranks the extent of the hazard as **Low**.

In support of the NFIP, FEMA identifies those areas that are more vulnerable to flooding by producing Flood Hazard Boundary Maps (FHBM), Flood Insurance Rate Maps (FIRM), and Flood Boundary and Floodway Maps (FBFM). Several areas of flood hazards are commonly identified on these maps, including the 1% annual chance flood zone. Flood zones are further delineated by risk and are assigned a letter signifier. The flood zone designations are defined and described in the following table.

**Table 8-24: Flood Zone Designations and Descriptions**

<table>
<thead>
<tr>
<th>Zone Designation</th>
<th>Percent Annual Chance of Flood</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Zone V</td>
<td>1%</td>
<td>Areas along coasts subject to inundation by the 1% annual chance of flooding with additional hazards associated with storm-induced waves. Because hydraulic analyses have not been performed, no base flood elevations (BFEs) or flood depths are shown.</td>
</tr>
<tr>
<td>Zones VE and V1-30</td>
<td>1%</td>
<td>Areas along coasts subject to inundation by the 1% annual chance of flooding with additional hazards associated with storm-induced waves. BFEs derived from detailed hydraulic analyses are shown within these zones. (Zone VE is used on new and revised maps in place of Zones V1-30.)</td>
</tr>
<tr>
<td>Zone A</td>
<td>1%</td>
<td>Areas with a 1% annual chance of flooding and a 26% chance of flooding over the life of a 30-year mortgage. Because detailed analyses are not performed for such areas, no depths or BFEs are shown within these areas.</td>
</tr>
<tr>
<td>Zone AE</td>
<td>1%</td>
<td>Areas with a 1% annual chance of flooding and a 26% chance of flooding over the life of a 30-year mortgage. In most instances, BFEs derived from detailed analyses are shown at selected intervals within these zones.</td>
</tr>
<tr>
<td>Zone AH</td>
<td>1%</td>
<td>Areas with a 1% annual chance of flooding where shallow flooding (usually areas of ponding) can occur with average depths between 1 – 3 feet.</td>
</tr>
</tbody>
</table>
Zone AO  1%
Areas with a 1% annual chance of flooding, where shallow flooding average depths are between 1 – 3 feet.

Zone X (shaded)  0.2%
Represents areas between the limits of the 1% annual chance of flooding and 0.2% chance of flooding.

Zone X (unshaded)  Undetermined
Areas outside of the 1% annual chance floodplain and 0.2% annual chance floodplain; areas of 1% annual chance sheet flow flooding where average depths are less than one (1) foot; areas of 1% annual chance stream flooding where the contributing drainage area is less than one (1) square mile, or areas protected from the 1% annual chance flood by levees. No BFE or depths are shown within this zone.

History of the Hazard

Flooding in Hayward and the broader Alameda and Contra Costa County region have typically occurred during the winter months when Pacific storms are more common. The occurrences of significant flooding typically have been the result of successive intense storms with heavy precipitation. The region has experienced flood events that have caused tens of millions of dollars in damages and numerous fatalities. The following provides insight into information of past flooding events that are significant to the CSU East Bay campus. No history of flooding is reported for the campus.

Table 8-25: Historic Flooding Events in Alameda County60

<table>
<thead>
<tr>
<th>Date</th>
<th>Event</th>
<th>Declaration</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>February 1970</td>
<td>Flood; Winter Storms</td>
<td>DR-283-CA</td>
<td>Countywide</td>
</tr>
<tr>
<td>December 1982</td>
<td>Flood</td>
<td>DR-651-CA</td>
<td>Countywide</td>
</tr>
<tr>
<td>February 1986</td>
<td>Flood; Winter Storms</td>
<td>DR-758-CA</td>
<td>Countywide</td>
</tr>
<tr>
<td>January 1993</td>
<td>Flood; Winter Storms</td>
<td>DR-979-CA</td>
<td>Countywide</td>
</tr>
<tr>
<td>January 1995</td>
<td>Flood; Heavy Rains</td>
<td>DR-1044-CA</td>
<td>Countywide</td>
</tr>
<tr>
<td>March 1995</td>
<td>Flood; Heavy Rains</td>
<td>DR-1046-CA</td>
<td>Countywide</td>
</tr>
</tbody>
</table>

### Potential Impacts of the Hazard

A flood will potentially result in extensive amounts of water entering onto developed areas. The force and volume of water that is generated by a flood may cause extensive structural damage in areas subject to standing or moving water. The effects of flooding may spread over significant distances covering large areas of land. The extent of the impacts would vary based on a number of factors such as the volume of water flooding, the time of the flood event, the amount of warning provided, the location and extent of the flood boundary, facility elevation, and distance from the flood source. Potential impacts resulting from flooding include:

- Injuries or loss of life
- Property destruction or damage
- Loss of property contents
- Infrastructure damage including roadways, bridges, other transportation means
- Public health hazards resulting from mold, mildew, and disease due to flood water
- Flooded or destroyed lifelines/supply routes
- Damaged or destroyed utilities
- Loss of community economic base
- Employment losses
- Agricultural (crops and livestock) damages or destruction
- Environmental damage
- Prolonged periods of necessary dewatering
- Flooding erosion may alter natural drainage channels
- Societal and community impacts
- Psychological impacts of impacted populations
Disruptions to education delivery to community
Damage or destruction of academic materials, fine arts, and research
Damage or destruction of university computer systems and networks
Damaged university infrastructure
Inability for campus operations to resume
Reduced or eliminated student engagement with academic programs
Reductions in campus revenues

Additionally, individuals who were unable to evacuate in time or refused to leave will likely need assistance or rescue from the flooded area. Remaining in or being trapped by flood waters places individuals in significant risk of injury or death. The impacts extend beyond the danger placed upon the affected individual and places greater resource demands on agencies and organizations making efforts to rescue trapped individuals.

Probability of Future Occurrence of the Hazard

Alameda County and Contra Costa County have numerous areas that are determined to be at risk from flooding. The location of the CSU East Bay campus resides outside of any Special Flood Hazard Area and is elevated in the hills east of Hayward. The CSU East Bay, Concord campus also is outside of Special Flood Hazard Area but is bordered by the Galindo Creek, considered a Regulatory Floodway, on the east side of the campus. Areas designated as a Special Flood Hazard Area remain at a distance from either campus. Slight potential exists for urban flooding due to heavy precipitation that overwhelms drainage systems on campus.

Based on the (above) factors, the planning committee ranks the probability of future occurrence for flooding as Unlikely.

Vulnerability to the Hazard

The CSU East Bay campus is subject to the effects of limited, small-scale flooding or ponding primarily resulting from excessive precipitation during isolated heavy storms, river/levee and/or drainage system overflow, or a combination of these. The Ward Creek and Ziele Creek are located close to the campus, however, present minimal potential for flooding and damage on campus and surrounding residential areas. The creek channels that surround the campus have limited storage or volume capacities and create limited vulnerabilities in the transportation network servicing the campus.

Vulnerability to flooding on the CSU East Bay campus will vary depending on when the flood was to occur and the location of people and assets located within any low lying areas. The risk to the campus population will be lessened during periods when classes are not in session or during periods of breaks.

It is unlikely, but should an urban flood occur, impacts may pertain to campus equipment, communication systems, protected documents, artwork, academic materials, computer
systems, research, and other critical activities on lower levels of buildings located in low lying areas on campus.

Estimate of Potential Losses

Estimates of potential losses will be influenced by a variety of factors. The volume and force of the water will determine the scale of damages affecting campus infrastructure, equipment, and other impacted features. The location and elevation above flood waters will affect the level of damage and individuals exposed. The time of the academic year, the day of week, and hour in which the flooding was to occur will influence the number of people on campus and potential casualties. The severity of the storms producing precipitation, the speed of the storms moving across the area, the level of snowpack in the higher elevations, and amount of resulting snowmelt will produce varying effects on damages produced and costs incurred. Losses will be generated by the physical damages, the loss of revenue, loss of academic research, loss of building contents, and community wide economic reductions.

Based on estimate replacement costs of facilities and structures on campus, the maximum total replacement costs due to flood are $164,768,550. However, it is unlikely for flood to cause destructive losses to the entire campus.

Table 8-26: Special Flood Hazard Area (SFHA) Estimated Losses

<table>
<thead>
<tr>
<th>Zone Designation</th>
<th>No. of Buildings</th>
<th>Maximum Replacement Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Zone V</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Zone VE &amp; V 1-30</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Zone A</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Zone AE</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Zone AH</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Zone AO</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Zone X .2%</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Zone X Minimal Risk</td>
<td>30</td>
<td>$164,768,550</td>
</tr>
<tr>
<td>Not in a SFHA</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>No Building Value Data Provided*</td>
<td>9</td>
<td>Unknown</td>
</tr>
</tbody>
</table>

*Buildings with no value defined are also included in the respective Zones they are found in.

Vulnerability Assessment Conclusions

While the campus is located in an area of minimal flood potential (Zone X), the primary vulnerabilities to flood on campus are people and assets in low lying areas exposed to mostly localized flooding and ponding from overflow of campus creeks or low probability, large-scale storms that produce heavy amounts of precipitation directly over
the campus and surrounding neighborhoods. The proximity to the Ward Creek and Ziele Creek further presents an additional flood hazard risk factor for the campus.

The potential for flooding on campus, although limited, generates potential for a number of cascading effects such as disruptions to the local economy, utility failures, disruptions to providing for the needs of the community, and development of public health hazards. These effects would be exacerbated by effects of seasonal flooding, ongoing heavy precipitation, or excessive run-off from the watershed contributing to the river system. The potential for widespread flooding and damage of structures due to the force of water has exponentially powerful impacts on particular populations among the campus community including those with access or functional needs, international students, the homeless, and students residing in the residence halls.

**Identified Data Limitations**

Missing campus structural replacement costs and complete inventory of building construction features or mitigation efforts to lessen the impact due to flood inundation. HAZUS generated analysis is focused on the broader community level versus finetuning the analysis to the micro-level for facilities such as a university campus.

**Hazardous Materials**

**Description of the Hazard**

A hazardous material is defined in California’s State Hazardous Materials Incident Contingency Plan (1991) as “a substance or combination of substances which, because of quantity, concentration, physical, chemical, or infectious characteristics may: cause, or significantly contribute to an increase in deaths or serious illnesses; and/or pose a substantial present or potential hazard to humans or the environment.” Hazardous materials are one or more of the following: flammable, corrosive or an irritant, oxidizing, explosive, toxic (poisonous or infectious), thermally unstable or reactive, or radioactive. Hazardous materials are ubiquitous in modern society and may be found at all stages of production, consumption, and disposal.

Federal and state laws permit the intentional release of some hazardous materials into the environment such that the risk to human health and the environment is thought to be acceptable. However, sometimes releases are unintentional, resulting from leaks, accidents, or natural hazards. This section focuses on such accidental releases and fall into the following key categories:

**Fixed Hazardous Materials Incident:** A fixed hazardous materials incident is the accidental release of chemical substances or mixtures during production or handling at a fixed facility.

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Transportation Hazardous Materials Incident: A transportation hazardous materials incident is the accidental release of chemical substances or mixtures during highway, waterway or air transport. Populations, built and natural environments are potentially impacted.

Pipeline Incident: A pipeline transportation incident occurs when a break in a pipeline creates the potential for an explosion or leak of a dangerous substance (oil, gas, etc.) possibly requiring evacuation. An underground pipeline incident can be caused by environmental disruption, accidental damage, or sabotage. Incidents can range from a small, slow leak to a large rupture where an explosion is possible. Inspection and maintenance of the pipeline system along with marked gas line locations and an early warning and response procedure can lessen the risk to those near the pipelines.

Hazardous materials can also be classified according to worker safety and health. Information provided by California Division of Safety and Health includes guidelines related to:

Safety hazards (fire and fire byproducts, electricity, flammable gases, unstable structures, demolition, sharp or flying objects, excavations)

Health hazards (carbon monoxide ash, soot and dust; asbestos; hazardous liquids; other hazardous substances; heat illness)

Natural-Technological Incidents (Natechs): During the past two decades, increasing attention has been given to hazardous materials releases resulting from Natechs or a natural disaster event that triggers a technological hazard event. Natechs are of particular concern for the following reasons:

- They can produce a simultaneous effect on many industrial facilities
- Can overwhelm response capacity
- Containment systems may fail
- May produce cascading disasters
- Response may be hindered by a disaster’s impact on the physical environment

Location of the Hazard

Hazardous materials and infrastructure such as fuel tanks, rail lines, chemicals, hazardous waste sites and gas pipelines to varying degrees are located within the CSU system

and/or within its surrounding communities. The planning committee indicates that chemicals are located in the science lab, but otherwise no known hazardous materials are present on campus. At larger scales (beyond the campus planning area) hazardous materials and infrastructure are located throughout the city of Hayward and Alameda County, and reflect different types, configurations and scales dispersed across these geographic areas.

Extent of the Hazard

There is no comprehensive statewide vulnerability assessment available at this time. As such, the true extent of the hazardous materials risk in California and its communities is not known, meaning no overarching conclusions have been reached which have been able to integrate all qualitative and quantitative risk factors to produce a comprehensive measure of the extent of the hazard.

However, for the CSU – East Bay planning committee, although no hazmat events have taken place on campus, and hazardous materials are limited to chemicals in the science building, railroad and gas pipelines, chemical and hazardous waste sites are located close to the campus. Based on these factors along with the types and levels of hazardous materials in the larger community, it is prudent to rank the extent of the hazard for the CSU – East Bay campus as Moderate, and to consider worst case scenarios as the main driver of policy in order to fully mitigate all possible hazardous materials event outcomes.

For example, 400 hazardous materials problems are tied to 32 past earthquakes, including more than 495 documented hazardous materials releases due to the Loma Prieta Earthquake alone (this number excludes innumerable leaks in Pacific Gas & Electric’s natural gas distribution system). That said, it is likely that many such hazardous materials releases have received little attention in the past because public authorities, the media, and the public have overlooked them in the rush to address and recover from immediate disaster threats, and that responsible parties may have an incentive to understate the extent of releases or not to report them at all.

History of the Hazard

According to the CA Governor’s Office of Emergency Services’ Hazardous Materials Spill Report, the state experiences from 10 to 30 spill events daily. As of April 2021, a total of 2,096 spill events had occurred so far this year. Such events have occurred in all the cities and/or counties where CSU campuses are located.

No hazmat incidents have taken place on the CSU – East Bay campus.

Potential Impacts of the Hazard

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A large hazardous materials release could affect an entire community or city under certain conditions related to direction of air flow (air-based chemical release) and population density or the contamination of a community’s main water supply. Either type of release could necessitate large scale evacuation. By contrast, in the rural unincorporated areas where population densities are low, even in the event of a large release, the number of homes that may need to be evacuated would be significantly lower than in an urban environment. The occurrence of a hazmat incident can also result in the shut-down of transportation corridors which can last for hours at a time while the impacted area is stabilized.

The release of some toxic gases may cause immediate death, disablement, or sickness if absorbed through the skin, injected, ingested, or inhaled. Contaminated water resources become unsafe and unusable, depending on the amount of contaminant. Some chemicals cause painful and damaging burns if they come in direct contact with skin. Prolonged and concentrated exposure to such chemicals can produce severe long-term impacts to respiratory, endocrine and nervous systems, heart and brain health.

The potential impacts of chemicals and toxic gases discussed here also apply to the students, staff and environment on the CSU – East Bay campus.

With regard to the natural environment overall, contamination of air, ground, or water may result in harm to fish, wildlife, livestock, and crops. The release of hazardous materials into the environment may cause debilitation, disease, or birth defects over a long period of time. Loss of livestock and crops may lead to economic hardships within the community.

Recent California examples include the 2016 Aliso Canyon methane gas leak\(^{68}\), which caused evacuation of nearby residents, many of whom experienced temporary health problems such as difficulty breathing and eye irritation; and the 2016 Fruitland metal recycle plant fire in Maywood, which released heavy metals such as lead, magnesium, copper, aluminum, antimony, calcium, iron, sulfur, tin, potassium, and zinc which pose severe risks to public health.\(^{69}\) Health effects from exposure to these metals included short-term symptoms such as irritation to the eyes, nose, throat, and lungs.

**Potential Impact of the Hazard (Natechs)**

Natural disasters, including earthquake, flood, and fire also pose risks to public health and the environment. For example, following the Northridge Earthquake, California State University (CSU) Northridge laboratories and chemical storage rooms experienced multiple chemical spills. Such incidents, triggered by a natural disaster, pose a significant risk to students, faculty, staff, and first responders. At a minimum, all CSU campuses with

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a science lab (including CSU – East Bay) is at risk of potential impact from a natural-
technological (combined impact) event.

In a severe flood event, floodwaters are often contaminated with hazardous materials
posing a threat to public and animal health, groundwater, and other parts of the
environment. These hazardous materials may be released from damaged or flooded
underground tank sites (e.g., gas stations or chemical storage facilities), propane tanks,
manure or human waste handling facilities, fertilizer and pesticide storage, agricultural
sites, and household hazardous waste.

In a fire event, (such as the October 2017 Northern California firestorms which destroyed
approximately 6,000 residences) entire neighborhoods can be burned to the ground.
Hazardous material release creates public health concerns which can delay the initial
steps of fire recovery, including reopening burned areas to residents and initiating debris
removal activities. The post-fire “toxic sweep” poses a risk of coming into contact with
toxic substances due to the presence of synthetic and hazardous materials.

Probability of Future Occurrence of the Hazard

The probability of occurrence for a hazmat event on the CSU – East Bay campus can be
viewed in two different ways: the history of occurrence serves as a sound predictor of
future probability assuming current risk and vulnerability factors remain somewhat
constant. For the purposes of the current estimate, no current data clearly indicates
otherwise. As such, the probability of occurrence is Low because the CSU – East Bay
campus has no known hazardous materials other than chemicals in the science lab, and it
has not experienced a hazmat event. That said, hazmat occurrences are largely based on
human error, and any changes in risk and vulnerability factors such as a decreased
vigilance in materials oversight and handling practices or changes in the amount of
chemicals or exposure will likely increase the probability on campus.

Vulnerability to the Hazard

Hazardous materials pose a risk to the CSU – East Bay campus. As identified by the
campus planning committee and on the hazmat map, the following vulnerabilities are
present on campus: chemicals are present in the science lab, and a rail line, gas pipelines,
chemical and hazardous waste sites are very close to the campus footprint. Gases and
chemicals or hazardous waste, if spilled or released, could severely impact human health
and campus operations.

Although it is quite difficult to produce a quantitative measure of vulnerability because
( unlike natural hazards) the probability of occurrence is dependent on human error, which
itself is variable based upon a fluctuating set of interrelated factors, some of which lack
prediction or control, given the complexity of how all natural and built environments and
hazmat risks factors interrelate at the local or campus level, it is prudent to assume for
planning purposes that the campus’ vulnerability is a sub-set of the larger community’s
vulnerability. As such, the CSU – East Bay leadership maintains vigilance to mitigate the
campus’ vulnerabilities identified above at a minimum.
Estimate of Potential Losses

As discussed previously, it is difficult if not impossible to produce an accurate quantitative measure of vulnerability because of the variable nature of a hazardous materials spill. For example, the release of a toxic airborne chemical in a populated area has severe impact potential, whereas the impact potential of a small chemical spill in a remote or rural area is most likely limited to remediation of soil. And, in both cases, the probability of occurrence is dependent on human error, which itself is variable based upon a fluctuating set of interrelated factors, some of which lack prediction or control. In all cases, different types and amounts of hazardous materials interact with fluctuating combinations of human error to produce different event outcomes with variable impact costs.

Vulnerability Assessment Conclusions

It is well understood that with regards to hazmat vulnerability, each campus and its surrounding community (including CSU – East Bay) operates through a complex and dynamic interaction between industrial and commercial inputs and outputs and the natural and built environment. Such activity produces hazardous materials that move through the environment along both convergent and divergent routes and across all levels of land-use from site to campus to city and county and beyond. It is also clear from a review of the Alameda County hazard mitigation plan and Cal OES’ records of hazardous material spills, that such events occur with great frequency and varying degrees of severity across jurisdictions statewide. As such, in assessing the vulnerability of the CSU – East Bay campus, campus-level risks and vulnerabilities are not discreet or isolated but can become exacerbated or augmented through connections to broader community-level hazmat risks and vulnerabilities.

Finally, in order to draw conclusions on vulnerability, it should be noted that any identified vulnerabilities at the campus level and/or community level are circumscribed and potentially reduced by targeted policy and program interventions. Numerous policies and programs have been established in recent years in response to California’s widespread and complex and integrated hazardous materials risks - California established the Unified Program which consolidates and integrates the administrative requirements, permits, inspections, and enforcement activities of the following environmental and emergency response programs: the Aboveground Petroleum Storage Act (APSA) Program, Area Plans for Hazardous Materials Emergencies, the California Accidental Release Prevention (CalARP) Program, the Hazardous Materials Release Response Plans and Inventories (Business Plans), Hazardous Material Management Plan (HMMP) and Hazardous Material Inventory Statement (HMIS) requirements (California Fire Code), the Hazardous Waste Generator and Onsite Hazardous Waste Treatment (tiered permitting) Programs, and the Underground Storage Tank Program.

Identified Data Limitations
The CSU – East Bay planning committee has provided information on campus-level hazmat materials and risks. Data limitations pertain to a comprehensive understanding of human activity and error related to materials control over the long term.
**Landslide**

Description of the Hazard

A landslide is a down-slope movement of soil, rock, or other debris, and can also be referred to as a mass movement or slope failure. These geological hazards can range in size from a few feet to over a mile in length and width and, when heavy and rapidly moving, can cause serious damage and loss of life.

Landslides are classified based on the type of material and type of movement involved. They can range from slow-moving earth flows to fast-moving debris flows, though many large slope failures involve more than one type of movement. The primary natural triggers of slope failures are water, seismic activity, and volcanic activity. Slope saturation by water can occur from intense rainfall, snowmelt, changes in ground-water levels, and surface-water level changes along coastlines. In winter months, El Niño storms or other high rainfall events may saturate soils and trigger slope failure.

**Deep-Seated Landslides**

Deep-seated landslides, ranging in depth from ten to several hundred feet, occur as a result of geologic and hydraulic changes, such as earthquakes or increased levels of groundwater. These landslides can move slowly or quickly and can cause extensive property damage, but rarely result in loss of life.

**Debris Flows Related to Shallow Landslides**

Shallow landslides may mobilize into rapidly moving debris flows and typically occur after sudden saturation of the ground. These types of debris flows are typically more dangerous because they move rapidly, causing both property damage and loss of life.

Debris flows may also occur as a result of post-fire conditions, where wildfires have left barren ground exposed to heavy rainfall. Intense rainfall, generally greater than .5 inch per hour, has the potential to trigger a post-fire debris flow. These landslides may impact lives and properties within the deposition zone and can result in downstream flooding. Post-fire debris flows often occur during the fall and winter following major summer fires.

**Location of the Hazard**

The susceptibility of an area to landslides depends on several variables, including magnitude of slope gradients, water content, ground cover, presence of erosion, and slope material and structure. However, landslides are most prevalent in terrain with weak material and steep slopes, and the highest risk is found in areas with high rainfall or high


earthquake potential. Slope failures are also most likely to occur in areas where they have occurred in the past. In California, the most landslide-prone areas are found along the coast and in the northern Franciscan Formation.

General landslide vulnerability can be estimated from the distribution of weak rocks and steep slopes as seen in Figure 8-11. Based on the Figure below, the CSU-East Bay campus is located between areas moderately susceptible to landslide.

Figure 8-11: Deep-Seated Landslide Susceptibility Surrounding CSU East Bay

Extent of the Hazard

In Hayward, landslides are more likely to occur in the hillsides east of CSU East Bay, which are susceptible to landslides as a result of rain or ground shaking. Seismic activity along the numerous Bay area faults may lead to landslides. The indirect impacts of landslides in the region may cover a larger geographical extent. Based on the campus’ close proximity to the landslide hazard zone, and the history of landslides on Alameda County, the planning committee ranks the extent of the landslide hazard for the campus as Moderate.

History of the Hazard

FEMA has declared nine major disasters involving landslides, mudslides, or mud flows since 1982. NOAA recorded fourteen debris hazard events in Alameda County from 2006 to 2019. The 1997-1998 El Nino storms caused abundant debris flow on the eastern hillsides of the county and approximately $400,000 in damage. No landslides have been recorded on, or immediately adjacent to the campus.

Potential Impacts of the Hazard

CSU East Bay may be impacted by the disruption of services as a result of landslides in the region. Landslides can result in physical damage to buildings and property and have the potential to significantly affect infrastructure. As a landslide moves, it distresses structural foundations by settlement, cracking, and tilting. Fast-moving flows can remove entire structures in one instance, while other types of flows can cause damage gradually.

Transportation and utility infrastructure are particularly vulnerable to landslides, since the failure of any component can disrupt service over a large area. The loss of power and communication and disruption of transportation can have cascading effects throughout an area, including impaired disposal of sewage, contamination of water supplies, and the release of flammable fuels. Transportation routes are also often expensive to clean up, and prolonged obstruction can disrupt the movement of people and goods for long periods of time.

Probability of Future Occurrence of the Hazard

Slope failures are also often triggered by other natural hazards, such as heavy rainfall or earthquakes, so landslide frequency is somewhat related to the frequency of these other hazards. As climate change impacts the frequency and intensity of triggers such as rain events, fires, and coastal erosion, landslides may generally occur more often. Historically, landslides have occurred frequently in the foothills and therefore are highly likely to occur in the future. The USGS has identified these foothills as a site where intense rainfall is likely to trigger a fast-moving downslope mudflow. Given the location of the campus adjacent to the landslide zone, and the historical occurrence of landslides in the county, the planning committee ranks the probability of the landslide hazard for the campus as Possible.

Vulnerability to the Hazard

The City of Hayward is susceptible to landslides associated with earthquakes and flooding. The vulnerability of the built environment to landslides depends on exposure and is more likely to incur damage as a result of proximity, rather than inferior structural design. The structures most vulnerable to landslides are buildings and utility/transportation lifelines, which can be impacted by either impact or ground deformation. Utilities and transportation infrastructure are particularly vulnerable, due to their geographic extent and susceptibility to physical distress. The CSU-East Bay campus may contain building and infrastructure vulnerabilities to some degree. See the landslide location map in relation to the campus along with landslide severity zones identified.
Campus leadership may decide to conduct a broader assessment of asset risk in the future. Finally, any population proximal to a landslide when it occurs is vulnerable to its impacts.

**Estimate of Potential Losses**

There are no current models for estimating potential losses from a landslide directly impacting the campus.

Although the economic impact of landslide damage can exceed that of the direct repair costs, there are currently no applicable methods for estimating indirect costs related to CSU East Bay.

**Vulnerability Assessment Conclusions**

Landslides could impact the campus in a variety of ways, primarily related to indirect impacts to transportation and utilities. Utility outages can impact health, particularly for vulnerable populations, and can cause interruptions in operations. Interruptions may impact student and employee’s ability to travel to campus and the delivery of classes and events.

**Identified Data Limitations**

The ability to predict future landslides at the CSU East Bay campus is limited. However, the USGS estimates that climate change-induced shifts in weather will increase the frequency of post-wildfire landslides, which are expected to occur almost every year in California.
**Power Outage**

**Description of the Hazard**

CSU East Bay is located in the eastern region of the San Francisco Bay along with the City of Oakland, Hayward, Fremont, Richmond, Berkley Emeryville, Alameda, and others. Most aspects of modern life, rely on the near continuous availability of utilities, such as electricity, water, and natural gas and the East Bay is no exception as it is a highly populated community with one of the Bay Area’s greatest population densities. An interruption in the supply or distribution of these services can leave highly populated areas, like the East Bay Area, without electricity or sanitation. These interruptions can produce cascading effects from other hazards, such as major windstorms, leading to intentional disruptions of transmission lines due to safety concerns.

A power outage event can interrupt day-to-day operations of the campus, like in-person classes, impede, or limit digital, telephonic or radio communications, create traffic jams around the busy avenues and boulevards surrounding the campus, close the student health center and close restaurants around campus and outside the campus. Additionally, thousands of CSUDH student residents in on-campus housing would also be affected by a power outage on campus and/or in the surrounding area.

An electric power disruptions and outages fall into two categories: intentional and unintentional.

The four types of **intentional** disruptions:

- Planned: Some disruptions are intentional and can be scheduled based maintenance or upgrading needs.
- Unscheduled: Some intentional disruptions must be done "on the spot" in response to an emergency.
- Demand-Side Management: Some customers (i.e., on the demand side) have entered into an agreement with their utility provider to curtail their demand for electricity during periods of peak system loads.
- Load Shedding: When the power system is under extreme stress due to heavy demand and/or failure of critical components, it is sometimes necessary to intentionally interrupt the service to selected customers to prevent the entire system from collapsing. These intentional interruptions result in rolling blackouts.

**Unintentional** or unplanned disruptions are outages that come with essentially no advance notice or warning. This type of disruption is the most problematic. The following are categories of unplanned disruptions:

- Accident by the utility, utility contractor, or others.
- Malfunction or equipment failure.
- Equipment overload (utility company or customer).
- Reduced capability (equipment that cannot operate within its design criteria).
• Tree contact other than from storms.
• Vandalism or intentional damage.
• Weather, including lightning, wind, earthquake, flood, and broken tree limbs taking down power lines.
• Wildfire that damages transmission lines.

Location of the Hazard

Although power outages can take place within a certain area, it has the potential to affect the entire planning area equally.

Extent of the Hazard

An electric power disruptions and outages fall into two categories: intentional and unintentional.

The four types of intentional disruptions:

Planned: Some disruptions are intentional and can be scheduled based maintenance or upgrading needs.

Unscheduled: Some intentional disruptions must be done "on the spot" in response to an emergency.

Demand-Side Management: Some customers (i.e., on the demand side) have entered into an agreement with their utility provider to curtail their demand for electricity during periods of peak system loads.

Load Shedding: When the power system is under extreme stress due to heavy demand and/or failure of critical components, it is sometimes necessary to intentionally interrupt the service to selected customers to prevent the entire system from collapsing. These intentional interruptions result in rolling blackouts.

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Equipment overload (utility company or customer).

Reduced capability (equipment that cannot operate within its design criteria).

Tree contact other than from storms.

Vandalism or intentional damage.

Weather, including lightning, wind, earthquake, flood, and broken tree limbs taking down power lines.

Wildfire that damages transmission lines.
In order to anticipate outage conditions and reduce impacts, campus facility managers and others keep track of conditions and data provided by the media, municipal utilities and the California Independent System Operator (CAISO) which is tasked with managing the power distribution grid that supplies most of California, except in areas served by municipal utilities. CAISO is thus the entity that coordinates statewide flow of electrical supply. CAISO uses a series of stage alerts to the media based on system conditions. The alerts are as follows:

Stage 1 - reserve margin falls below 7 percent.
Stage 2 - reserve margin falls below 5 percent.
Stage 3 - reserve margin falls below 1.5 percent.

Rotating blackouts become a possibility when Stage 3 is reached. Utility agencies aim to advise affected areas approximately 48 hours in advance of a potential PSPS event and will attempt notification again approximately 24 hours before power is shut off. Campus staff respond accordingly.

Given the prevalence of rolling blackouts and other power outages in California, the campus maintains safety precautions, situational awareness, access to emergency power generators and other protocols for managing campus power outages. Given that recorded outages have taken place on campus, the planning committee ranks the extent of the power outage hazard as Moderate.

History of the Hazard

CSU East Bay has experienced power outages for various reasons over time. The university worked with the community’s local electric utility company, Power, Gas and Electric (PG&E) to restore energy to the campus for its facilities, assets, resident halls, and classrooms.

A loss of power incident affecting the campus occurred on October 17, 2019, CSU East Bay was impacted by a PG&E mandated Public Safety Power Shut Off (PSPS) creating challenges for students, especially commuter students, making it difficult for students to get to the University. CSU East Bay is considered a commuter school, where a large majority of their students drive, at times hours, to get to campus. Mass power outages make it hard for commuter students to make it to their class on time and safely. With climate change related hazards, like wildfires, PSPS’s will continue throughout California when wildfire threats exacerbate in areas within proximity of the Bay Area, especially the East Bay.

Potential Impacts of the Hazard

Instructors, campus residents, staff and administration rely on electricity for basic survival and operations. During a widespread power failure, it may take days to restore operations. Electrical power may be the only cooling source for many individuals around the campus and its community, and long-term outages can potentially put people’s health and life at risk. Disruptions in the supply of heating fuel may put people and property at
risk during extremely cold weather if it relies on electric generation or heating mechanisms instead of gas. Additionally, many medical devices, communications devices, and security rely on power to maintain their functions.

Climate Change and Energy Shortage

Climate change is expected to bring more frequent and intense natural disasters. These changes have created a variability at a rate that makes historical data a poor predictor of future climate. For example, the warmest years on record in California occurred in 2014, 2015, and 2016. The 2016-2017 year broke the record as the wettest ever recorded in the northern Sierra Nevada Mountains.

Changes in temperatures, precipitation patterns, extreme events, and sea-level rise have the potential to decrease the efficiency of thermal power plants and substations, decrease the capacity of transmission lines, render hydropower less reliable, spur an increase in electricity demand, and put energy infrastructure at risk of flooding.

With climate warming, higher costs from increased demand for cooling in the summer are expected to outweigh the decreases in heating costs in the cooler seasons. Hotter temperatures in California will mean more energy (typically measured in “cooling-degree days”) needed to cool homes and businesses both during heat waves and on a daily basis, during the daytime peak of the diurnal temperature cycle. During future heat waves, historically cooler coastal cities (e.g., San Francisco and Los Angeles) are projected to experience greater relative increases in temperature, such that areas that never before relied on air conditioning will experience new cooling demands.

Secondary impacts of energy shortages are most often felt by vulnerable populations. For example, those who rely on electric power for life-saving medical equipment, such as respirators, are extremely vulnerable to power outages. Also, during periods of extreme heat emergencies, the elderly and the very young are more vulnerable to the loss of cooling systems requiring power sources.

Probability of Future Occurrence of the Hazard

The probability of California experiencing a power outage can be difficult to quantify but is a hazard that occurs annually during the same seasonal periods of temperature variance throughout the calendar year. Hayward and Alameda County experience such outages. As such, the probability ranking for the area is Likely; although the campus has most likely recorded fewer events than the surrounding area, it is prudent to assign this same ranking for the campus.

Climate models suggest summer global temperatures are likely to increase while changes between temperature extremes would be more pronounced. As such, it is expected that power outages will occur more frequently in the future.

Vulnerability to the Hazard

Based on the data available, and in consideration of the increasing effects of climate change, the campus remains vulnerable to power outages in terms of impacts to people,
power infrastructure and campus operations. Nonetheless, as discussed campus leadership works to reduce vulnerabilities through consistent use of safety and operational protocols and emergency power sources to ensure it is able to mitigate an interruption to electrical power.

Estimate of Potential Losses

The data provided by Cal State East Bay State does not report any value for potential losses due to power outage.

Vulnerability Assessment Conclusions

The primary concern for campus leadership is that a loss of power can lead to potential hazards to students, faculty, and staff at Channel Islands. Safety and operations protocols center on the following “direct impact” set of concerns:

Elevators, entry ways, air filtration systems and lighting provide the campus community with the necessary infrastructure and systems to function and navigate through the campus and to maintain a safe campus environment and visibility during nighttime hours. The vulnerable population (especially students with physical disabilities) may be the most heavily affected by loss of power as they rely on elevators, entry ways with automatic doors, and locks and lights may impede on a disabled student’s ability to travel and utilize the campus and its structures safely.

The use of communication devices, billing, records, and electrical tools may also become unusable due to a loss of electricity. Many records and billing items may have to revert to “by-hand” procedures and paper copies may be needed for continuity of operations. Additionally, classrooms may not be usable if lighting equipment is not functioning impacting a semester or quarter’s progress for the academic year.

Identified Data Limitations

Cal State East Bay did not report any monetary or life losses due to a power outage. Also, the campus did not report any incidents involving a power outage directly affecting the campus community and operations.
Volcano (Associated Air Quality)

Description of the Hazard

The US Geological Service defines volcanoes as “openings or vents where lava, tephra (small rocks), and steam erupt on to the Earth’s surface. Through a series of cracks within and beneath the volcano, the vent connects to one or more linked storage areas of molten or partially molten rock (magma). This connection to fresh magma allows the volcano to erupt over and over again in the same location.”

A volcanic eruption occurs when magma, lighter than surrounding rock, is driven upwards by its buoyancy and by pressure from the dissolved gases contained within it. Gases are released from magma as it reaches the surface and pressure decreases. Magma can be erupted in several ways and violent eruptions typically cause tiny pieces of tephra (ash) to be carried away by the wind. This ash is hard, does not dissolve in water, is extremely abrasive and mildly corrosive, and conducts electricity when wet. The gases released in an eruption include carbon dioxide, sulfur dioxide, hydrogen sulfide, and hydrogen halides. Depending on their concentration, these are potentially hazardous to people, animals, agriculture, and property.

Location of the Hazard

There are eight volcanic areas located throughout California. Seven of these - Medicine Lake Volcano, Mount Shasta, Lassen Volcanic Center, Clear Lake Volcanic Field, Long Valley Volcanic Region, Coso Volcanic Field, and Salton Buttes – are considered active volcanoes. No portion of CSU East Bay or Alameda County is located within a volcano hazard zone.

Extent of the Hazard

Volcanic hazards are most severe within a few miles of the volcano vent and the severity generally decreases with distance. Ash impact zones can range from tens to hundreds of miles from the vent source. The US Geological Survey has estimated zones surrounding active volcanoes wherein two (2) inches or more of ashfall following an eruption is possible. While CSU East Bay does not fall within an estimated ashfall zone, lighter dustings of ash outside of those areas may directly or indirectly impact the campus. As such, the planning committee ranks the extent of the hazard for the campus as Low.

History of the Hazard

No historical eruption events in California have affected the campus. Over the last 1,000 years, there have been at least 12 eruptions in California. The most recent volcanic

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eruption in California occurred at Lassen Peak about 100 years ago, when a major explosion delivered windborne ash over 275 miles away.

Potential Impacts of the Hazard

The specific impacts vary widely and depend on which type of volcano erupts, the style of explosion, the volume of lava, the eruption duration, and the local water conditions. As CSU East Bay is not proximal to an active volcano, only the potential impacts of ashfall and gases have been detailed. While both these hazards can be widespread, their most severe impacts are generally seen closer to the volcanic source.

Although ashfall is typically a nonlethal volcanic hazard, it is the most widespread and disruptive. Falling ash can damage crops, electronics, and machinery. It can also impact human health by irritating the respiratory tract, eyes, and skin. The particles may enter drinking water and structures and may cause structure failure if it is thick and heavy enough. Even a fine layer of ash can disrupt utilities. A portion of California’s major electric transmission lines, aerial telecommunication lifelines, transportation corridors, and water storage and conveyance lie within the state’s volcano hazard zones. Impacts to any of these can impact operations at CSU East Bay.

The potential impacts of gases released during volcanic eruptions are as follows:

Carbon dioxide typically becomes diluted very quickly and is not life threatening. However, it can become trapped in higher concentrations in low-lying areas and has the potential to be fatal.

Sulfur dioxide can cause acid rain and air pollution downwind of a volcano.

Hydrogen sulfide can cause irritation of the upper respiratory tract. At high concentrations it can cause unconsciousness and death.

Hydrogen halides can coat ash particles and, once deposited, poison drinking water, agricultural crops, and grazing land.

Probability of Future Occurrence of the Hazard

The US Geological Survey, based on the record of volcanic activity in California, estimates that the probability of another small- to moderate-sized eruption in the next thirty years is about 16 percent. As such, the annual probability of future occurrence for the campus is ranked by the committee as Unlikely.

Vulnerability to the Hazard

Populations living near volcanoes are the most vulnerable to eruptions and lava flows. However, volcanic ash can travel and affect populations miles away. The location and thickness of ash in any given area is a function of the severity of the eruption and wind speed and direction. For CSU East Bay, there is low vulnerability to the immediate impacts of volcanic eruptions due to the limited area affected and remote potential of an
eruption. In the event of a widespread ashfall event, the elderly, infants, and populations with existing respiratory disease will be at higher risk.

**Estimate of Potential Losses**

Impacts to critical infrastructure, agriculture, and property from ashfall have the potential to cause widespread disruption, damage, and economic loss throughout the state. In the event of a widespread ashfall event, impacts will be immediate.

Current modeling is not precise enough to allow for an assessment of potential losses from ashfall to structures or infrastructure on or surrounding the campus.

**Vulnerability Assessment Conclusions**

CSU East Bay is unlikely to experience the direct impacts of a volcanic event. While the campus may be indirectly impacted by ashfall elsewhere in the state, direct ashfall impacts are generally unlikely but possible in a widespread event. However, the likelihood of any volcanic eruption in the state impacting the campus is very low.

**Identified Data Limitations**

Not all active volcanoes in California have been zoned for hazards by the US Geological Survey. This, together with the infrequent occurrence of volcanic explosions and number of factors determining type and extent of impacts, make the quantification of potential loss difficult.
Wildfire

Description of the Hazard

While wildfires are a natural part of California’s ecosystem, wildfires in California represent a hazard that presents one of the greatest probabilities of destruction along with a demonstrated history of catastrophic fire events in recent years. The destructive fire seasons of 2017 to 2020 illustrated the destructive forces fire presents to communities across the state. Wildfires may result in the structural loss, infrastructure loss, dangerous air quality, environmental damages, economic impacts, injuries, and loss of life. In many communities throughout California, wildfire presents greatest risk to human life and property.

Wildfires have been defined as any free burning vegetation fire that initiates from an unplanned ignition, whether natural or human caused demanding fire suppression actions to contain. These fires are prone to become uncontrolled, spreading through vegetative fuels rapidly exposing people and structures to harm. Wildfires present a significant risk to communities across the state, as evidenced by increasing trends of structural losses from wildland fires. This risk is elevated in areas where development and community growth has intersected, also known as the wildland-urban interface (WUI). In the interface setting, development itself can provide additional fuel for large fires. Recent fires have also demonstrated the ability of fire to consume populated areas in extreme conditions.

California’s Mediterranean climate in combination with its geography and vast population create a combination of factors that promotes an optimal environment for large fire growth and consequences. As there is great diversity of geographic characteristics across the state, the risks and potential consequences of wildfire must be assessed locally. The physical location, weather patterns, local fuel types and volume, extent of the WUI, topography, and additional factors will factor differently from part of the state to another.

The behavior of wildfires in California is significantly influenced by three distinct geographic factors. These factors will help shape the size, direction of spread, rate of combustion, fire intensity, and ability to pre-heat fuels. The physical factors contributing to wildfire behavior include:

Topography – The rate in which wildfires spread increases with greater slopes in topography. The greater the slope will result in more pre-heating of fuel above the advancing fire. The direction that a slope faces will also influence fire behavior as south facing slopes receive greater solar radiation and thus drier vegetation that is more susceptible to combustion. Ridgetops often denote the end of fire spread as fire has greater difficulty spreading downhill.

Weather – Weather factors substantially in influencing the behavior of wildfires. Wind, temperature, humidity, lightning, and lack of precipitation all contribute to a fire’s ability or inability to spread and intensify. California routinely experiences conditions in which these factors are in alignment to contribute to extreme fire behavior during the summer and fall seasons. High winds, low humidity, and high temperatures provide an environment promoting extreme fire activity.

Fuels – Certain types of vegetation are increasingly prone to igniting and promote more intense burning. Areas with greater “fuel loading” (amount of fuel present in terms of weight of fuel per unit of area) increases the amount of fuel to fuel a fire. Greater volumes of dead or dry vegetation compared to live plants is a critical factor. Vegetation during drought conditions will experience decrease in moisture content increasing the conditions for combustion. Fuels close proximity to one another allows for rapid spread through contact or radiant exposures.

A risk assessment for wildfires should be implemented within a geospatial context focusing on the specific location features and incorporates the three components of the wildfire risk triangle – likelihood, intensity, and susceptibility.

Location of the Hazard

Substantial portions of the State of California are exceptionally vulnerable to wildfire activity or reside in a wildland-urban interface (WUI) area due to the vast open spaces, rangelands, forests and other lands with high susceptibility to fire occurring throughout the state. The campuses in Hayward and Concord are located in the hills of the San Francisco East Bay. These hills are largely covered in moderate to high fuel density areas. In general, areas considered to be within Local Fire Hazard Severity Zones defined by the Fire and Resource Assessment Program (FRAP) within the California Department of Forestry and Fire Protection (CalFire) occur immediately south of the Hayward campus and south of the Concord campus. These hills surrounding the East Bay communities can be topographically diverse, contain heavier vegetative fuels, and often have residential development interspersed.

The CSU East Bay /Hayward campus is located in the hills of the eastern portion of the City of Hayward. The area immediately surrounding the campus is predominately developed with residential land uses. The campus has open fields containing short grasses and moderate fuels to the south of the main campus. The area to the south of campus is designated as a Local High Fire Hazard Severity Zone. To the north of the campus, are residential neighborhoods. To the north of the campus, are residential neighborhoods and a valley containing Ward Creek containing heavy fuels.

The CSU Easy Bay /Concord campus is located in the hills of Concord near the base of Mt. Diablo. The campus has open fields containing short grasses and moderate fuels to the south and west of the campus. The area to the south of campus is designated as a Local High Fire Hazard Severity Zone. To the north of campus are residential neighborhoods across Ygnacio Valley Road, however grassy fields lie between the campus and the road. To the east of the campus are residential neighborhoods separated by open grassy fields.
Figure 8-12: Hayward County Fire Hazard Severity Zones

Figure 8-13: Contra Costa County Fire Hazard Severity Zones


Extent of the Hazard

While the threat to fire directly affecting the campus is considerable, the direct effect of fire generated smoke is also likely to occur. Fires are likely to occur in close proximity to the campus generating smoke that could envelop the campus in the right atmospheric conditions. Fires that are large enough to generate volumes of smoke to cover great distances have the potential to affect the air quality of the San Francisco Bay Area including the campus. This will especially be the case in weather conditions creating strong offshore winds. The potential for this impact has been demonstrated during the summers of 2018, 2019, and 2020 as fires burned across the state and spread smoke over vast distances. Fires burning well outside of the Alameda County region have the potential to distribute smoke onto the CSU East Bay campus.

Given that the area immediately surrounding the CSU East Bay campus is in proximity to fire hazard zones designated as High Fire Hazard Severity Zones (HFHSZ), and that the County and surrounding hillsides are considered to be of high fire threat including Very
High Fire Hazard Severity Zones (VHFHSZ) with a history of wildfires, the planning committee ranks the extent of the wildfire hazard for the campus as High.

The National Fire Danger Rating System (NFDRS) is the current system in use for rating and classifying the potential danger of fire. The NFDRS tracks the effects of previous weather events on both dead and live fuel loads and adjusts accordingly based on future or predicted weather conditions. These complex relationships and equations are computed, and the outputs are expressed in terms that users can quickly and easily understand. The current NFDRS is used by all federal and most state agencies to assess fire danger conditions.

The following table depicts the NFDRS, from the US Forest Service’s Wildland Fire Assessment System.

Table 8-27: National Fire Danger Rating System

<table>
<thead>
<tr>
<th>Rating</th>
<th>Basic Description</th>
<th>Detailed Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>CLASS 1: Low Danger (L)</td>
<td>Fires not easily started</td>
<td>Fuels do not ignite readily from small firebrands. Fires in open or cured grassland may burn freely a few hours after rain, but wood fires spread slowly by creeping or smoldering and burn in irregular fingers. There is little danger of spotting.</td>
</tr>
<tr>
<td>COLOR CODE: Green</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CLASS 2: Moderate Danger (M)</td>
<td>Fires start easily and spread at a moderate rate</td>
<td>Fires can start from most accidental causes. Fires in open cured grassland will burn briskly and spread rapidly on windy days. Woods fires spread slowly to moderately fast. The average fire is of moderate intensity, although heavy concentrations of fuel – especially draped fuel -- may burn hot. Short-distance spotting may occur but is not persistent. Fires are not likely to become serious and control is relatively easy.</td>
</tr>
<tr>
<td>COLOR CODE: Blue</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CLASS 3: High Danger (H)</td>
<td>Fires start easily and spread at a rapid rate</td>
<td>All fine dead fuels ignite readily, and fires start easily from most causes. Unattended brush and campfires are likely to escape. Fires spread rapidly and short-distance spotting is common. High intensity burning may develop on slopes or in concentrations of fine fuel. Fires may become serious and their control difficult, unless they are hit hard and fast while small.</td>
</tr>
<tr>
<td>COLOR CODE: Yellow</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### CLASS 4: Very High Danger (VH)

**COLOR CODE:** Orange

- Fires start very easily and spread at a very fast rate.
- Fires start easily from all causes and immediately after ignition, spread rapidly and increase quickly in intensity. Spot fires are a constant danger. Fires burning in light fuels may quickly develop high-intensity characteristics - such as long-distance spotting - and fire whirlwinds when they burn into heavier fuels. Direct attack at the head of such fires is rarely possible after they have been burning more than a few minutes.

### CLASS 5: Extreme (E)

**COLOR CODE:** Red

- Fire situation is explosive and can result in extensive property damage.
- Fires under extreme conditions start quickly, spread furiously, and burn intensely. All fires are potentially serious. Development into high intensity burning will usually be faster and occur from smaller fires than in the Very High Danger class (4). Direct attack is rarely possible and may be dangerous, except immediately after ignition. Fires that develop headway in heavy slash or in conifer stands may be unmanageable while the extreme burning condition lasts. Under these conditions, the only effective and safe control action is on the flanks, until the weather changes or the fuel supply lessens.

Due to the impacts of wildfires on public health, agencies across the nation have adopted the use of the Air Quality Index (AQI) to communicate and provide a consistent approach to air quality measurements and categorization. The AQI primarily focuses on the health effects caused by pollutants in the air such as smoke. The goal of the AQI is to provide advisories to assist the public in determining when to reduce exposures to inhalation of air pollution as pollution levels rise.
Table 8-28: Air Quality Index for Ozone and Particulate Pollution

<table>
<thead>
<tr>
<th>Daily AQI Color</th>
<th>Levels of Concern</th>
<th>Values of Index</th>
<th>Description of Air Quality</th>
</tr>
</thead>
<tbody>
<tr>
<td>Green</td>
<td>Good</td>
<td>0 to 50</td>
<td>Air quality is satisfactory, and air pollution poses little or no risk.</td>
</tr>
<tr>
<td>Yellow</td>
<td>Moderate</td>
<td>51 to 100</td>
<td>Air quality is acceptable. However, there may be a risk for some people, particularly those who are unusually sensitive to air pollution.</td>
</tr>
<tr>
<td>Orange</td>
<td>Unhealthy for Sensitive Groups</td>
<td>101 to 150</td>
<td>Members of sensitive groups may experience health effects. The general public is less likely to be affected.</td>
</tr>
<tr>
<td>Red</td>
<td>Unhealthy</td>
<td>151 to 200</td>
<td>Some members of the general public may experience health effects; members of sensitive groups may experience more serious health effects.</td>
</tr>
<tr>
<td>Purple</td>
<td>Very Unhealthy</td>
<td>201 to 300</td>
<td>Health alert: The risk of health effects is increased for everyone.</td>
</tr>
<tr>
<td>Maroon</td>
<td>Hazardous</td>
<td>301 and higher</td>
<td>Health warning of emergency conditions: everyone is more likely to be affected.</td>
</tr>
</tbody>
</table>

History of the Hazard

The State of California has a long history of chronic and destructive wildfires throughout the state. On average, 8,300 wildfires have caused burnt 928,245 acres across the state over the 20-year period between 2000 and 2020. California Department of Forestry and Fire Protection also has a long history of wildfire activity primarily in the foothills and mountains of the Oakland Hills, Hayward Hills, and Diablo Range. Wildfires occurring in Alameda County have resulted in thousands of acres burned and millions of dollars in damages.

80 California Department of Forestry and Fire Protection. Stats and Events. Retrieved 05.03.2021 from: https://www.fire.ca.gov/stats-events/
The area immediately surrounding the CSU East Bay campus is in proximity to fire hazard zones designated as High Fire Hazard Severity Zones (HFHSZ). Additionally, the County is surrounded by areas that are considered to be of high fire threat that would produce vast quantities of smoke and particulates into the air. The East Bay campus has experienced multiple days of poor air quality due to fires burning in Bay Area and neighboring counties. The 2017, 2018, and 2020 fire seasons in particular illustrated the increase in wildfire generated smoke saturating the air of communities throughout the state including the San Francisco Bay Area. CSU East Bay personnel reported the ongoing development of policies and procedures to address the response to poor air quality days.

Table 8-29: Historic Alameda County Large-Scale Fires

<table>
<thead>
<tr>
<th>Date</th>
<th>Fire</th>
<th>Location</th>
<th>Declaration</th>
<th>Damages</th>
</tr>
</thead>
<tbody>
<tr>
<td>8/18/1966</td>
<td>La Costa</td>
<td>Sunol</td>
<td>NA</td>
<td>1,278 acres</td>
</tr>
<tr>
<td>7/5/1970</td>
<td>Carnegie #3</td>
<td>East County</td>
<td>NA</td>
<td>4,389 acres</td>
</tr>
<tr>
<td>7/1983</td>
<td>Del Valle</td>
<td>Del Valle</td>
<td>NA</td>
<td>4,713 acres</td>
</tr>
<tr>
<td>10/1991</td>
<td>Oakland Hills (Tunnel)</td>
<td>Oakland</td>
<td>DR-919-CA</td>
<td>1,622 acres</td>
</tr>
<tr>
<td>8/2003</td>
<td>Devil</td>
<td>Southeast County</td>
<td>NA</td>
<td>5,444 acres</td>
</tr>
<tr>
<td>7/2005</td>
<td>Tesla</td>
<td>East County</td>
<td>NA</td>
<td>6,744 acres</td>
</tr>
<tr>
<td>8/2020</td>
<td>SCU Lightning Complex</td>
<td>East County</td>
<td>FM-5338-CA; DR-4558-CA</td>
<td>396,624 acres*</td>
</tr>
</tbody>
</table>

*Includes acreage across six counties (Alameda, Contra Costa, Merced, San Joaquin, Santa Clara, and Stanislaus)

Fire has contributed significantly to Alameda County’s hazard and disaster history. Some particular fires that have shaped the way fire plays into preparedness, planning, response, recovery, and mitigation efforts are described in the following.

The October 1991 Tunnel Fire, otherwise known as the Oakland Hills Fire, occurred in the hills of eastern Oakland, CA. Strong winds, drought, low humidity, heavy fuels, and inadequate separations between fuels and structures allowed an earlier fire to rekindle and rapidly spread. This fire clearly demonstrated the challenges faced in a wildland urban interface environment. The area affected is a residential community of Oakland comprising thousands of homes. The fire required a massive mutual aid effort forced the evacuation of several neighborhoods, burned 3,354 structures, killed 25 people, and resulted in $1.5 billion in damages.  

Potential Impacts of the Hazard

The location of the CSU East Bay campus on a hillside near areas designated as High Fire Hazard Severity Zones places a threat that flame, ember, and smoke exposure from wildfire to the campus. There is potential for fire to occur from any direction of the campus. The surrounding hillsides and valleys are composed of light to moderate fuels. The threat from fire and the impacts fire would have on the university is due to the campus being located adjacent to open hillsides and field susceptible to fire spread.

Potential impacts to the campus community resulting from wildfires include:

Injuries or loss of life

Campus property destruction or damage

Residential property destruction or damage

Commercial property destruction or damage

Loss of property contents

Infrastructure damage

Damaged or destroyed lifelines/supply routes

Damaged or destroyed utilities

Damaged or destroyed critical facilities supporting campus emergency support needs

Threat or damage to power plant

Loss of community economic base

Employment losses

Loss to ground supporting vegetation on hillsides resulting in erosion or landslides in future precipitation events

Agricultural (crops and livestock) damages or destruction

Environmental damage

Societal and community impacts

Damage to organizations and facilities providing support services to vulnerable populations

Greater evacuation challenges for those most vulnerable

Psychological impacts of impacted populations

Disruptions to education delivery to community

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Potential impacts resulting from wildfire generated smoke include:

- Dangerous levels of air pollution
- Human Health Effects
  - Similar health impacts to pets
- Air conditioning systems overwhelmed
- Greater demands on air filtration systems
- Greater demands on healthcare systems
- Reduced outdoor work productivity
- Closures of academic sessions

Additionally, there remains a number of secondary impacts from wildfires that could affect the campus community. Utilities feeding areas of Alameda County including the campus may be damaged resulting in power outages. Fire related damage in the watersheds will likely cause future landslides, degradation to plants supporting hillsides, and impact the hydroelectric power capabilities. Fires may present threats to areas of recreation, scenic value, and wildlife that are a part of the culture of the campus community. Finally, the campus may experience effects of evacuated individuals arriving on campus from other areas as a location of refuge.

Probability of Future Occurrence of the Hazard

Based on the wildfire threat potential in the area on and surrounding the CSU East Bay campus and the CSU East Bay Concord campus, including the immediate proximity to hillsides with extensive vegetative growth, and the historic occurrences of fires, the probability of wildfire related damage and impacts from smoke is considered Possible.

Based on the wildfire threat potential in the area surrounding the campus and the San Francisco East Bay region, including the volume of areas in elevated Fire Hazard Severity Zones throughout the Alameda and Contra Costa Counties, the past occurrences of wildfire generated smoke from areas beyond Alameda County, the probability of wildfire generated smoke impacts to air quality is considered Possible.

Vulnerability to the Hazard

The CSU East Bay campus is subject to direct impact from wildfire due to the campus location within a wildland-urban interface zone. The campus is identified to reside near a designated local High Fire Hazard Severity Zone. The campus is surrounded on three sides by hillsides and open lands containing combustible vegetation combined with residential development. Additionally, vulnerabilities to the effects of wildfire would lie within the campus community who may reside or work in locations that are exposed to the Fire Hazard Severity Zones in other parts of the surrounding region. Wildfires occurring in other areas of the region may result in the displacement of large numbers of
people. These effects may spill onto the campus in the form of evacuees or facility support to emergency resources.

Fire directly threatening the campus would likely take the form of vegetation fires along the hillsides and extending onto the campus or localized fires involving single structures or small areas. Smaller vegetation fires are possible surrounding the campus in the urban forest or fields surrounding the city. These incidents would likely have significant impact to the campus.

The primary basis of vulnerability is based on the population affected and the built environment exposed. In general, newer construction will be more fire resistant than older buildings as building and fire codes and construction technology have improved. Density of buildings and proximity of fuels to buildings or equipment at risk of combustion would additionally influence the fire’s ability to spread to structures. Structures with vegetation and other combustibles near the structure increases the ability of fire to spread to buildings.

Access to the west using Carlos Bee Blvd or Harder Road servicing access to Hayward could become cutoff during fire incidents. Hayward Blvd exiting the back of campus may also be impacted by fire making it impassible. The university is limited by these routes for access to and from the campus. Access for supplies, equipment, and emergency services in addition to evacuation away from the campus would likely be forced to use alternative routes into Hayward.

Additional concerns regarding vulnerabilities to wildfire are related to the smoke that fires in the area would produce. The recent summer seasons have clearly demonstrated the reality of large wildfires producing enough smoke to fill the Bay Area even from substantial distances away. These recent fires have displayed how the effects of this smoke impact the general population and especially vulnerable populations. CSU East Bay students, faculty, and staff both on campus and off campus face these same vulnerabilities related to smoke filled air.

Smoke generated from large wildfires pose a threat in terms of diminished air quality that would be exposed to the population within the area of smoke distribution. Individuals with existing health problems such as respiratory or cardiac illnesses are increasingly vulnerable to wildfire generated smoke. Staff who work in roles requiring outdoor activity will be increasingly exposed during days where the air quality index is considered unhealthy or worse. Student athletes participating in outdoor sports and engaging in aerobic activities are increasingly vulnerable to the effects of wildfire.

The vulnerability to members of the campus community in which wildfire generated smoke on the CSU East Bay campus will vary depending on when the air quality was to reach unhealthy levels. The risk to the campus population will be lessened during periods when classes are not in session or during periods of breaks. Conversely, during the days and hours that classes are in session and staff are at their workplaces, the human vulnerability increases. However, in region-wide events this vulnerability may be shared with the homes and workplaces of members of the campus community and their families.
Vulnerable populations will likely face disproportionate health safety issues from smoke filled air, experience increased stresses, may require the need to remain away from the campus enclosed at home, and may find difficulty in accessing equipment or supplies to aid in a specific need.

**Estimate of Potential Losses**

Estimates of potential losses will be influenced by a variety of factors. Costs would also be likely to include mitigation or repairs of HVAC systems, sealing of doors and windows, and other methods of keeping smoke from entering buildings. Secondary costs would include lost academic days during campus closures, lost staff on campus productivity, and health and medical interventions for affected members of the campus community.

Based on estimate replacement costs of facilities and structures on campus, the maximum total replacement costs due to wildfire are $164,768,550. Due to the lack of a complete inventory of building and facility costs, the total replacement estimate is likely much higher.

Table 8-30: Wildfire Hazard Potential (WHP) Zone Estimated Losses

<table>
<thead>
<tr>
<th>WHP Zone</th>
<th>No. of Buildings</th>
<th>Maximum Replacement Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Extreme</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Very High</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>High</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Moderate</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Low</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Very Low</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Non-Burnable</td>
<td>30</td>
<td>$164,768,550</td>
</tr>
<tr>
<td>No Building Value Data Provided*</td>
<td>9</td>
<td>Unknown</td>
</tr>
</tbody>
</table>

*Buildings with no value defined are also included in the respective Zones they are found in.*

**Vulnerability Assessment Conclusions**

The occurrence of wildfires has been a frequent event in Alameda County, including wildfire incidents that have threatened the CSU East Bay campus and the Concord campus. The location of the CSU East Bay campus exposed to open hillsides with light to moderate vegetative fuels along the western edges presents a threat of fire to the campus community and campus assets. The Concord campus is similarly exposed to the open fields and hillside from the base of Mt. Diablo. These environments are ideal for the development of wildfire activity in the right conditions. The consequences of fires in these areas would present primary and secondary consequences to the CSU East Bay campuses and expose vulnerabilities on the campus and to the campus community.
The topography and weather conditions of the region allows for smoke filled air to linger in the valleys of San Francisco Bay Area with the potential for unhealthy air quality depending on wind conditions. Large fires burning from even far away locations in northern California have demonstrated to fill expansive areas with smoke filled air.

Communities located within or near the Wildland Urban Interface throughout the Bay Area may be subject to damaging fires. These same communities may be home to members of the campus community. The potential for large-scale wildfires in the region further generates the added potential for a number of cascading effects such as disruptions to the local economy, utility failures, disruptions to providing for the needs of the community, and development of public health hazards. The potential for large-scale wildfires and resulting damage of homes and businesses has exponentially powerful impacts on particular populations among the campus community including those with access or functional needs, international students, and homeless students.

**Identified Data Limitations**

Missing campus structural replacement costs and an inventory of building construction types to include status of earthquake retrofitting. HAZUS generated analysis is focused on the broader community level versus finetuning the analysis to the micro-level for facilities such as a university campus.

**Severe Weather (Wind, Tornado, Lightning, Hail)**

*Description of the Hazard*

Severe weather can be described as a variety of weather or climate events that are beyond or near the ends of the range of observed weather patterns and behavior. These events can include high or extreme winds, storms, lightning, hail, tornadoes, heat waves, unusually cold temperatures, extreme rainfall, and flooding. According to the Intergovernmental Panel on Climate Change (IPCC), to be classified as severe (or extreme), the occurrence of each value of a climate or weather variable (e.g., wind, hail, lightning, tornado, etc.) must be “above (or below) a threshold value near the upper (or lower) ends of the range of observed values of the variable.”

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Severe weather in California can be generated by local, regional, and/or global weather and climate influences. From the individual thunderstorm to the Santa Ana wind event to the strong El Niño, damaging weather elements that are produced by and accompany severe weather and climate phenomena (e.g., damaging winds, hail, lightning, and tornadoes) occur throughout California and the California State University (CSU) system.

Global Scale Influences on Severe Weather in California: El Niño, La Niña, and ENSO

The El Niño-Southern Oscillation (ENSO) is a recurring climate pattern involving changes in the temperature of waters in the central and eastern tropical Pacific Ocean. On periods ranging from about three (3) to seven (7) years, the surface waters across a large swath of the tropical Pacific Ocean warm or cool by anywhere from 1°C to 3°C, compared to normal. This oscillating warming and cooling pattern, referred to as the ENSO cycle, directly affects rainfall distribution in the tropics and can have a strong influence on weather across the United States and other parts of the world.

El Niño and La Niña are extreme phases of the ENSO cycle, with a third phase occurring between them called the Neutral phase. The El Niño phase is characterized by unusually warm ocean temperatures and weaker-than-normal east winds in the Equatorial Pacific, while the La Niña phase is characterized by unusually cold ocean temperatures and stronger-than-normal east winds in the Equatorial Pacific. Both extreme ENSO phases lead to significant differences from the average ocean temperatures, winds, surface pressure, and rainfall across parts of the tropical Pacific. The Neutral phase indicates that conditions are near their long-term average.

The extreme ENSO phases affect the frequency and intensity of weather events across the world, including in California. On average, areas across California experience exceptionally stormy winters with increased precipitation under El Niño conditions, but experience less stormy and drier winters under La Niña conditions. This variability in storminess and precipitation brought on by El Niño and La Niña events affects the both the frequency and intensity of severe weather conditions experienced by all CSU campuses, including CSU East Bay.

Regional Climate Influences on Severe Weather across California

Most of the weather in California is influenced by the wet-winter/ dry-summer Mediterranean climate pattern. In the summer months, Pacific storm tracks are deflected

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85 Retrieved on 07.18.2021 from https://www.weather.gov/mhx/ensowhat
88 Retrieved on 07.16.2021 from https://www.pmel.noaa.gov/elnino/what-is-el-nino
north due to the position of the Pacific High (i.e., a large-scale atmospheric circulation over the Northeast Pacific Ocean), preventing Pacific storms from reaching California. As a result, most summer storms are generated due to the incursion of moist air from the Gulf of Mexico or the Gulf of California, and occur as scattered, locally heavy showers in the desert and mountain regions of the state. In the winter months, the Pacific High decreases in intensity and moves south, permitting powerful Pacific storms to move into and across the state; these storms can produce extreme winds, heavy rains (including “atmospheric river” events), and widespread coastal and inland flooding. (Please see the Flood Hazard profile in this document for information on Floods.) As a result, storm events accompanied by precipitation in California are far more frequent in the winter months than they are in the summer months.

While the Mediterranean climate pattern influences the seasonal frequency, intensity, geographic spread, and type of some severe weather events CSU campuses experience (including CSU East Bay), other severe weather phenomena may occur in California at any time of the year. For example, near the coast and over the Central Valley, there appears to be no defined seasonality to thunderstorms, and these storms are usually light and infrequent. Thunderstorms are more intense and more frequent in the intermediate and higher elevations of the Sierra Nevada, and occur with greater frequency during the summer months.

**Types of Storms in California**

The 2018 California State Hazard Mitigation Plan (SHMP) defines a storm as a violent atmospheric disturbance occurring over land and/or water that is distinguished by its strength, characteristics, and the scale of the resulting damage. The SHMP also lists the following types of storms that produce hazardous conditions and potential damage throughout the state of California. These storms affect (in varying degrees) all CSU campuses, including CSU East Bay.

- **Thunderstorm**: A rain-bearing cloud that also produces lightning. Thunderstorms can produce some of nature’s most destructive and deadly weather including tornadoes, hail, strong winds, lightning and flooding. Thunderstorms are caused by an atmospheric imbalance from warm unstable air rising rapidly into the atmosphere. Lightning, which occurs during all thunderstorms, can strike anywhere. Thunderstorms can produce some of nature’s most destructive and
deadly weather including tornadoes, hail, strong winds, lightning and flooding.\textsuperscript{96} \textit{Severe thunderstorms} are more intense, violent, and dangerous thunderstorms. The National Oceanic and Atmospheric Administration (NOAA) defines a severe thunderstorm as any storm that produces one or more of the following elements: Damaging winds or speeds of 58 mph (50 knots) or greater, hail 1 inch in diameter or larger, and/or a tornado.\textsuperscript{97} \textsuperscript{98}

- **Hailstorm**: a type of storm that precipitates round chunks of ice. Hailstorms usually occur during regular thunderstorms.\textsuperscript{99}
- **Wind storm**: marked by high wind with little or no precipitation.\textsuperscript{100}
- **Winter storm**: A storm that can produce a combination of freezing rain, sleet, heavy snow, and/or strong winds.\textsuperscript{101}
- **Coastal storm**: large wind-driven waves and/or storm surge that strike the coastal zone.\textsuperscript{102}
- **Ice storm**: Ice storms are one of the most dangerous forms of winter storms. When surface temperatures are below freezing, but a thick layer of above-freezing air remains aloft, rain can fall into the freezing layer and freeze upon impact into a glaze of ice. In general, 8 millimeters (0.31 inch) of accumulation is all that is required, especially in combination with breezy conditions, to start downing power lines as well as tree limbs. Ice storms also make unheated road surfaces too slick to drive on. Ice storms can vary in time range from hours to days and can cripple small towns and large urban centers alike.\textsuperscript{103}
- **Snowstorm**: A heavy fall of snow accumulating at a rate of more than 5 centimeters (2 inches) per hour that lasts several hours. Snowstorms, especially

\textsuperscript{96} Retrieved on 07.14.2021 from https://www.noaa.gov/explainers/severe-storms
\textsuperscript{97} Retrieved on 07.15.2021 from https://www.noaa.gov/explainers/severe-storms
\textsuperscript{98} Retrieved on 07.15.2021 from https://www.weather.gov/safety/thunderstorm
ones with a high liquid equivalent and breezy conditions, can down tree limbs, cut off power, and paralyze travel over a large region.\textsuperscript{104}

**Severe Weather Hazard Elements: Wind Hazards, Hail, and Lightning**

This hazard profile concentrates on the following types of severe weather hazards: \textbf{wind hazards (including tornadoes), hail, and lightning}. These hazards are produced by a variety of weather phenomena, including thunderstorms, coastal storms, winter storms, and topographically-enhanced downslope winds. While storm and downslope wind hazards are responsible for severe weather events across the CSU system, only the wind, tornado, hail, and lightning elements generated by these hazards are covered in this profile. (Storm-related hazards such as flooding and extreme temperatures are covered in other sections of this document.)

**Wind Hazards**

\textbf{Wind} is the horizontal movement of air past any given point. Wind begins with differences in air pressures; pressure that is higher at one point than another sets up a force, pushing the high towards the low pressure.\textsuperscript{105} Wind gusts are defined as “rapid fluctuations in the wind speed with a variation of 10 knots or more between peaks and lulls.” \textsuperscript{106}

Wind hazards in California take several forms: High Wind, Strong Winds, Thunderstorm Winds, Mountain-Valley (Downslope) Winds, and Tornadoes. These hazards are encountered across California, and have the potential to cause harm to or loss of life and/or property throughout California and the CSU system (including CSU East Bay).

**High Winds, Strong Winds, and Thunderstorm Winds**

The National Weather Service reports three (3) types of wind events that occur areas over land: High Winds, Strong Winds, and Thunderstorm Winds. Collectively, these reports are used to determine the frequency with which wind hazard events have affected areas across the U.S., including California.

**High Winds**

High winds are defined as sustained non-convective winds of 35 knots (40 mph) or greater lasting for 1 hour or longer, or gusts of 50 knots (58 mph) or greater for any duration (or otherwise locally/regionally defined). In some mountainous areas, the above numerical values are 43 knots (50 mph) and 65 knots (75 mph), respectively.\textsuperscript{107}


\textsuperscript{106} Retrieved on 07.15.2021 from https://forecast.weather.gov/glossary.php?word=wind%20gust

\textsuperscript{107} Retrieved on 07.17.2021 from https://www.nws.noaa.gov/directives/sym/pd01016005curr.pdf
**Strong Winds**

Strong winds are defined as non-convective winds gusting less than 50 knots (58 mph), or sustained winds less than 35 knots (40 mph), resulting in a fatality, injury, or damage.\(^{108}\)

**Thunderstorm Winds**

Thunderstorm winds are winds that arise from thunderstorm convection (occurring within 30 minutes of lightning being observed or detected), with speeds of at least 50 knots (58 mph). They can also be winds of any speed (non-severe thunderstorm winds below 50 knots (58 mph)) producing a fatality, injury, or damage.\(^{109}\)

Please note: **Straight-line wind** is a term used to define any thunderstorm wind that is not associated with rotation. It is used mainly to differentiate from the rotational winds found in tornado-producing storms.\(^{110}\) However, it is not a term used in the NCEI Storm Events Database, and therefore cannot be used to determine severe weather history of or potential impacts to CSU campuses.

**Tornadoes**

A tornado is an extreme severe weather wind hazard. A tornado is a rapidly rotating column of air extending from a thunderstorm to the surface of the Earth.\(^{111}\) This column extends between cloud and the Earth’s surface. The damage from tornadoes comes from the strong winds they contain and the flying debris they create. It is generally believed that rotational wind speeds can be as high as 300 mph in the most violent tornadoes.\(^{112}\) On a local scale, tornadoes are the most violent and most destructive of all atmospheric phenomena.\(^{113}\)

**Mountain-Valley (Downslope) Wind Systems: Santa Ana, Diablo, and Sundowner Winds.**

**Santa Ana Winds.** A type of wind hazard that is peculiar to Southern California is called a **Santa Ana Wind.** Santa Ana winds are strong, topographically-enhanced, extremely dry downslope winds that originate inland and affect coastal southern California and northern Baja California (Mexico).\(^{114}\) They occur when air from a region of high pressure over the dry, desert region of the southwestern U.S. flows westward towards low pressure located off the California coast. This creates dry winds that flow east to west through the mountain passages in Southern California. These winds have a strong seasonal

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\(^{110}\) Retrieved on 07.15.2021 from https://www.nssl.noaa.gov/education/svrwx101/wind/types/

\(^{111}\) Retrieved on 07.15.2021 from https://www.earthnetworks.com/tornado/

\(^{112}\) Retrieved on 07.15.2021 from https://www.nssl.noaa.gov/education/svrwx101/tornadoes/faq/

\(^{113}\) Retrieved on 07.15.2021 from https://www.weather.gov/bgm/severedefinitions

component; they are most common during the cooler months of the year, occurring from September through May. Santa Ana winds typically feel warm (or even hot) because as the cool desert air moves down the side of the mountain, it is compressed, which causes the temperature of the air to rise. If strong enough, Santa Ana winds can cause major property damage, and may present difficulties for airborne and seagoing transportation. They also may increase wildfire risk because of the dryness of the winds and the speed at which they can spread a flame across the landscape.\(^{115}\) (Note: The Wildfire hazard is profiled elsewhere in this document.)

Figure below illustrates the mechanisms involved in the generation of Santa Ana winds across Southern California.

Figure 8-14: What Drives a Santa Ana Wind?\(^{116}\)

**Diablo Winds.** The Diablo wind is another type of topographically-enhanced downslope wind phenomenon that occurs in the North-Central areas of California. Diablo winds are

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offshore wind events that flow northeasterly over Northern California’s Coast Ranges, often creating high wind speeds downwind of major canyons and over ridges, and extreme fire danger for the San Francisco Bay Area. Diablo winds are driven by a surface pressure gradient that forms in response to an inverted pressure trough that develops over California.\textsuperscript{117}

\textbf{Sundowner Winds.} Sundowner winds are significant and potentially damaging downslope wind and warming events that periodically occur along a short segment of the southern California coast in the vicinity of Santa Barbara, CA. The unique topography of this coastal region promotes the development of Sundowner wind events: over a length of about 100 km, the coastline is oriented approximately west–east, with the adjoining narrow coastal plain bounded by a steeply rising (to elevations greater than 1200 m) and coast-parallel mountain range. Called Sundowner winds because they often begin in the late afternoon or early evening, their onset is typically associated with a rapid rise in temperature and decrease in relative humidity, and the winds tend to blow from the north from the Santa Ynez Mountains to the coast of Santa Barbara County, California. During the more intense Sundowner wind events, wind speeds can be of gale force 39-54 miles per hour or higher, and can even reach hurricane force (≥ 74 miles per hour) in the most extreme cases. Temperatures over the coastal plain, and even at the coast itself, can rise significantly above 37.8°C (100°F). Seasonally, Sundowner winds peak in March, April, and May, with a minimum during summer and a secondary peak in winter that often corresponds with Santa Ana winds. In addition to causing a dramatic change from the more typical marine-influenced local weather conditions, Sundowner wind episodes have produced significant wind-related property and agricultural damage, as well as conditions of extreme fire danger.\textsuperscript{118 119 120}

\textit{Hail}

Hail is a form of precipitation consisting of solid ice that forms inside thunderstorm updrafts.\textsuperscript{121} It is roughly round in shape and at least 0.2’ in diameter. Hail develops in the upper atmosphere as ice crystals that are bounced about by high velocity updraft winds; the ice crystals accumulate frozen droplets and fall after developing enough weight. The size of hailstones varies and is a direct consequence of the severity and size of the storm that produces them – the higher the temperatures at the Earth’s surface, the greater the

\begin{itemize}
\item \textsuperscript{117} Retrieved on 07.13.2021 from https://www.fireweather.org/diablo-winds
\item \textsuperscript{121} Retrieved on 07.14.2021 from https://www.nssl.noaa.gov/education/svrwx101/hail/
\end{itemize}
strength of the updrafts and the amount of time hailstones are suspended, and therefore the greater the size of the hailstone.\textsuperscript{122}

\textbf{Lightning}

Lightning is an electrical discharge produced by a thunderstorm. Lightning rapidly heats the air in its immediate vicinity to about 50,000\textdegree F - about five times the temperature of the surface of the sun. This compresses the surrounding air and creates a supersonic shock wave, which decays to an acoustic wave that is heard as thunder.\textsuperscript{123}

The discharge may occur within or between clouds, between the cloud and air, between a cloud and the ground, or between the ground and a cloud.\textsuperscript{124} Lightning that is produced from thunderstorms in which precipitation evaporates before reaching the ground is called “dry lightning.”

\textbf{Location of the Hazard}

Severe weather is a non-spatial hazard, and can occur anywhere in the CSU system, including either at the CSU East Bay main campus or at satellite campus facilities owned by the school. No one area of the campus – or of the surrounding community – is subject to experiencing severe weather more than any other area.

There is geographic variability among the different types of mountain and valley wind events (as a sub-category of the severe weather hazard). Santa Ana winds occur in Southern California, Diablo winds occur in North-Central California, and Sundowner winds occur almost exclusively in Santa Barbara County, California.

\textbf{Extent of the Hazard}

Severe weather hazards are non-spatial hazards that potentially affect all CSU East Bay campus areas equally. However, the smallest geographic unit of measurement for almost all official severe weather event data is at the county level. Because the severe weather data used do not exist at the campus level, it is assumed that the same (or similar) severe weather risks to CSU East Bay campuses reflect those of the surrounding community and County. As a result, all assets and people at CSU East Bay campuses are at risk from the effects of severe weather and can expect to experience at least some (or the complete range of) endemic severe weather hazards. In consideration of the campus’ design, layout, and operations, the severe weather history and degree of severity in the Hayward (Alameda County), Oakland (Alameda County), and Concord (Contra Costa County), and the history and degree of severity of each severe weather sub-type identified by the extent scales (below), the campus planning committee ranks the overall extent of the

Severe Weather hazard as **MODERATE**. See each sub-hazard below for the planning committee’s sub-type extent ranking.

**Wind Hazard: Non-Rotational**

The Beaufort Scale is an empirical measure that relates wind speed to observed conditions at sea or on land. Its full name is the Beaufort wind force scale. First developed in 1805, it is still used today to estimate wind strengths.

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125 Retrieved on 07.15.2021 from https://www.rmets.org/resource/beaufort-scale

Table 8-31: Beaufort Wind Force Scale\textsuperscript{127}

<table>
<thead>
<tr>
<th>Force</th>
<th>Speed</th>
<th>Description</th>
<th>Specifications for use at sea</th>
<th>Specifications for use on land</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0-1</td>
<td>Calm</td>
<td></td>
<td>Calm; smoke rises vertically.</td>
</tr>
<tr>
<td></td>
<td>0-1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>1-3</td>
<td>Light Air</td>
<td>Ripples with the appearance of scales are formed, but without foam crests.</td>
<td>Direction of wind shown by smoke drift, but not by wind vanes.</td>
</tr>
<tr>
<td></td>
<td>1-3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>4-7</td>
<td>Light Breeze</td>
<td>Small wavelets, still short, but more pronounced. Crests have a glassy appearance and do not break.</td>
<td>Wind felt on face; leaves rustle; ordinary vanes moved by wind.</td>
</tr>
<tr>
<td></td>
<td>4-6</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>8-12</td>
<td>Gentle Breeze</td>
<td>Large wavelets. Crests begin to break. Foam of glassy appearance. Perhaps scattered white horses.</td>
<td>Leaves and small twigs in constant motion; wind extends light flag.</td>
</tr>
<tr>
<td></td>
<td>7-10</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>13-18</td>
<td>Moderate Breeze</td>
<td>Small waves, becoming larger; fairly frequent white horses.</td>
<td>Raises dust and loose paper; small branches are moved.</td>
</tr>
<tr>
<td></td>
<td>11-16</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>19-24</td>
<td>Fresh Breeze</td>
<td>Moderate waves, taking a more pronounced long form; many white horses are formed.</td>
<td>Small trees in leaf begin to sway; crested wavelets form on inland waters.</td>
</tr>
<tr>
<td></td>
<td>17-21</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>25-31</td>
<td>Strong Breeze</td>
<td>Large waves begin to form; the white foam crests are more extensive everywhere.</td>
<td>Large branches in motion; whistling heard in telegraph wires; umbrellas used with difficulty.</td>
</tr>
<tr>
<td></td>
<td>22-27</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

\textsuperscript{127} Retrieved on 07.15.2021 from https://www.weather.gov/mfl/beaufort
<table>
<thead>
<tr>
<th>7</th>
<th>32-38</th>
<th>28-33</th>
<th>Near Gale</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td><strong>Sea heaps up and white foam from breaking waves begins to be blown in streaks along the direction of the wind.</strong></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td><strong>Whole trees in motion; inconvenience felt when walking against the wind.</strong></td>
</tr>
<tr>
<td>8</td>
<td>39-46</td>
<td>34-40</td>
<td>Gale</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td><strong>Moderately high waves of greater length; edges of crests begin to break into spindrift. The foam is blown in well-marked streaks along the direction of the wind.</strong></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td><strong>Breaks twigs off trees; generally impedes progress.</strong></td>
</tr>
<tr>
<td>9</td>
<td>47-54</td>
<td>41-47</td>
<td>Severe Gale</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td><strong>High waves. Dense streaks of foam along the direction of the wind. Crests of waves begin to topple, tumble and roll over. Spray may affect visibility</strong></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td><strong>Slight structural damage occurs (chimney-pots and slates removed)</strong></td>
</tr>
<tr>
<td>10</td>
<td>55-63</td>
<td>48-55</td>
<td>Storm</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td><strong>Very high waves with long overhanging crests. The resulting foam, in great patches, is blown in dense white streaks along the direction of the wind. On the whole the surface of the sea takes on a white appearance. The tumbling of the sea becomes heavy and shock-like. Visibility affected.</strong></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td><strong>Seldom experienced inland; trees uprooted; considerable structural damage occurs.</strong></td>
</tr>
<tr>
<td>11</td>
<td>64-72</td>
<td>56-63</td>
<td>Violent Storm</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td><strong>Exceptionally high waves (small and medium-size ships might be for a time lost to view behind the waves). The sea is completely covered with long white patches of foam lying along the direction of the wind. Everywhere the edges of the wave crests are blown into froth. Visibility affected.</strong></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td><strong>Very rarely experienced; accompanied by widespread damage.</strong></td>
</tr>
<tr>
<td>12</td>
<td>73+</td>
<td>64+</td>
<td>Hurricane</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td><strong>The air is filled with foam and spray. Sea completely white with driving spray; visibility very seriously affected.</strong></td>
</tr>
</tbody>
</table>
Based on those extent ranking factors identified (above), the planning committee ranks the extent of non-rotational wind hazards as **MODERATE**.

**Extent: Tornado**

Tornadoes have their own severity/extent scale. Until 2007, tornadoes were measured and described according to the Fujita Scale.\(^{128}\)

In February 2007, use of the Fujita Scale was discontinued. In its place, the Enhanced Fujita (EF) Scale is used. The Enhanced Fujita scale considers how most structures are designed and is thought to be a much more accurate representation of the surface wind speeds in the most violent tornadoes. Like the original Fujita scale, the Enhanced Fujita scale is a set of wind estimates (not measurements) based on damage.

It is important to note the date that a tornado occurred. Tornadoes that occurred prior to February, 2007 are classified using the original Fujita scale and will not be converted to the Enhanced Fujita Scale.

Table below illustrates the Fujita Scale in use prior to February 2007.

Table 8-32: Fujita Tornado Scale (Pre-February 2007)\(^{129}\)

<table>
<thead>
<tr>
<th>F-Scale Number</th>
<th>Intensity Phrase</th>
<th>Wind Speed</th>
<th>Type of Damage</th>
</tr>
</thead>
<tbody>
<tr>
<td>F0</td>
<td>Gale tornado</td>
<td>40-72 mph</td>
<td>Some damage to chimneys; breaks branches off trees; pushes over shallow-rooted trees; damages sign boards.</td>
</tr>
<tr>
<td>F1</td>
<td>Moderate tornado</td>
<td>73-112 mph</td>
<td>The lower limit is the beginning of hurricane wind speed; peels surface off roofs; mobile homes pushed off foundations or overturned; moving autos pushed off the roads; attached garages may be destroyed.</td>
</tr>
<tr>
<td>F2</td>
<td>Significant tornado</td>
<td>113-157 mph</td>
<td>Considerable damage. Roofs torn off frame houses; mobile homes demolished; boxcars pushed over; large trees snapped or uprooted; light object missiles generated.</td>
</tr>
</tbody>
</table>

---

\(^{128}\) Retrieved on 07.19.2021 from https://www.weather.gov/tae/ef_scale

<table>
<thead>
<tr>
<th>Category</th>
<th>Description</th>
<th>Wind Speed</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>F3</td>
<td>Severe tornado</td>
<td>158-206 mph</td>
<td>Roof and some walls torn off well-constructed houses; trains overturned; most trees in forest uprooted.</td>
</tr>
<tr>
<td>F4</td>
<td>Devastating tornado</td>
<td>207-260 mph</td>
<td>Well-constructed houses leveled; structures with weak foundations blown off some distance; cars thrown and large missiles generated.</td>
</tr>
<tr>
<td>F5</td>
<td>Incredible tornado</td>
<td>261-318 mph</td>
<td>Strongframe houses lifted off foundations and carried considerable distances to disintegrate; automobile sized missiles fly through the air in excess of 100 meters; trees debarked; steel reinforced concrete structures badly damaged.</td>
</tr>
<tr>
<td>F6</td>
<td>Inconceivable tornado</td>
<td>319-379 mph</td>
<td>These winds are very unlikely. The small area of damage they might produce would probably not be recognizable along with the mess produced by F4 and F5 wind that would surround the F6 winds. Missiles, such as cars and refrigerators would do serious secondary damage that could not be directly identified as F6 damage. If this level is ever achieved, evidence for it might only be found in some manner of ground swirl pattern, for it may never be identifiable through engineering studies.</td>
</tr>
</tbody>
</table>

Table below illustrates the Enhanced Fujita (EF) Scale, currently in use. Tornadoes that have occurred since February, 2007 are classified using the Enhanced Fujita Scale.
<table>
<thead>
<tr>
<th>Enhanced Fujita Category</th>
<th>Wind Speed</th>
<th>Potential Damage</th>
</tr>
</thead>
<tbody>
<tr>
<td>EF0 65-85 mph</td>
<td>Light damage. Peels surface off some roofs; some damage to gutters or siding; branches broken off trees; shallow-rooted trees pushed over.</td>
<td></td>
</tr>
<tr>
<td>EF1 86-110 mph</td>
<td>Moderate damage. Roofs severely stripped; mobile homes overturned or badly damaged; loss of exterior doors; windows and other glass broken.</td>
<td></td>
</tr>
<tr>
<td>EF2 111-135 mph</td>
<td>Considerable damage. Roofs torn off well-constructed houses; foundations of frame homes shifted; mobile homes completely destroyed; large trees snapped or uprooted; light-object missiles generated; cars lifted off ground.</td>
<td></td>
</tr>
<tr>
<td>EF3 136-165 mph</td>
<td>Severe damage. Entire stories of well-constructed houses destroyed; severe damage to large buildings such as shopping malls; trains overturned; trees debarked; heavy cars lifted off the ground and thrown; structures with weak foundations blown away some distance.</td>
<td></td>
</tr>
<tr>
<td>EF4 166-200 mph</td>
<td>Devastating damage. Well-constructed houses and whole frame houses completely leveled; cars thrown and small missiles generated.</td>
<td></td>
</tr>
<tr>
<td>EF5 &gt;200 mph</td>
<td>Incredible damage. Strong frame houses leveled off foundations and swept away; automobile-sized missiles fly through the air in excess of 100 m (107 yd); high-rise buildings have significant structural deformation; incredible phenomena will occur.</td>
<td></td>
</tr>
</tbody>
</table>

Based on the extent ranking factors identified (above), the planning committee ranks the extent of tornados as **LOW**.

**Extent: Hail**

The National Oceanic and Atmospheric Administration and the Tornado and Storm Research Organization (TORRO) have combined efforts to create the Hailstorm Intensity Scale. Table provides details of this scale.

Table 8-34: Combined NOAA/TORRO Hailstorm Intensity Scale\(^{131}\)

<table>
<thead>
<tr>
<th>Size Code</th>
<th>Intensity Category</th>
<th>Typical Hail Diameter</th>
<th>Approximate Size</th>
<th>Typical Damage Impacts</th>
</tr>
</thead>
<tbody>
<tr>
<td>H0</td>
<td>Hard Hail</td>
<td>Up to 0.33”</td>
<td>Pea</td>
<td>No damage</td>
</tr>
<tr>
<td>H1</td>
<td>Potentially Damaging</td>
<td>0.33” – 0.60”</td>
<td>Marble or Mothball</td>
<td>Slight damage to plants and crops</td>
</tr>
<tr>
<td>H2</td>
<td>Potentially Damaging</td>
<td>0.60” – 0.80”</td>
<td>Dime or grape</td>
<td>Significant damage to fruit, crops, and vegetation</td>
</tr>
<tr>
<td>H3</td>
<td>Severe</td>
<td>0.80” – 1.20”</td>
<td>Nickel to Quarter</td>
<td>Severe damage to fruit and crops, damage to glass and plastic structures, paint and wood scored</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Extent</th>
<th>Size</th>
<th>Description</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>H4</td>
<td>Severe</td>
<td>1.20” – 1.60”</td>
<td>Half Dollar to Ping Pong Ball</td>
<td>Widespread glass damage, vehicle body damage</td>
</tr>
<tr>
<td>H5</td>
<td>Destructive</td>
<td>1.60” – 2.0”</td>
<td>Silver Dollar to Golf Ball</td>
<td>Wholesale destruction of glass, damage to tiled roofs, significant risk of injuries</td>
</tr>
<tr>
<td>H6</td>
<td>Destructive</td>
<td>2.0” – 2.4”</td>
<td>Lime or Egg</td>
<td>Aircraft body dented; brick walls pitted</td>
</tr>
<tr>
<td>H7</td>
<td>Very Destructive</td>
<td>2.4” – 3.0”</td>
<td>Tennis Ball</td>
<td>Severe roof damage, risk of serious injuries</td>
</tr>
<tr>
<td>H8</td>
<td>Very Destructive</td>
<td>3.0” – 3.5”</td>
<td>Baseball to Orange</td>
<td>Severe damage to aircraft body</td>
</tr>
<tr>
<td>H9</td>
<td>Super Hailstorms</td>
<td>3.5” – 4.0”</td>
<td>Grapefruit</td>
<td>Extensive structural damage, risk of severe or fatal injuries to persons caught in the open</td>
</tr>
</tbody>
</table>

Based on those extent ranking factors identified (above), the planning committee ranks the extent of the hail hazard as **LOW**.
**Extent: Lightning**

The National Weather Service (NWS) uses a Lightning Activity Level (LAL) scale to indicate the frequency and character of cloud-to-ground (C/G) lightning. The scale uses a range of 1 – 6, with 6 being the high end of the scale. Table below provides details of the LAL scale.

Table 8-35: Lightning Activity Level (LAL) Scale

<table>
<thead>
<tr>
<th>Rank</th>
<th>Cloud and Storm Development</th>
<th>Areal Coverage</th>
<th>Counts C/G per 5 Minutes</th>
<th>Counts C/G per 15 Minutes</th>
<th>Average C/G per Minute</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>No Thunderstorms</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>2</td>
<td>Cumulus clouds are common but only a few reaches the towering stage. A single thunderstorm must be confirmed in the rating area. The clouds mostly produce virga, but light rain will occasionally reach ground. Lightning is very infrequent.</td>
<td>&lt;15%</td>
<td>1-5</td>
<td>1-8</td>
<td>&lt;1</td>
</tr>
<tr>
<td>3</td>
<td>Cumulus clouds are common. Swelling and towering cumulus cover less than 2/10 of the sky. Thunderstorms are few, but 2 to 3 occur within the observation area. Light to moderate rain will reach the ground, and lightning is infrequent.</td>
<td>15% to 24%</td>
<td>6-10</td>
<td>9-15</td>
<td>1-2</td>
</tr>
</tbody>
</table>

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132 Retrieved on 07.19.2021 from [https://graphical.weather.gov/definitions/defineLAL.html](https://graphical.weather.gov/definitions/defineLAL.html)
### Lightning Activity Level Scale

<table>
<thead>
<tr>
<th>Rank</th>
<th>Cloud and Storm Development</th>
<th>Areal Coverage</th>
<th>Counts C/G per 5 Minutes</th>
<th>Counts C/G per 15 Minutes</th>
<th>Average C/G per Minute</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>Swelling cumulus and towering cumulus cover 2-3/10 of the sky. Thunderstorms are scattered but more than three must occur within the observation area. Moderate rain is commonly produced, and lightning is frequent.</td>
<td>25% to 50%</td>
<td>11-15</td>
<td>16-25</td>
<td>2-3</td>
</tr>
<tr>
<td>5</td>
<td>Towering cumulus and thunderstorms are numerous. They cover more than 3/10 and occasionally obscure the sky. Rain is moderate to heavy, and lightning is frequent and intense.</td>
<td>&gt;50%</td>
<td>&gt;15</td>
<td>&gt;25</td>
<td>&gt;3</td>
</tr>
<tr>
<td>6</td>
<td>Dry lightning outbreak. (LAL of 3 or greater with majority of storms producing little or no rainfall.)</td>
<td>&gt;15%</td>
<td>None</td>
<td>None</td>
<td>None</td>
</tr>
</tbody>
</table>

Based on those extent ranking factors identified (above), the planning committee ranks the extent of the lightning hazard as **LOW**.

**Extent: Thunderstorms that Generate Wind, Tornado, Hail, and Lightning Hazard Events**

Thunderstorms are not explicitly identified as a severe weather category for this hazard profile. However, they are responsible for most tornado, lightning, and hail hazard events – as well as a significant number of wind hazard events – across California and the CSU system. While individual thunderstorms affect relatively small areas, there are many instances in which thunderstorms can cluster together and/or travel in a line over long distances, producing significant damage over large geographic areas.

A thunderstorm is classified as “severe” when certain meteorological parameters within the thunderstorm are reached (i.e., damaging winds or speeds of 58 mph (50 knots) or greater, hail 1 inch in diameter or larger, and/or a tornado). However, there is currently no...
established, objective severity scale for thunderstorms.133 134 That said, according to the Glossary of Meteorology published by the American Meteorological Society (AMS), a thunderstorm is reported as light, medium, or heavy according to following five (5) characteristics:

- the nature of the lightning and thunder;
- the type and intensity of the precipitation, if any;
- the speed and gustiness of the wind;
- the appearance of the clouds; and
- the effect upon surface temperature.135

A thunderstorm may also be classified by the nature of the overall weather situation in which the thunderstorm is produced, including:

- **Airmass Thunderstorm**: A thunderstorm produced by local convection within an unstable air mass;136

- **Frontal Thunderstorm**: An individual thunderstorm the initiation of which results from rising motion associated with a front, or a thunderstorm within a convective system generated and organized by frontal rising motion;137 or

- **Squall-line Thunderstorm**: An individual thunderstorm included within a squall line (i.e., a continuous or broken line of active deep moist convection frequently associated with thunder). 138 139

Based on the extent ranking factors identified (above) in relation to campus layout and operations, and past event low degree of severity, the planning committee ranks the extent of the thunderstorm hazard as **LOW**.
History of the Hazard

Severe weather hazards have been an annual occurrence in Alameda County and Contra Costa County, as well as on CSU East Bay main campus (Alameda County) and satellite campus (Contra Costa County). Historical data for these hazards are presented below.

**Historical Storm Data Collection: NCEI Storm Events Database**

Historical information regarding severe weather hazards can be found using The National Centers for Environmental Information (NCEI) Storm Events Database. The Storm Events Database contains searchable, archived National Weather Service (NWS) storm data from January 1950 to April 2021, as entered by NOAA's National Weather Service (NWS). Due to changes in the data collection and processing procedures over time, there are unique periods of record available depending on the event type. For example, from 1950 through 1954, only tornado events were recorded; from 1955 through 1995, only tornado, thunderstorm wind, and hail events were introduced into the database; from 1996 to present, 45 additional event types are recorded, including high wind, strong wind, and lightning events. To obtain the most accurate portrayal of severe weather event frequency, searches of the Storm Events Database are conducted using data collected since 01/01/1996. As a reminder, all official severe weather event data is at the county level. Severe weather data do not exist at the campus level. That said, it may be the case that the campus to some degree experiences the severe weather events reported for the surrounding community and County.

**Alameda County**

**Wind Hazards (excluding Tornadoes)**

Information obtained from the NCEI Storm Event Database website shows the number of events (or occurrences) of wind hazard events in Alameda County since 1996. Here, wind hazard events include all “High Wind,” “Strong Wind,” and “Thunderstorm Wind” storm reports.

- **High Wind**: at least 88 events, or approximately 3.47 events per year

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144 National Climatic Data Center. Storm Events Database. Retrieved 07.29.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28Z%29+High+Wind&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=ALAMEDA%3A1&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA
- **Strong Wind**: at least 253 events, or 9.97 events per year\textsuperscript{145}
- **Thunderstorm Wind**: at least 8 events, or approximately 0.32 events per year\textsuperscript{146}
- **All Wind Hazard events** (excluding Tornadoes): at least 343 events, or approximately 13.54 events per year.\textsuperscript{147} (Note: This was determined by conducting a simultaneous search of the component wind hazards of high wind, strong wind and thunderstorm wind.)

Overall, in Alameda County, there have been at least 343 wind hazard events since 1996, excluding tornadoes.\textsuperscript{148} That translates to an approximate average historical frequency of occurrence of **13.54** wind hazard events per year.

Please note: Differences between the sums of individual component severe weather hazard event Database searches (i.e., 349 events) and simultaneous Database searches of all severe weather hazard events (i.e., 343 events) may be due to the following factors: (1) multiple event types are in the same record (e.g., "Thunderstorm Wind/Hail" or "Hail/Tornado;" and/or (2) severe weather hazard events such as “Thunderstorm Wind” or “Hail” that are reported for Alameda County have actually taken place hundreds of miles away, but are erroneously recorded as events that have occurred in the County.\textsuperscript{149}

When such a discrepancy arises, the more conservative aggregate hazard wind event value (i.e., 343 events) is used to determine the historical frequency of occurrence for the severe weather hazard. The origin of this discrepancy is unknown at this time.

\begin{itemize}
  \item \textsuperscript{145} National Climatic Data Center. Storm Events Database. Retrieved 07.29.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28Z%29+Strong+Wind&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=ALAMEDA%3A1&hailfilter=0.00&tornfilter=0.00&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA
  \item \textsuperscript{146} National Climatic Data Center. Storm Events Database. Retrieved 07.29.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Thunderstorm+Wind&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=ALAMEDA%3A1&hailfilter=0.00&tornfilter=0.00&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA
  \item \textsuperscript{147} National Climatic Data Center. Storm Events Database. Retrieved 07.29.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28Z%29+High+Wind&eventType=%28Z%29+Strong+Wind&eventType=%28C%29+Thunderstorm+Wind&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=ALAMEDA%3A1&hailfilter=0.00&tornfilter=0.00&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA
  \item \textsuperscript{148} National Climatic Data Center. Storm Events Database. Retrieved 07.29.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28Z%29+High+Wind&eventType=%28Z%29+Strong+Wind&eventType=%28C%29+Thunderstorm+Wind&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=ALAMEDA%3A1&hailfilter=0.00&tornfilter=0.00&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA
Historical Wind Hazard Losses for Alameda County since 1996

According to the NCEI Storm Events Database, the wind hazard events that Alameda County has experienced since 1996 have been costly. There have been 5 deaths and 9 injuries, and property damage estimates have totaled approximately $6,974,000; there have been no crop damages reported.\(^\text{150}\)

Tornado Wind Hazards

Information from the NCEI Storm Events Database indicates that since 1996, there have been no reported tornadoes hazard events in Alameda County.\(^\text{151}\)

Historical Tornado Hazard Losses for Alameda County since 1996

Because there have been no reported tornado hazard events for Alameda County since 1996, there are no tornado hazard event losses for that time period.

Hail

Information from the NCEI Storm Events Database indicates that since 1996, there have been 19 reported events of hail in Alameda County, which translates to approximately 0.75 hail events per year.\(^\text{152}\) (Note: The NCEI Storm Event Database search results for hail indicate that there has been a total of 20 reports of hail since 1996. However, one (1) entry is for a hail event in San Diego County, hundreds of miles away from Alameda County. The origin of this discrepancy is unknown at this time.)

Historical Hail Hazard Losses for Alameda County since 1996

According to the NCEI Storm Events Database, the hail hazard events that Alameda County has experienced since 1996 have been costly. While there have been no deaths or injuries, property damage estimates have totaled approximately $5,000,000; additional but negligible property damage (i.e., $10) and crop damage estimates (i.e., $10) have also

\(^\text{150}\) National Climatic Data Center. Storm Events Database. Retrieved 07.29.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28Z%29+High+Wind&eventType=%28Z%29+Strong+Wind&eventType=%28C%29+Thunderstorm+Wind&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=ALAMEDA%3A1&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitButton=Search&statefips=6%2CCALIFORNIA

\(^\text{151}\) National Climatic Data Center. Storm Events Database. Retrieved 07.29.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Tornado&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=ALAMEDA%3A1&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitButton=Search&statefips=6%2CCALIFORNIA

\(^\text{152}\) National Climatic Data Center. Storm Events Database. Retrieved 07.29.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Hail&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=ALAMEDA%3A1&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitButton=Search&statefips=6%2CCALIFORNIA
been reported.\textsuperscript{153} (Note: The San Diego County hail event that was included erroneously in the search results for Alameda County accounted for all hail hazard event injuries (i.e., 5) and almost all crop damage estimates (i.e., $300,000) presented in the search results. There was one (1) hail event in Alameda County that generated negligible crop damage.)

**Lightning**

Information from the NCEI Storm Events Database indicates that since 1996, there have been two (2) reported events of lightning in Alameda County, which translates to \textbf{0.08} lightning events per year.\textsuperscript{154}

**Historical Lightning Hazard Losses for Alameda County since 1996**

According to the NCEI Storm Events Database, the lightning hazard events that Alameda County has experienced since 1996 have been negligible. There have been no reports of deaths, injuries, or crop damage from lightning, and property damage estimates have totaled $3,000.\textsuperscript{155}

**All Severe Weather Hazard Events Recorded by the NCEI Storm Events Database**

Information obtained from the NCEI Storm Events Database indicates that there have been 364 occurrences of the severe weather hazard in Alameda County. This translates to \textbf{14.37} severe weather hazard occurrences per year.\textsuperscript{156}

Please note: Differences between the sums of individual component severe weather hazard event Database searches (i.e., 370 events) and simultaneous Database searches of all severe weather hazard events (i.e., 364 events) may be due to the following factors: (1) multiple event types are in the same record (e.g., “Thunderstorm Wind/Hail” or “Hail/Tornado;” and/or (2) severe weather hazard events such as “Thunderstorm Wind”

\textsuperscript{153} National Climatic Data Center. Storm Events Database. Retrieved 07.29.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Hail&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=ALAMEDA%3A1&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA

\textsuperscript{154} National Climatic Data Center. Storm Events Database. Retrieved 07.29.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Lightning&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=ALAMEDA%3A1&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA

\textsuperscript{155} National Climatic Data Center. Storm Events Database. Retrieved 07.29.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Lightning&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=ALAMEDA%3A1&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA

\textsuperscript{156} National Climatic Data Center. Storm Events Database. Retrieved 07.29.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Hail&eventType=%28Z%29+HighWind&eventType=%28C%29+Lightning&eventType=%28Z%29+StrongWind&eventType=%28C%29+ThunderstormWind&eventType=%28C%29+Tornado&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=ALAMEDA%3A1&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA
or “Hail” that are reported for Alameda County have actually taken place hundreds of miles away, but are erroneously recorded as events that have occurred in the County.  

When such a discrepancy arises, the more conservative aggregate hazard wind event value (i.e., 364 events) is used to determine the historical frequency of occurrence for the severe weather hazard. The origin of this discrepancy is unknown at this time.

**Historical, Aggregated Severe Hazard Losses for Alameda County since 1996**

According to the NCEI Storm Events Database, the severe weather events that Alameda County has experienced since 1996 have been costly. There have been 5 deaths and 9 injuries, and property and crop damage estimates have totaled approximately $11,977,000 and $10, respectively.  

*It is important to note that for all Alameda County severe weather hazard events recorded on the Storm Events Database, all deaths and injuries, as well as 58.2% of all property damage estimates, have been attributed to wind hazard events alone. Almost all of the remaining property damage estimates (i.e., 41.7%) have been attributed due to hail hazard events. Reported crop damage estimates have been negligible.*

**Contra Costa County**

**Wind Hazards (excluding Tornadoes)**

Information obtained from the NCEI Storm Event Database shows the number of events (or occurrences) of wind hazard events in Contra Costa County since 1996.  

Here, wind hazard events include all “High Wind,” “Strong Wind,” and “Thunderstorm Wind” storm reports.

- **High Wind:** at least 88 events, or approximately 3.47 events per year

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- **Strong Wind**: at least 253 events, or 10.0 events per year\(^{162}\)
- **Thunderstorm Wind**: at least 7 events, or approximately 0.28 events per year\(^{163}\)
- **All Wind Hazard events** (excluding Tornadoes): at least 342 events, or approximately 13.50 events per year.\(^{164}\) (Note: This was determined by conducting a simultaneous search of the component wind hazards of high wind, strong wind and thunderstorm wind.)

Overall, in Contra Costa County, there have been at least 342 wind hazard events since 1996, excluding tornadoes.\(^{165}\) That translates to an approximate average historical frequency of occurrence of 13.50 wind hazard events per year.

Please note: Differences between the sums of individual component severe weather hazard event Database searches (i.e., 348 events) and simultaneous Database searches of all severe weather hazard events (i.e., 342 events) may be due to the following factors: (1) multiple event types are in the same record (e.g., "Thunderstorm Wind/Hail" or "Hail/Tornado;" and/or (2) severe weather hazard events such as "Thunderstorm Wind" or "Hail" that are reported for Contra Costa County have actually taken place hundreds of miles away, but are erroneously recorded as events that have occurred in the County.\(^{166}\) When such a discrepancy arises, the more conservative aggregate hazard wind event value (i.e., 342 events) is used to determine the historical frequency of occurrence for the severe weather hazard. The origin of this discrepancy is unknown at this time.

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\(^{162}\) National Climatic Data Center. Storm Events Database. Retrieved on 08.04.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28Z%29+Strong+Wind&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=CONTRA%2BCOSTA%3A13&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA

\(^{163}\) National Climatic Data Center. Storm Events Database. Retrieved on 08.04.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Thunderstorm+Wind&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=CONTRA%2BCOSTA%3A13&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA

\(^{164}\) National Climatic Data Center. Storm Events Database. Retrieved on 08.04.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28Z%29+High+Wind&eventType=%28Z%29+Strong+Wind&eventType=%28C%29+Thunderstorm+Wind&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=CONTRA%2BCOSTA%3A13&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA

\(^{165}\) National Climatic Data Center. Storm Events Database. Retrieved on 08.04.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28Z%29+High+Wind&eventType=%28Z%29+Strong+Wind&eventType=%28C%29+Thunderstorm+Wind&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=CONTRA%2BCOSTA%3A13&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA

Historical Wind Hazard Losses for Contra Costa County since 1996

According to the NCEI Storm Events Database, the wind hazard events that Contra Costa County has experienced since 1996 have been costly. There have been five (5) deaths and nine (9) injuries, and property damage estimates have totaled approximately $6,964,000; there have been no crop damages reported.\(^{167}\)

**Tornado Wind Hazards**

Information from the NCEI Storm Events Database indicates that since 1996, there have been three (3) reported events of tornadoes in Contra Costa County, which translates to approximately 0.12 tornado events per year.\(^{168}\) Reports of tornadoes in Contra Costa County since 1996 have been of two (2) tornadoes with severity ratings of F0/EF0, and one (1) tornado with a severity rating of F1/EF1.\(^{169}\)

Historical Tornado Hazard Losses for Contra Costa County since 1996

According to the NCEI Storm Events Database, the tornado hazard events that Contra Costa County has experienced since 1996 have been costly. While there have been no deaths, injuries, or crop damage, property damage estimates have totaled approximately $275,000.\(^{170}\)

**Hail**

Information from the NCEI Storm Events Database indicates that since 1996, there have been 12 reported events of hail in Contra Costa County, which translates to approximately

\(^{167}\) National Climatic Data Center. Storm Events Database. Retrieved on 08.04.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28Z%29+High+Wind&eventType=%28Z%29+Strong+Wind&eventType=%28C%29+Thunderstorm+Wind&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=CONTRA%2BCOSTA%3A13&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statetfips=6%2CCALIFORNIA

\(^{168}\) National Climatic Data Center. Storm Events Database. Retrieved on 08.04.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Tornado&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=CONTRA%2BCOSTA%3A13&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statetfips=6%2CCALIFORNIA

\(^{169}\) National Climatic Data Center. Storm Events Database. Retrieved on 08.04.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Tornado&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=CONTRA%2BCOSTA%3A13&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statetfips=6%2CCALIFORNIA

\(^{170}\) National Climatic Data Center. Storm Events Database. Retrieved on 08.04.2021 from National Climatic Data Center. Storm Events Database. Retrieved on 08.04.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Tornado&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=CONTRA%2BCOSTA%3A13&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statetfips=6%2CCALIFORNIA
0.47 hail events per year.\(^{171}\) (Note: The NCEI Storm Event Database search results for hail indicate that there has been a total of 13 reports of hail since 1996. However, one (1) entry is for a hail event in San Diego County, hundreds of miles away from Contra Costa County. The origin of this error is unknown at this time.)

**Historical Hail Hazard Losses for Contra Costa County since 1996**

According to the NCEI Storm Events Database, there have been no reported deaths, injuries, property damage, or crop damage from hail hazard events in Contra Costa County since 1996.\(^{172}\) (Note: The San Diego County hail event that was included erroneously in the search results for hail hazard events in Contra Costa County accounted for all injuries (i.e., 5) and crop damage estimates (i.e., $300,000) presented in the search results.)

**Lightning**

Information from the NCEI Storm Events Database indicates that since 1996, there have been no reported events of lightning in Contra Costa County.\(^{173}\)

**Historical Lightning Hazard Losses for Contra Costa County since 1996**

Because there have been no lightning hazard events reported in the County since 1996, there have been no lightning-related deaths, injuries, property damage, or crop damage.\(^{174}\)

**All Severe Weather Hazard Events Recorded by the NCEI Storm Events Database**

*Contra Costa County*

\(^{171}\) National Climatic Data Center. Storm Events Database. Retrieved on 08.04.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Hail&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=CONTRA%2BCOSTA%3A13&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA

\(^{172}\) National Climatic Data Center. Storm Events Database. Retrieved on 08.04.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Hail&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=CONTRA%2BCOSTA%3A13&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA

\(^{173}\) National Climatic Data Center. Storm Events Database. Retrieved on 08.04.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Lightning&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=CONTRA%2BCOSTA%3A13&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA

\(^{174}\) National Climatic Data Center. Storm Events Database. Retrieved on 08.04.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Lightning&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=CONTRA%2BCOSTA%3A13&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA
Information obtained from the NCEI Storm Events Database indicates that there have been 357 occurrences of the severe weather hazard in Contra Costa County. This translates to 14.09 severe weather hazard occurrences per year.175

Please note: Differences between the sums of individual component severe weather hazard event Database searches (i.e., 364 events) and simultaneous Database searches of all severe weather hazard events (i.e., 357 events) may be due to the following factors: (1) multiple event types are in the same record (e.g., “Thunderstorm Wind/Hail” or “Hail/Tornado,” and/or (2) severe weather hazard events such as “Thunderstorm Wind” or “Hail” that are reported for Contra Costa County have actually taken place hundreds of miles away, but are erroneously recorded as events that have occurred in the County.176 When such a discrepancy arises, the more conservative aggregate hazard wind event value (i.e., 357 events) is used to determine the historical frequency of occurrence for the severe weather hazard. The origin of this discrepancy is unknown at this time.

Historical, Aggregated Severe Hazard Losses for Contra Costa County since 1996

According to the NCEI Storm Events Database, the severe weather events that Contra Costa County has experienced since 1996 have been costly. There have been five (5) deaths and nine (9) injuries, and property damage estimates have totaled approximately $7,239,000; no crop damages have been reported.177 It is important to note that for all Contra Costa County severe weather hazard events recorded on the Storm Events Database, all deaths and injuries, and 96.2% of all property damage estimates have been attributed to wind hazard events alone.

Wind Hazards Not Included in the NCEI Storm Events Database

Santa Ana Winds

Santa Ana wind events occur at least twice per month from October through April.178 From 1948 to 2012, total of 2056 events on the 65-year record were recorded in the Southern California region, yielding an average of 32 occurrences per year. Typical Santa

175 Re National Climatic Data Center. Storm Events Database. Retrieved on 08.04.2021 from
https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Hail&eventType=%28Z%29+HightWind&eventType=%28C%29+Lightning&eventType=%28Z%29+Strong+Wind&eventType=%28C%29+Thunderstorm+Wind&eventType=%28C%29+Tornado&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=CONTRA%2BCOSTA%3A13&hailfilter=0.00&tornfilter=0.00&windfilter=0.00&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA


177 National Climatic Data Center. Storm Events Database. Retrieved on 08.04.2021 from
https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Hail&eventType=%28Z%29+HightWind&eventType=%28C%29+Lightning&eventType=%28Z%29+Strong+Wind&eventType=%28C%29+Thunderstorm+Wind&eventType=%28C%29+Tornado&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=CONTRA%2BCOSTA%3A13&hailfilter=0.00&tornfilter=0.00&windfilter=0.00&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA

Ana wind events last 1–2 days and represent 27% of the occurrences, with events lasting up to 6 days accounting for 90% of all occurrences. The remaining 10% are made up almost entirely of events lasting between 7 and 12 days.¹⁷⁹ ¹⁸⁰

Figure below shows the mean monthly frequency per season of Santa Ana Wind events detected from 1948 to 2012. Extreme Santa Ana wind events are shown in dark red, and are defined as those events that are above the 90th percentile of all events on record.

Figure 8-15: Mean Annual Frequency of Santa Ana Wind events (1948-2012)¹⁸¹ ¹⁸²

**Diablo Winds**

Diablo wind events occur approximately **2.5 events per year**. These events are most frequent during the fall and early winter seasons, with the highest frequency of events occurring in October. As a result, the highest risk of Diablo-wind-related damage is in the fall and early winter.\(^{183}\)

Figure below shows the monthly frequency of Diablo winds (along with average live fuel moisture content). The Diablo Wind data are derived from a 17-year climatology of San Francisco Bay Area regional surface weather stations.\(^{184}\)

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\(^{184}\) Retrieved on 07.15.2021 from https://www.fireweather.org/diablo-winds
Sundowner Winds

Strong sundowner wind events occur approximately **2-3 times per year**. These events can create sharp temperature rises, local gale force winds, and significant weather-related problems. Rare, “explosive” types of sundowner wind events occur about 6 times per century that present dangerous weather situations, generating extremely strong and hot winds that can reach gale force or higher speeds.\(^{185}\)

### Historical Frequency of All Severe Weather Hazards

Table below shows the average historical frequency of severe weather hazard events for Alameda County since 1996.)

Table 8-36: Severe Weather Hazard Event Frequencies for Alameda County since 1996.

<table>
<thead>
<tr>
<th>Severe Weather Hazard Category</th>
<th>Average Number of Hazard Events Per Year</th>
</tr>
</thead>
</table>

---

\(^{185}\) Retrieved on 07.13.2021 from https://www.fireweather.org/diablo-winds

<table>
<thead>
<tr>
<th>Wind (Includes High, Strong and Thunderstorm Winds ONLY)</th>
<th>13.54</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tornado</td>
<td>0</td>
</tr>
<tr>
<td>Hail</td>
<td>0.75</td>
</tr>
<tr>
<td>Lightning</td>
<td>0.08</td>
</tr>
<tr>
<td>Diablo Wind</td>
<td>2.5</td>
</tr>
<tr>
<td>Santa Ana Wind *</td>
<td>32</td>
</tr>
<tr>
<td>Sundowner Wind*</td>
<td>2 to 3</td>
</tr>
</tbody>
</table>

* Note: The Santa Ana and Sundowner wind hazards are not present in Alameda County. They are included here for information purposes only.

Table below shows the average historical frequency of severe weather hazard events for Contra Costa County since 1996.)
Table 8-37: Severe Weather Hazard Event

Frequencies for Contra Costa County since 1996.

<table>
<thead>
<tr>
<th>Severe Weather Hazard Category</th>
<th>Average Number of Hazard Events Per Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wind (Includes High, Strong and Thunderstorm Winds ONLY)</td>
<td>13.50</td>
</tr>
<tr>
<td>Tornado</td>
<td>0.12</td>
</tr>
<tr>
<td>Hail</td>
<td>0.47</td>
</tr>
<tr>
<td>Lightning</td>
<td>0</td>
</tr>
<tr>
<td>Diablo Wind</td>
<td>2.5</td>
</tr>
<tr>
<td>Santa Ana Wind</td>
<td>32</td>
</tr>
<tr>
<td>Sundowner Wind</td>
<td>2 to 3</td>
</tr>
</tbody>
</table>

* Note: The Santa Ana and Sundowner wind hazards are not present in Contra Costa County. They are included here for information purposes only.

Potential Impacts of the Hazard

The significance (or priority) of a hazard’s potential impacts is based primarily on the frequency and resulting damage caused by the hazard, including deaths/injuries and property, crop, and economic damage. All assets and people within all CSU East Bay campus areas are at risk from the effects of severe weather hazards.

Wind Hazards (Including Tornadoes)

Wind hazard events have the potential to impact people, property, and operations on campuses across the CSU system. People caught in the open during an extreme wind event are exposed to high winds and debris, and could be injured or killed.

The habitability of buildings can be compromised (by damaging roofs, windows, or other weak points in the building envelope), leading to long-term operational issues for the campus. As with most university campuses, space is always at a premium at CSU East Bay campuses, and the loss of any currently utilized space due to building or structural damage would likely disrupt operations and the University’s mission.
Extreme wind events can result in power failure, which would impact the operation of the campus. Fallen tree limbs and other potential transportation hazards may also cause disruption to the surrounding community and limit ingress/egress to the campus.

**CSU East Bay Main Campus, Hayward, and Oakland Center, Oakland (Alameda County)**

The City of Hayward Local Hazard Mitigation Plan 2015 does not identify any wind hazards (including tornadoes) as significant; however, the City of Oakland’s 2021-2026 Hazard Mitigation Plan identifies “high wind” as a significant severe weather hazard that has a “high” impact on people and a “low” impact on property in the community.\(^{187} \) \(^{188} \)

As a result, wind hazards are considered to have a moderate potential impact on both communities and (by extension) on both the CSU East Bay main campus and the CSU East Bay – Oakland Center campus.

**CSU East Bay – Concord Campus, Concord (Contra Costa County)**

The 2018 Contra Costa County Hazard Mitigation Plan groups together several sub-hazards (i.e., heavy rains/atmospheric rivers/thunderstorms, extreme heat, and damaging winds) into one all-encompassing “severe weather” hazard; in the Plan, the severe weather hazard is considered to have a “medium” impact on people and a “low” impact on property in the community. As a result, wind hazards (including tornadoes) are considered to have a minimal to moderate potential impact on the CSU East Bay – Concord campus.\(^{189} \)

**Hail**

Hail typically impacts property by damaging structures, cars, and utilities as it falls. Dents in cars, broken glass, and holes in roofs are common impacts of hail. Injuries to people from hail are less common, though they can happen, as hail is a hard object falling in an unpredictable manner at a fairly high rate of speed.

**CSU East Bay Main Campus, Hayward, and Oakland Center, Oakland (Alameda County)**

Neither of the Alameda County communities in which CSU East Bay campuses are located (i.e., Hayward and Oakland) identifies hail as a significant hazard; therefore, hail is


not profiled as a hazard in either community’s local hazard mitigation plan. Because of this, hail hazards are considered to have a minimal potential impact on both communities and (by extension) on both the CSU East Bay main campus and the CSU East Bay – Oakland Center campus.

**CSU East Bay – Concord Campus, Concord (Contra Costa County)**

The 2018 Contra Costa County Hazard Mitigation Plan groups together several sub-hazards (i.e., heavy rains/atmospheric rivers/thunderstorms, extreme heat, and damaging winds) into one all-encompassing “severe weather” hazard; in the Plan, the severe weather hazard is considered to have a “medium” impact on people and a “low” impact on property in the community. As a result, hail hazards are considered to have a minimal to moderate potential impact on the CSU East Bay – Concord campus.

**Lightning**

Lightning strikes the United States about 20-25 million times a year. Although most lightning occurs in the summer months, people can be struck at any time of year. Since 1990, lightning has killed an average of 39 people each year in the United States, and hundreds more have been injured. Property losses due to lightning have been very costly across the U.S. For example, from 2005 through 2020, U.S. homeowner’s insurance claim payouts for lightning losses totaled approximately $15,334,600,000, or $958,412,500 worth of payouts per year. (Commercial claim payouts for lightning losses for the U.S. were not available.)

**CSU East Bay Main Campus, Hayward, and Oakland Center, Oakland (Alameda County)**

Neither of the Alameda County communities in which CSU East Bay campuses are located (i.e., Hayward and Oakland) identifies lightning as a significant hazard; therefore, lightning is not profiled as a hazard in either community’s local hazard mitigation plan.

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Because of this, lightning hazards are considered to have a minimal potential impact on both communities and (by extension) on both the CSU East Bay main campus and the CSU East Bay – Oakland Center campus.

**CSU East Bay – Concord Campus, Concord (Contra Costa County)**

The 2018 Contra Costa County Hazard Mitigation Plan groups together several sub-hazards (i.e., heavy rains/atmospheric rivers/thunderstorms, extreme heat, and damaging winds) into one all-encompassing “severe weather” hazard; in the Plan, the severe weather hazard is considered to have a “medium” impact on people and a “low” impact on property in the community. As a result, lightning hazards are considered to have a minimal to moderate potential impact on the CSU East Bay – Concord campus.198

**Probability of Future Occurrence of the Hazard**

Areas throughout California, including all California State University (CSU) campuses, experience severe weather events every year. Future occurrences of such events are projected to increase in both their frequency and intensity.

**CSU East Bay Main Campus, Hayward, and Oakland Center, Oakland (Alameda County)**

The City of Hayward Local Hazard Mitigation Plan 2015 does not identify any wind hazards (including tornadoes) as significant; however, the City of Oakland’s 2021-2026 Hazard Mitigation Plan identifies “high wind” as a significant hazard that has a “high” probability of occurrence (i.e., likelihood of annual occurrence).199 200 Also, according to the NCEI Storm Events Database, wind hazards have occurred in both communities and across the County far more than once annually – at an average of 13.54 wind hazard events per year since 1996. Furthermore, while the severe weather hazard is a non-spatial hazard that affects all areas of both CSU East Bay campus locations in Alameda County equally, the smallest geographic unit of measurement for almost all official severe weather event data is at the county level. Because the severe weather data used in this assessment do not exist at the campus level, it is assumed that the severe weather

probabilities for both the CSU East Bay main campus and the CSU East Bay – Oakland Center campus reflect those of the surrounding communities and County.

Based on the data available from the aforementioned local hazard mitigation plans and from the NCEI Storm Events Database, the severe weather hazard (in the form of wind hazards) is expected to occur on (or otherwise impact) both CSU East Bay campuses located in Alameda County campus at least once on an annual basis. Therefore, the probability of future occurrence of the severe weather hazard for both the CSU East Bay main campus and the CSU East Bay – Oakland Center campus is **HIGHLY LIKELY**.

**CSU East Bay – Concord Campus, Concord (Contra Costa County)**

The 2018 Contra Costa County Hazard Mitigation Plan identifies severe weather (including damaging winds and thunderstorms) as a significant hazard that has a “high” probability of occurrence, and states that the County planning area can expect to experience exposure to and adverse impacts from some type of severe weather event at least annually. Also, according to the NCEI Storm Events Database, some of these same severe weather hazards have occurred in Contra Costa County at least once per year. Furthermore, while the severe weather hazard is a non-spatial hazard that affects all areas of the CSU East Bay – Concord campus equally, the smallest geographic unit of measurement for almost all official severe weather event data is at the county level. Because the severe weather data used in this assessment do not exist at the campus level, it is assumed that the severe weather probabilities for the CSU East Bay – Concord campus reflect those of the surrounding community and County identified in the Table below.

Based on the data available from both the 2018 Contra Costa County Hazard Mitigation Plan and the NCEI Storm Events Database, the severe weather hazard is expected to occur on (or otherwise impact) the CSU East Bay – Concord campus at least once on an annual basis. Therefore, the probability of future occurrence of the severe weather hazard for the CSU East Bay – Concord campus is **HIGHLY LIKELY**.

**CSU East Bay – All Campus Areas**

The probability of future occurrence of the severe weather hazard for all CSU East Bay campus areas is **HIGHLY LIKELY**.

The following tables show the probabilities of future occurrence for component severe weather hazards for CSU East Bay campuses in Alameda County and Contra Costa County.

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Table 8-38: Severe Weather Hazard Probabilities of Future Occurrence for Alameda County and CSU East Bay (Main Campus and Oakland Conference Center)

<table>
<thead>
<tr>
<th>Severe Weather Hazard Category</th>
<th>Average Number of Hazard Events Per Year</th>
<th>Probability of Future Occurrence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wind (Includes High, Strong and Thunderstorm Winds ONLY)</td>
<td>13.54</td>
<td>Highly Likely</td>
</tr>
<tr>
<td>Tornado</td>
<td>0</td>
<td>Unlikely</td>
</tr>
<tr>
<td>Hail</td>
<td>0.75</td>
<td>Likely</td>
</tr>
<tr>
<td>Lightning</td>
<td>0.08</td>
<td>Unlikely</td>
</tr>
<tr>
<td>Diablo Wind</td>
<td>2.5</td>
<td>Highly Likely</td>
</tr>
<tr>
<td>Santa Ana Wind**</td>
<td>32</td>
<td>Not Rated</td>
</tr>
<tr>
<td>Sundowner Wind**</td>
<td>2 to 3</td>
<td>Not Rated</td>
</tr>
<tr>
<td>Severe Weather Hazard</td>
<td></td>
<td>Highly Likely</td>
</tr>
</tbody>
</table>

** Note: The Santa Ana and Sundowner wind hazards are not present in Alameda County, and therefore are not rated for probability of future occurrence. They are included here for information purposes only.
Vulnerability to the Hazard

People, structures, and assets on all CSU East Bay campuses are all vulnerable to the impacts associated with severe weather. Infrastructure can be damaged or destroyed by hail, wind, tornadoes, thunderstorms, and lightning, which can result in service interruptions and outages. Structures can be damaged or destroyed by hail, wind, tornadoes, thunderstorms, and lightning. People can be injured or killed by lightning, flying debris, hail, or extreme wind events. All CSU East Bay campuses also have vehicles that are all vulnerable to a severe weather event.

Estimate of Potential Losses

Severe weather is a non-spatial hazard that affects the all CSU East Bay campus areas. Each of the hazards associated with severe weather can result in losses throughout the planning area.

All structures at all CSU East Bay campuses are at risk from severe weather. There are approximately 39 buildings that could be damaged by wind, hail, and/or lightning. If even a fraction of these assets were to be damaged, the resulting estimated losses would still...
be in the millions of dollars. The total replacement costs due to severe weather hazard are $164,768,550 for 30 buildings, and unknown for the remaining nine (9) buildings. An analysis of projected dollar losses to campus buildings from severe weather as a percentage of building replacement costs is also not currently available, though CSU leadership may pursue such data in the future.

The population at all CSU East Bay campuses varies throughout the day. As of Fall, 2019, CSU East Bay had 14,705 students and 1,764 faculty and staff. All are at risk from severe weather events, with 16,469 being directly vulnerable in this scenario.

Vulnerability Assessment Conclusions

Severe weather presents a variety of hazards to CSU East Bay campuses. People, assets, infrastructure, and vehicles can all be damaged by this hazard, and losses can quickly begin to rise. In the aggregate, severe weather is a frequently occurring hazard (mostly in the form of wind hazard events) that presents a variety of risks to CSU East Bay.

It is evident that CSU East Bay has vulnerabilities to and risks from severe weather hazard incidents, and that pre-event planning, communication, and mitigation efforts should be implemented. Public education and outreach regarding areas of shelter that could be used by campus populations during severe weather events is considered by campus leadership to be one viable mitigation option. The campus planning committee will continue to look for feasible and cost-effective options for the mitigation of severe weather risks going forward.

Identified Data Limitations

Numerous federal agencies maintain a variety of records regarding losses associated with hazards. Unfortunately, no single source is considered to offer a definitive accounting of all losses. The Federal Emergency Management Agency (FEMA) maintains records on federal expenditures associated with declared major disasters. The US Army Corps of Engineers (USACE) and the Natural Resources Conservation Service (NRCS) collect data on losses during the course of some of their ongoing projects and studies. Additionally, the National Oceanic and Atmospheric Administration’s (NOAA) National Centers for Environmental Information (NCEI) collects and maintains data about natural hazards in summary format, as well as occurrences, dates, injuries, deaths, and estimated costs for individual storm events. Many of these databases and other data collection services, including the NCEI, have inherent data limitations when searching for information at a scale as small as a single campus.

The best available data and records have been used throughout this section. Where no data or records exist or could be located, that deficiency is noted.

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8.4 Social Risk Resilience Assessment

Overview

While every person is vulnerable to risk, individuals from diverse populations such as those with access and functional needs are disproportionately more vulnerable and may be at a higher risk to harm in a disaster event. In addition to physical vulnerabilities, the intersectionality between physical hazard risks and population social vulnerabilities must be considered to holistically address overall campus risk.

As inclusivity is a high priority for CSU, addressing campus risk and resilience must be done through the lens of inclusion and equity. Addressing social vulnerability is an increasingly critical requirement of state and national doctrines and described in Section 4.4 of the HVRA Base Plan. Every individual of the campus’s richly diverse population group needs to have the capacity, skills, and knowledge in order to understand, access, and participate in risk reduction and disaster response in ways that are meaningful to their own unique situation. In a campus community, having strong social support networks and active involvement in community disaster responses may negatively or positively impact these opportunities and reduce the resilience-building process. This section offers a glimpse into the CSU East Bay campus’s unique social construct, population demographics, strengths and concerns and presents a high-level assessment of the resilience, coping capacities and potential social vulnerabilities of students, staff and faculty. The research variables that were asked are often considered sensitive subjects, and few are traditionally included in emergency management/hazard mitigation planning.

This social resilience assessment of college campuses is the first of its kind in the nation. The research methodology unfolded as the interviews with campuses progressed. The assessment data presented are not definitive or authoritative. The answers, analysis, and suggested trends are strictly indicators for potential social risk. They do not represent an accurate data capture as limitations on the data gathering process influenced an ability to provide accuracy. This assessment provides indications of increased risk, not accuracy of response or a true reflection of the situation of the campus. The information presented is to be considered in the context of the more detailed system-wide CSU social vulnerability assessment that is included in the baseline HVRA.

Campus-Identified Populations of Concern

During the campus interview, the following responses were provided when asked, “In considering the diverse population group(s) amongst student body, faculty and staff, which are of the most concern in your emergency management planning?”
### Table 8-40: High level summary of campus populations of concern

<table>
<thead>
<tr>
<th>Question</th>
<th>Campus Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>Which population groups amongst the student body, faculty, and staff, are of the most concern for physical and social vulnerabilities in emergency management planning?</td>
<td>None</td>
</tr>
<tr>
<td>Which population groups are most difficult to reach in an event?</td>
<td>Students that do not communicate by email</td>
</tr>
</tbody>
</table>
| Which population groups have little/limited support networks if impacted by an event? | - Populations experiencing homelessness  
  - Socially or economically disadvantaged populations  
  - Populations who speak English as a foreign language  
  - International students |

### Resilience Variables Related to Campus Emergency Management

The interviewees were asked to reflect on a set of 12 variables for the campus populations of student, faculty and staff: homelessness (*housing insecurity*), food security, health and wellness, disability/access and functional needs (AFN), racial equity, digital equity, communications, international students, immigrants/immigration status issues (*undocumented, DACA, etc.*), LGBTQI (Lesbian Gay Bisexual Transgender Questioning (or queer) Intersex), and transportation dependency. They were also offered an opportunity to add any other factor they wanted to include. The following two questions were asked:

- Is this factor a particular issue of concern for emergency management on your campus? Responses were summarized as **Very High, High, Medium, Low**
- Is this factor reflected in the emergency plans and processes for your campus? Responses were summarized as **Yes, No, In Progress, NA**
In order to provide a high-level qualitative response for the answers, the approach of averaging response was taken. If conflicting answers were expressed by the interviewees, the answer (code) was averaged out. A detailed explanation of the response averaging approach is included in the base HVRA.

Table 8-41: Graph of campus-specific emergency management issues of concern and inclusion in emergency management plans and processes

<table>
<thead>
<tr>
<th>Issue of Concern</th>
<th>Plans &amp; Processes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Homelessness (Housing Insecurity)</td>
<td>Medium</td>
</tr>
<tr>
<td>Food Security</td>
<td>High</td>
</tr>
<tr>
<td>Health &amp; Wellness</td>
<td>Medium</td>
</tr>
<tr>
<td>AFN</td>
<td>High</td>
</tr>
<tr>
<td>Racial Equity</td>
<td>High</td>
</tr>
<tr>
<td>Digital Equity</td>
<td>Low</td>
</tr>
<tr>
<td>Comms.</td>
<td>High</td>
</tr>
<tr>
<td>International Students</td>
<td>High</td>
</tr>
<tr>
<td>Immigrants / Immigration Status</td>
<td>Low</td>
</tr>
<tr>
<td>LGBTQI</td>
<td>Medium</td>
</tr>
<tr>
<td>Transportation Dependency</td>
<td>High</td>
</tr>
</tbody>
</table>

Qualitative Narrative: Campus Overview of Potential Resilience Vulnerabilities

The following are interview notes of interest:

- Strong interest was expressed for developing elements for many of these issues/populations in the different plans but have not yet had the opportunity to do so. It was specifically noted that homelessness, health and wellness and racial equity will be addressed in the emergency plans.

- The group of students who don’t read emails is an issue. They have had to strategize and prioritize because everyone has a different method for preferred contact.
- Digital equity is in the Business Continuity Plan (BCP) not in the EOP and the plan is to leave it on the BCP side.
- Writing a communications plan now. Currently the outreach through alerts is English only.

Campus High Hazards and Potentially Vulnerable Populations

This section provides a brief introduction to the link between socially vulnerable populations and a particular hazard type. While extensive research has been conducted on the impacts of hazards, not all linkages have been documented or published, and detail for finding them are beyond the scope of this assessment. It’s important to note, the intersectional nature of what makes an individual’s personal experience and resilience to an event is played out by unique factors for that individual or population. The nuanced social vulnerabilities often come from the social and physical environment in which a person is embedded.

In order to aid in further assessing campus resilience, below is a general description of the known impacts. From some hazards, the descriptions are robust, while others are only brief introductions.

Table 8-42: CSU East Bay *Highly Likely, Likely and Possible* Hazards

<table>
<thead>
<tr>
<th>Hazard</th>
<th>Future Occurrence Probability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Communicable Disease</td>
<td>Highly Likely</td>
</tr>
<tr>
<td>Drought</td>
<td>Highly Likely</td>
</tr>
<tr>
<td>Earthquake</td>
<td>Possible</td>
</tr>
<tr>
<td>Erosion</td>
<td>Highly Likely</td>
</tr>
<tr>
<td>Landslide</td>
<td>Possible</td>
</tr>
<tr>
<td>Power Outage</td>
<td>Likely</td>
</tr>
<tr>
<td>Wildfire</td>
<td>Possible (Fire); Possible (Smoke)</td>
</tr>
</tbody>
</table>
Drought

The 2012-2016 drought had severe effects on two vulnerable sectors of our population: those in low-income brackets, and those, especially Native Americans, who rely on subsistence fishing for their livelihoods. Water bills increased throughout the state. Due to rising water prices, for the working poor, many have paid four to five percent of their income for water. Since many CSU students are commuters, and many living with families, future drought impacts may potentially affect a percentage of non-resident students. NASA’s modeling shows that future droughts are likely to last longer and be more intense, even leading to “megadroughts” in the western states. Fresh water supplies are predicted to be full of extremes, with both droughts and extreme precipitation events being more severe. The interrelationship between drought and other hazard conditions may lead to a set of secondary impacts. Drought conditions lead to water quality issues due to loss of drinking water, increased fire danger that leads to drought-induced fires and elevated AQI levels, as well as extreme heat or prolonged heat events.

Earthquake

Impacts on populations from earthquakes are complex, with long-term implications on social stability for all populations. In addition to the physical impact exposure during a no-notice earthquake event and the social and logistical challenges of a recovering community, an earthquake can have lasting impacts long afterwards due to post traumatic stress disorder (PTSD).

Socioeconomic vulnerabilities of populations at risk were analyzed in the hypothetical yet scientifically realistic earthquake sequence that is being used to better understand hazards for the San Francisco Bay region during and after a magnitude-7 earthquake (mainshock) on the Hayward Fault and its aftershocks. In this study, the at-risk populations located in areas of concentrated damage are anticipated to experience longer recovery trajectories, increased long term housing displacement, and transportation impacts due to dependencies on transit dependencies. When neighborhood schools close, families with school age children may move to other areas to keep their children in schools. Persons with access and functions needs are likely to be more dependent on access to functioning medical, social and personal health care services that would be overwhelmed by the event and therefore increasing their vulnerabilities. For the homeless populations, the loss of social community services and damages to shelters could add to protracted relocations. For the young and mobile populations who rent, the major disruption to housing, jobs and transit will also drive relocation. Widespread


housing damage and preexisting housing market constraints will make it “extremely
challenging” for the socially and economically vulnerable populations to find alternative
housing near their home communities. Those who utilize interim and irregular housing
for months and years after a disaster are more vulnerable to physical, social, and mental
disorders, including suicide, substance abuse, and physical and verbal abuse. Aftershocks
and post disaster conditions delay population return and increase outmigration.

**Erosion**

Risk from erosion relates to earthen and infrastructural losses. The degree of vulnerability
to these events and their impacts depends on human behavior and the traditional social
factors such as situational awareness, prior knowledge of hazards, social capital and
decision-making capabilities, as well as increased vulnerability due to social factors, such
as racial and economic disparities.

**Landslides**

Although infrastructural losses are of secondary importance to the risk to humans
themselves, research investigating the vulnerability of people to landslides is rare. The
many reasons for this lack of data are related to the fact that the collapse of occupied
buildings which makes it a function of structural vulnerability and therefore, indirect. The
degree of vulnerability to landslides by an individual considered at high risk, or even the
general populations, also depends on human behavior, including many of the traditional
social factors that are difficult to measure such as situational awareness, prior knowledge
of hazards, and decision-making capabilities.

Landslides can result in primary lifeline failures through the loss of roads or power and
communication lines. Transportation routes are often expensive to clean up, and
prolonged obstruction can disrupt the movement of people and goods. Risk from
landslide relates to earthen and infrastructural losses. The degree of vulnerability to these
events and their impacts depends on human behavior and the traditional social factors
such as situational awareness, prior knowledge of hazards, social capital and decision-
making capabilities, as well as increased vulnerability due to social factors, such as racial
and economic disparities.

**Power Outage/Public Safety Power Shutdowns (PSPS)**

Loss of power creates economic hardship to a region experiencing regular PSPS events,
such as those experienced throughout the state over the recent years. Many businesses

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https://doi.org/10.3133/sir20175013v3, accessed 0162021

close, including gas stations, grocery stores, and local retail establishments. These impacts may deeply impact students dependent on support jobs, as well impacting family members of campus staff and faculty. PSPS increases risks to the public due to inability to use medical devices, spoilage of food and medicines, and disruption to infrastructure, such as supply of clean water and electricity used to run home medical equipment, such as lift chairs and ventilators.

**Wildfire**

Increased wildfire threat occurs especially in the end of fall, when conditions are driest, but before the winter rains have come; an east-to-west wind gusts exacerbate fire risk. Wildfire threats have the concomitant threat of Public Safety Power Shutoffs (PSPS). And, in the case of an actual wildfire, danger exists both from fire and from the smoke. Recent wildfires have demonstrated that some demographics are disproportionately affected. Native Americans are six times more likely to be affected than white people. Blacks and Hispanic people are 50 percent more vulnerable. These values take into account the likelihood of a community being affected and the greater difficulty of that community to recover. These statistics reflect the lack of access to resources to pay for insurance, to rebuild and recover, to implement fire safety measures, and to access other resources. Price gouging after a fire (such as documented in Sonoma County after the 2017 Tubbs Fire) further exacerbates the disparity. 208 Furthermore, the disabled and the elderly are at particular risk from extreme wildfire conditions, as they are often not as able to effectively evacuate. Of the 85 people who died in the Camp Fire in Butte in 2018, 62 of them were at least 65 years old. 209

Smoke from wildfires creates a significant public health threat. Especially vulnerable are individuals who have heart or lung issues, such heart disease, lung disease or asthma. Those most vulnerable include the medically fragile, elderly and children. Air Quality Indexes track the level of the following: 210 particulate matter, surface levels of ozone, carbon monoxide, sulfur dioxide, and nitrogen dioxide. All of these can cause respiratory distress and harm lungs. 211

The California Department of Public Health reports the increased public health risks, and risk indicators that include: heat-related ED visits, populations living in wildfire areas,

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Hazard Mitigation and Emergency Management Planning

The goal of this high-level assessment is to provide a starting point to encourage further exploring campus social risks and vulnerabilities, as well as to inform and to enhance holistic emergency management and hazard mitigation decision making, planning processes and future adaptive risk management strategies. By including the social resilience factors, mitigation investments may move beyond standardized planning and regulations, structure and infrastructure projects, and natural systems protections to embrace a more expanded, customized emergency operations plan and an education and outreach program unique to the campus.

A more robust social resilience inquiry is strongly encouraged to develop an accurate picture, based on methodical and scientific research-based data. Such an effort would be envisioned through both nuanced discussions with a variety of campus stakeholders and the invitation of nontraditional stakeholders to join in a collaborative resilience partnership. Such a forward-leaning effort would be directly in keeping with CSU’s commitment to inclusion and equity in risk reduction.

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Section 09
California State University, Fresno

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9.1 University Profile

University History

California State University, Fresno (CSU Fresno/ Fresno State University) was founded as the Fresno State Normal School in 1911 as a teacher’s college, and began offering advanced degrees in 1949. Seven years later, the school moved its campus a short distance north to its current location. It became a charter institution of the California State University System in 1961 and changed its name in 1972 to California State University, Fresno. Today, the school includes 10 colleges and is classified as a Doctoral/Professional University by the Carnegie Institute. CSU Fresno is designated as both a Hispanic-Serving Institution (HSI) and an Asian American and Native American Pacific Islander-Serving Institution (AANAPISI).

University Governance

The campus president is the chief executive officer who oversees the administration of the entire university. The president manages campus operations and fundraising, sets campus priorities, and oversees the hiring and support of staff and faculty. The president also maintains a close working relationship with the CSU’s systemwide office, reporting to the chancellor and participating in the systemwide Executive Council.

The provost is the chief academic officer of the university, overseeing all academic affairs and programs of the university. The provost reports directly to the president.

Both the University Cabinet and University Advisory Board operate in advisory capacities to the campus president. The Cabinet is comprised of senior leaders on campus who provide advice to the president in addressing strategic and operational issues and in pursuing new initiatives. The Advisory Board, made up of community members and professionals, assists the University in effectively carrying out its mission, and is used at the discretion of the president to seek counsel and advice as needed.

University Mission

“To boldly educate and empower students for success.”

CSU Fresno outlines four strategic priorities in support of their goals. The priorities are directed towards supporting a sustainable campus environment, developing community partnerships, enhancing teaching and student support services, and attracting talented and diverse faculty and staff.

University Location

The CSU Fresno main campus encompasses 388 acres in the City of Fresno, CA (population 530,000). Located in the San Joaquin Valley, the campus is proximal both to the agricultural regions of California’s Central valley and to the Sierra Nevada Mountains. In addition to the main campus, CSU Fresno manages the University Agricultural Laboratory, a 1,000-acre farm, and 4,500 acres of Sierra foothill rangeland located at the San Joaquin Experimental Range.
University Population

Typically, enrollment at CSU Fresno exceeds 20,000 per semester. In fall 2020, the 25,341-student population was overwhelmingly made up of undergraduate degree seekers, among whom the average age is 21.7. Hispanic students make up 54.9% of all CSU Fresno students, with white students making up the second most populous group at 18.2%. The combined populations of Asian, Pacific Islander, and Native American students make up 12.8% of the total student body. A majority of CSU Fresno undergraduate students are first-generation and full-time, and many are Pell Grant eligible.

In addition to the student population, CSU Fresno is home to 2,533 employees, 58.5% of whom are faculty.

9.2 Interim Final Rule for Hazard Vulnerability and Risk Assessment

Requirement §201.6(c)(2): The plan shall include a risk assessment that provides the factual basis for activities proposed in the strategy to reduce losses from identified hazards. Local risk assessments must provide sufficient information to enable the jurisdiction to identify and prioritize appropriate mitigation actions to reduce losses from identified hazards.

Requirement §201.6(c)(2)(i): [The risk assessment shall include a] description of the type...location and extent of all natural hazards that can affect the jurisdiction. The plan shall include information on previous occurrences of hazard events and on the probability of future hazard events.

Requirement §201.6(c)(2)(ii): [The risk assessment shall include a] description of the jurisdiction’s vulnerability to the hazards described in paragraph (c)(2)(i) of this section. This description shall include an overall summary of each hazard and its impact on the community.

Requirement §201.6(c)(2)(ii): [The risk assessment] must also address National Flood Insurance Program (NFIP) insured structures that have been repetitively damaged floods.

Requirement §201.6(c)(2)(ii)(A): The plan should describe vulnerability in terms of the types and numbers of existing and future buildings, infrastructure, and critical facilities located in the identified hazard area.

Requirement §201.6(c)(2)(ii)(B): [The plan should describe vulnerability in terms of an] estimate of the potential dollar losses to vulnerable structures identified in paragraph (c)(2)(ii)(A) of this section and a description of the methodology used to prepare the estimate...

Requirement §201.6(c)(2)(ii)(C): [The plan should describe vulnerability in terms of] providing a general description of land uses and development trends within the community so that mitigation options can be considered in future land use decisions.
Requirement §201.6(c)(2)(iii): For multi-jurisdictional plans, the risk assessment must assess each jurisdiction’s risks where they vary from the risks facing the entire planning area.

9.3 Hazard Identification and Risk Assessment

Overview of California State University, Fresno History of Hazards

Numerous federal agencies maintain a variety of records regarding losses associated with hazards. Unfortunately, no single source is considered to offer a definitive accounting of all losses. The Federal Emergency Management Agency (FEMA) maintains records on federal expenditures associated with declared major disasters. The US Army Corps of Engineers (USACE) and the Natural Resources Conservation Service (NRCS) collect data on losses during the course of some of their ongoing projects and studies. Additionally, the National Oceanic and Atmospheric Administration’s (NOAA) National Centers for Environmental Information (NCEI) database collects and maintains data about natural hazards in summary format. The data includes occurrences, dates, injuries, deaths, and estimated costs. Many of these databases and other data collection services, including the NCEI, have inherent data limitations when searching for information at a university scale.

The best available data and records were used throughout this assessment.

Hazard Identification

As part of the initial hazard identification process, the Campus Assessment Team considered potential hazards with the most chance to significantly affect the planning area. The hazards include those that have occurred in the past and may occur in the future. A variety of sources were used to develop the list of hazards considered including national, regional, and local sources such as emergency operations plans, FEMA’s How-To Series, websites, published documents, databases, and maps, as well as discussion among the Campus Assessment Team members.

In the initial phase of the planning process, the Campus Assessment Team considered XX hazards and the risks they create for the University and its material assets, population, and operations. The hazards initially considered, and the determinations as to the treatment of those hazards, are shown in Table 9-1 (following).

Table 9-1: Hazard Identification Determinations

<table>
<thead>
<tr>
<th>Hazard</th>
<th>Determination (Yes/No)</th>
<th>Reason for Determination</th>
<th>Future Occurrence Probability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Communicable Disease</td>
<td>Yes</td>
<td>Hazard of concern for campus</td>
<td>Highly Likely</td>
</tr>
<tr>
<td>Dam and Levee Failure</td>
<td>Yes</td>
<td>Hazard of concern for campus</td>
<td>Unlikely</td>
</tr>
<tr>
<td>Hazard</td>
<td>Yes/No</td>
<td>Hazard of concern for campus</td>
<td>Future Occurrence Probability</td>
</tr>
<tr>
<td>-----------------------------</td>
<td>--------</td>
<td>------------------------------</td>
<td>------------------------------</td>
</tr>
<tr>
<td>Drought</td>
<td>Yes</td>
<td>Hazard of concern for campus</td>
<td>Highly Likely</td>
</tr>
<tr>
<td>Earthquake</td>
<td>Yes</td>
<td>Hazard of concern for campus</td>
<td>Possible</td>
</tr>
<tr>
<td>Erosion</td>
<td>Yes</td>
<td>Hazard of concern for campus</td>
<td>Highly Likely</td>
</tr>
<tr>
<td>Extreme Temperature</td>
<td>Yes</td>
<td>Hazard of concern for campus</td>
<td>Likely (Heat); Possible (Cold)</td>
</tr>
<tr>
<td>Flood</td>
<td>Yes</td>
<td>Hazard of concern for campus</td>
<td>Possible</td>
</tr>
<tr>
<td>Hazardous Materials</td>
<td>Yes</td>
<td>Hazard of concern for campus</td>
<td>Possible</td>
</tr>
<tr>
<td>Landslide</td>
<td>Yes</td>
<td>Hazard of concern for campus</td>
<td>Unlikely</td>
</tr>
<tr>
<td>Power Outage</td>
<td>Yes</td>
<td>Hazard of concern for campus</td>
<td>Likely</td>
</tr>
<tr>
<td>Sea Level Rise</td>
<td>No</td>
<td>Not a hazard of concern for campus</td>
<td>N/A</td>
</tr>
<tr>
<td>Tsunami</td>
<td>No</td>
<td>Not a hazard of concern for campus</td>
<td>N/A</td>
</tr>
<tr>
<td>Volcano</td>
<td>Yes</td>
<td>Hazard of concern for campus</td>
<td>Unlikely</td>
</tr>
<tr>
<td>Wildfire</td>
<td>Yes</td>
<td>Hazard of concern for campus</td>
<td>Unlikely (Fire; Possible (Smoke))</td>
</tr>
</tbody>
</table>

**Future Occurrence Probability**

In order to determine the probability of future occurrences of each hazard profiled, the following scale was developed:

- Highly Likely- 76%-100% that the hazard would occur annually.
- Likely- 50%-75% that the hazard would occur annually.
- Possible- 11%-49% that the hazard would occur each annually.
- Unlikely- 0%-10% that the hazard would occur each annually.
**Communicable Disease**

**Description of the Hazard**

Communicable diseases are illnesses that occur due to infectious agents or their toxic products, and are infectious due to their potential of transmission from one person or species to another by a replicating agent.¹ They may be transmitted from a reservoir to a susceptible host either directly as from an infected person or animal or indirectly through the agency of an intermediate plant or animal host, vector, or the inanimate environment. Communicable diseases are clinically evident illness resulting from the presence of pathogenic microbial agents, including pathogenic viruses, pathogenic bacteria, fungi, protozoa, multi-cellular parasites, and aberrant proteins known as prions.² The degree of spread of a communicable disease depends on both the ability of an organism to enter, survive and multiply in the host and the comparative ease with which the disease is transmitted to other hosts.³

Some ways in which communicable diseases spread are by:

- Travel through the air, such as tuberculosis, measles, or COVID-19;
- Physical contact with an infected person, such as through touch (staphylococcus), sexual intercourse (gonorrhea, HIV), fecal/oral transmission (hepatitis A), or droplets (influenza, TB, COVID-19);
- Contact with a contaminated surface or object (Norwalk virus), food (salmonella, E. coli), blood (HIV, hepatitis B), or water (cholera); and
- Bites from insects or animals capable of transmitting the disease (mosquito: malaria and yellow fever; flea: plague).⁴

Collectively, the twenty-three (23) campuses and Chancellor’s Office of the California State University (CSU) system have identified nine (9) communicable disease hazards that that have had significant impacts on their respective student, faculty, and staff populations. Of these communicable diseases, COVID-19 is considered to be the most prominent and widespread agent across all CSU campuses. (See Table 9-2 below.)

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Table 9-2 Communicable Diseases Identified CSU Campuses

<table>
<thead>
<tr>
<th>Collective List of Communicable Diseases Identified by All CSU Campuses</th>
<th>Number of CSU Campuses (Including Chancellor’s Office) Identifying Communicable Disease Having Significant Impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>COVID-19 (SARS-CoV-2)</td>
<td>24</td>
</tr>
<tr>
<td>Meningitis</td>
<td>7</td>
</tr>
<tr>
<td>Measles</td>
<td>6</td>
</tr>
<tr>
<td>Influenza (Including H1N1/Swine Flu)</td>
<td>6</td>
</tr>
<tr>
<td>Tuberculosis</td>
<td>5</td>
</tr>
<tr>
<td>Norovirus</td>
<td>4</td>
</tr>
<tr>
<td>Mumps</td>
<td>2</td>
</tr>
<tr>
<td>E. Coli</td>
<td>2</td>
</tr>
<tr>
<td>Sexually Transmitted Diseases (STDs)</td>
<td>2</td>
</tr>
</tbody>
</table>

(Source: Interviews with CSU campus staff at CSU campuses and at CSU Chancellor’s Office.)

With the exception of COVID-19, there is variability among CSU campuses regarding which communicable diseases have had the greatest impact on individual campus communities. Table 9-3 shows the communicable disease hazards that have had the greatest impact on each CSU campus.

Table 9-3 Communicable Disease Hazards at CSU Campuses with Greatest Impact

<table>
<thead>
<tr>
<th>CSU Campus</th>
<th>Identified Communicable Disease Hazards with the Greatest Impact on CSU Campus</th>
</tr>
</thead>
<tbody>
<tr>
<td>CSU Bakersfield</td>
<td>COVID-19, Meningitis</td>
</tr>
<tr>
<td>CSU Channel Islands</td>
<td>COVID-19, Measles</td>
</tr>
<tr>
<td>Chico State</td>
<td>COVID-19, Tuberculosis</td>
</tr>
<tr>
<td>CSU Dominguez Hills</td>
<td>COVID-19</td>
</tr>
<tr>
<td>Cal State East Bay</td>
<td>COVID-19, Meningitis</td>
</tr>
<tr>
<td><strong>Fresno State</strong></td>
<td>COVID-19, Meningitis, Tuberculosis</td>
</tr>
<tr>
<td>Cal State Fullerton</td>
<td>COVID-19, Influenza</td>
</tr>
<tr>
<td>Humboldt State</td>
<td>COVID-19, Measles, Norovirus, Influenza, STDs</td>
</tr>
<tr>
<td>Cal State Long Beach</td>
<td>COVID-19</td>
</tr>
</tbody>
</table>
### Descriptions of Identified Communicable Disease Hazards at Fresno State

Fresno State has identified three (3) communicable disease hazards that have had the greatest impact on campus – COVID-19, Meningitis, and Tuberculosis. The following are brief descriptions of the communicable disease hazards at Fresno State.

**COVID-19 (SARS-CoV-2)**

Coronaviruses are a family of viruses that can cause illnesses such as the common cold, severe acute respiratory syndrome (SARS) and Middle East respiratory syndrome (MERS). In 2019, a new coronavirus was identified as the cause of a disease outbreak that originated in China. This virus is now known as the **severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2)**. The disease it causes is called Coronavirus Disease 2019 (COVID-19). In March 2020, the World Health Organization (WHO) declared the COVID-19 outbreak a pandemic.

(***Source***: Interviews with CSU campus staff at CSU campuses and at CSU Chancellor's Office.)
Signs and symptoms of coronavirus disease 2019 (i.e., COVID-19) may appear two to 14 days after exposure. Common signs and symptoms can include fever, cough, and tiredness. Early symptoms of COVID-19 may also include a loss of taste or smell.

The virus that causes COVID-19 spreads easily among people, and more continues to be discovered over time about how it spreads. Data has shown that the COVID-19 virus spreads mainly from person to person among those in close contact (within about 6 feet, or 2 meters). The virus is transmitted by respiratory droplets being released when someone with the virus coughs, sneezes, breathes, sings or talks. These droplets can be inhaled or land in the mouth, nose or eyes of a person nearby. In some situations, the COVID-19 virus can spread by a person being exposed to small droplets or aerosols that stay in the air for several minutes or hours (i.e., airborne transmission). It's not yet known how common it is for the virus to spread this way. The COVID-19 virus can also spread if a person touches a surface or object with the virus on it and then touches his or her mouth, nose or eyes; however, this is not considered to be a main way it spreads.

The severity of COVID-19 symptoms can range from very mild to severe. Some people may have only a few symptoms, and some people may have no symptoms at all. However, some people may experience worsened symptoms, such as worsened shortness of breath and pneumonia. People who are older have a higher risk of serious illness from COVID-19, and the risk increases with age. People who have existing medical conditions also may have a higher risk of serious illness from COVID-19. In some cases, the disease can cause severe medical complications and may even lead to death.5

**Meningitis**

Meningitis is an inflammation of the fluid and membranes (meninges) surrounding the brain and spinal cord. The swelling from meningitis typically triggers signs and symptoms such as headache, fever and a stiff neck. Early meningitis symptoms may mimic the flu (influenza). Symptoms may develop over several hours or over a few days.

Most cases of meningitis in the United States are caused by a viral infection, but bacterial, parasitic and fungal infections are other causes. Some cases of meningitis improve without treatment in a few weeks. Others can be life-threatening and require emergency antibiotic treatment. Bacterial meningitis is particularly serious and can be fatal within days without prompt antibiotic treatment. Delayed treatment also increases the risk of permanent brain damage or death.6

**Tuberculosis**

Tuberculosis (TB) is a potentially serious infectious disease that mainly affects the lungs. Tuberculosis is caused by bacteria that spread from person to person through

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microscopic droplets released into the air. This can happen when someone with the untreated, active form of tuberculosis coughs, speaks, sneezes, spits, laughs or sings.

Although tuberculosis is contagious, it’s not easy to catch. It is more likely for someone to get tuberculosis from a close family member or coworker than from a stranger. Most people with active TB who have had appropriate drug treatment for at least two weeks are no longer contagious.

Many strains of tuberculosis resist the drugs most used to treat the disease. People with active tuberculosis must take several types of medications for many months to eradicate the infection and prevent development of antibiotic resistance.7

Location of the Hazard

Communicable diseases have the potential to affect the entire Fresno State planning area equally. As a result, the communicable disease hazard can be found at the Fresno State University campus located in Fresno, CA (Fresno County). Because of the ubiquitous nature of many communicable diseases, students, faculty, staff at (and visitors to) Fresno State are at risk of exposure to the communicable disease hazard.8

CSU Student Housing Locations and Populations

Although CSU-campus-owned student housing opportunities have been severely limited due to the COVID-19 pandemic, this situation is temporary. Eventually, students will be allowed back on campus at full capacity, and many of these students will be living in campus-owned housing. When this occurs, over 53,000 students (i.e., just over 11% of the CSU total enrollment) will be at increased risk of exposure to communicable disease hazards, owing to the “close-quarters” living arrangements in student housing. For CSU – Fresno, approximately 5% of its 24,139 enrolled students or 1,207 students reside in student housing.

Extent of the Hazard

Various communicable diseases are categorized by the Center for Disease Control and Prevention (CDC) by levels of containment called Biosafety Levels (or BSLs). The higher the BSL, the greater the level of containment and level of effort necessary to prevent transmission of the disease, and therefore the greater the hazard. Biosafety Levels prescribe procedures and levels of containment for a particular microorganism or material (including research involving recombinant or synthetic nucleic acid molecules) and procedures associated with that containment. BSLs also consider primary barriers (e.g., biosafety cabinets), secondary barriers, facility design, air handling, laboratory

security, etc. BSLs are graded from 1 to 4; as the BSL increases so does the relative risk of the agent/procedures as well the stringency of procedures and facility design.

Figure 9-1 describes the different BSLs, and provides examples of communicable diseases that would typically fall into these classifications, as well as the typical protections that would be necessary to prevent transmission of each of the diseases.

Figure 9-1 Biosafety Levels (BSLs)\(^9\)

![BSL Diagram]

The Extent of Fresno State Communicable Disease Hazards Except COVID-19:

Before the COVID-19 pandemic, there were cases of Meningitis and Tuberculosis at Fresno State. Meningitis would be classified at the BSL-2 containment level, while Tuberculosis would be classified at either the BSL-2 or BSL-3 containment level.\(^10\) 11

The Extent of Fresno State COVID-19 Communicable Disease Hazard:


As a microorganism, the SARS-CoV-2 (COVID-19) virus requires a high level of containment. It is therefore classified at BSL-3.\(^{12}\)

**History of the Hazard**

Most communicable disease data are maintained by at the state and at the county levels and are not generally available at the municipal or campus levels, unless (a) the CSU campus falls under the jurisdiction of a city-level health department, or (b) a geographically specific outbreak occurs on campus or in the local community. The exception to this is the current COVID-19 pandemic, where both campus and County-level case data have been collected. As a result, it is important to provide COVID-19 case statistics for both CSU campuses and the counties where CSU campus assets are located.

Figure 9-3 (below) shows County-level COVID-19 case and mortality data. These case data are updated on at least a weekly basis. (Please note that the COVID-19 case numbers here may not reflect the most recent updates.)

Before the start of the fall 2020 semester, Fresno State had 17 cases of COVID-19. As of March 15, 2021, Fresno State is aware of 145 members of the campus community who have tested positive for COVID-19 since the start of the pandemic, and who were on campus during the time when they may have been infected.\(^{13}\)

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Figure 9-2 Fresno County COVID-19 Case Data\textsuperscript{14}

### Confirmed cases in Fresno County

<table>
<thead>
<tr>
<th>Episode date</th>
<th>Reported date</th>
</tr>
</thead>
<tbody>
<tr>
<td>102,795 total confirmed cases</td>
<td></td>
</tr>
<tr>
<td>12 new cases (0.0% increase)</td>
<td></td>
</tr>
<tr>
<td>1.6 cases per 100K (7-day average)</td>
<td></td>
</tr>
</tbody>
</table>

### Confirmed deaths in Fresno County

<table>
<thead>
<tr>
<th>Death date</th>
<th>Reported date</th>
</tr>
</thead>
<tbody>
<tr>
<td>1,719 total confirmed deaths</td>
<td></td>
</tr>
<tr>
<td>-1 new deaths (-0.1% increase)</td>
<td></td>
</tr>
<tr>
<td>0.10 deaths per 100K (7-day average)</td>
<td></td>
</tr>
</tbody>
</table>

Potential Impacts of the Hazard

Communicable disease outbreaks and pandemics potentially have (and will continue to have) direct impact on life, health, and safety across the CSU system (including Fresno State). The extent of this impact is contingent on the type of infection or contagion, the severity of the outbreak, and the speed at which it is transmitted. Property and infrastructure integrity may be affected if large portions of the campus population contract communicable diseases at the same time and are therefore unable to perform maintenance, operations, and educational tasks. This would be particularly disruptive if those impacted are first responders or other essential personnel. Long-term outbreaks affecting large numbers of Fresno State students could result in cancelled classes, delayed matriculation, or other disruptions to the CSU System’s mission. This has already occurred with the current COVID-19 pandemic and could occur again with more virulent strains of communicable diseases, including COVID-19.

Communicable disease hazards found across the CSU system (including Fresno State) vary both by level of containment (BSL) (described previously) and by level of individual/public health risk, or Risk Group (RG) level. While BSLs describe the procedures and required levels of containment in a laboratory setting, Risk Groups (RGs) reflect the potential effects of disease exposure on humans or animals. Like BSLs, RGs

range from Level 1 (RG1) to Level 4 (RG4), with Level 1 (RG1) posing minimal risk to healthy individuals and public health and Level 4 (RG4) posing a very serious or extreme risks to individuals and public. BSLs generally correlate with Risk Group (RG) Levels (e.g., a RG2 agent is worked with at BSL-2), but there are exceptions (e.g., production volumes, high-risk procedures, etc.).

The World Health Organization’s (WHO) Laboratory Biosafety Manual, 3rd ed., NIH Guidelines, categorizes Risk Groups (RGs) in the following way:

Table 9-4: WHO Risk Group Categorization

<table>
<thead>
<tr>
<th>Risk Group (RG)</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>RG1</td>
<td>Rarely associated with disease in healthy adult humans or animals and pose no-to-little public health risk (e.g., Saccharomyces cerevisiae, E. coli K-12 strain derivatives often used for recombinant/molecular biology, many environmental organisms)</td>
</tr>
<tr>
<td>RG2</td>
<td>Associated with mild to moderate disease for which preventative measures or post exposure treatments are often available; public health impact is limited (e.g., Streptococcus pyogenes, Salmonella, hepatitis B virus)</td>
</tr>
<tr>
<td>RG3</td>
<td>Associated with serious to lethal human disease for which preventative vaccines or post-exposure therapies may be scarce. Public health impact is limited-to-moderate (e.g., Mycobacterium tuberculosis, hantaviruses, West Nile virus, SARS)</td>
</tr>
<tr>
<td>RG4</td>
<td>Associated with serious to lethal human disease for which preventative vaccines or post exposure therapies are not usually available. Public health impact is high (e.g., Ebola virus, Marburg virus, smallpox virus, etc.)</td>
</tr>
</tbody>
</table>

Table 9-8 describes the four (4) Risk Group Levels (RGs), and provides examples of communicable diseases that would typically fall in to these classifications, and the typical protections that would be necessary to prevent transmission of the disease. It is important to note that all but two (2) communicable disease hazards identified by CSU campuses fall under either the lower-risk RG1 or RG2 categories. COVID-19 and tuberculosis are the two (2) communicable diseases fall under the higher-risk RG3 category. However, with the advent of the recently-developed COVID-19 vaccine, and with the expectation of an increasingly robust vaccine supply, it is possible that the RG level

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for COVID-19 could be lowered in the future, thereby reducing both the extent and the potential impact of COVID-19.

Table 9-5 Risk Group Levels (RGs) with Example Diseases and Recommended Precautions

<table>
<thead>
<tr>
<th>Level</th>
<th>Examples</th>
<th>Typical Protection to Prevent Transmission</th>
</tr>
</thead>
<tbody>
<tr>
<td>Risk Group Level I</td>
<td>E. Coli</td>
<td>Precautions are minimal, most likely involving gloves and some sort of facial protection. Usually, contaminated materials are left in open (but separately indicated) waste receptacles. Decontamination procedures for this level are similar in most respects to modern precautions against everyday viruses (i.e.: washing one’s hands with anti-bacterial soap, washing all exposed surfaces of the lab with disinfectants, etc.).</td>
</tr>
<tr>
<td>Risk Group Level II</td>
<td>Chicken Pox, Hepatitis A, B, C, Lyme disease, Salmonella, Mumps, Measles, Malaria, Scrapie, Dengue Fever, HIV</td>
<td>These bacteria and viruses cause mild disease in humans or are difficult to contract via aerosol. Routine diagnostic work with clinical specimens can be done safely at BSL-2, using BSL-2 practices and procedures.</td>
</tr>
</tbody>
</table>

17 CDC/National Institutes of Health. *Biosafety in Microbiological and Biomedical Laboratories, 6th Ed.* Print. Retrieved 05.03.2021 from: [https://www.cdc.gov/labs/BMBL.html](https://www.cdc.gov/labs/BMBL.html)
| Risk Group Level III | Anthrax  
West Nile Virus  
SARS Virus (Including COVID-19)  
Tuberculosis  
Typhus  
Yellow Fever  
Hantaviruses  
Avian Flu  
| These bacteria and viruses cause severe to fatal disease in human, but vaccines or other treatments do exist to combat them. Laboratory personnel have specific training in handling pathogenic and potentially lethal agents and are supervised by competent scientists who are experienced in working with these agents. This is considered a neutral or warm zone. |
| Risk Group Level IV | H5N1 (Bird Flu)  
Dengue Hemorrhagic Fever  
Marburg Virus  
Ebola Virus  
Smallpox  
Lassa Fever  
Crimean-Congo Hemorrhagic Fever  
Other Hemorrhagic Diseases  
| These viruses and bacteria cause severe to fatal disease in humans, for which vaccines or other treatments are not available. When dealing with biological hazards at this level the use of a Hazmat suit and a self-contained oxygen supply is mandatory. The entrance and exit of a BSL-4 lab will contain multiple showers, a vacuum room, an ultraviolet light room, autonomous detection system, and other safety precautions designed to destroy all traces of the biohazard. Multiple airlocks are employed and are electronically secured to prevent both doors opening at the same time. All air and water service going to and coming from a BSL-4 lab will undergo similar decontamination procedures to eliminate the possibility of an accidental release. |

**Probability of Future Occurrence of the Hazard**

There are significant data limitations regarding non-COVID-19 communicable disease cases, as the information thereof is outdated, anecdotal, and/or inadequate. As a result, it is not feasible to provide quantitative probabilities of future occurrence for non-COVID-19 communicable disease hazards. However, based on the limited data, it is feasible to present qualitative probabilities of future occurrence based on ranges of communicable disease frequency.
Table 9-9 shows a probability scale of future occurrence for the nine (9) communicable disease hazards profiled in this assessment. This scale is divided into four (4) levels of probability:

Table 6-9: Likelihood of Future Hazard Occurrence

<table>
<thead>
<tr>
<th>Likelihood</th>
<th>Parameters for Determining Likelihood</th>
</tr>
</thead>
<tbody>
<tr>
<td>Highly Likely</td>
<td>76 – 100% probability that hazard will occur annually (high to very high frequency)</td>
</tr>
<tr>
<td>Likely</td>
<td>50 – 75% probability that hazard will occur annually (moderate to high frequency)</td>
</tr>
<tr>
<td>Possible</td>
<td>11 – 49% probability that hazard will occur annually (low to moderate frequency)</td>
</tr>
<tr>
<td>Unlikely</td>
<td>0 – 10% probability that hazard will occur annually (very low to low frequency)</td>
</tr>
</tbody>
</table>

Due to significant data limitations surrounding non-COVID communicable diseases, the probability of future occurrence of CSU-system-wide communicable disease is measured by the proportion of campuses that have identified a particular communicable disease as having an impact on the campus community. In this measure, the more frequent a communicable disease is seen as impactful CSU-wide, the greater the probability of future occurrence.

Note: Each communicable disease’s system-wide probability ranking (below) reflects the ranking at the individual CSU campus level unless noted otherwise.

Table 9-7 Probability of Future Occurrence of Communicable Disease Hazard for CSU System

<table>
<thead>
<tr>
<th>Collective List of Communicable Diseases Identified by All CSU Campuses</th>
<th>Number of CSU Campuses (Including Chancellor’s Office) Identifying Communicable Disease Having Significant Impact</th>
<th>Proportion of CSU Campuses Identifying Communicable Disease as Having Significant Impact System-Wide</th>
<th>CSU System-Wide Probability Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>COVID-19 (SARS-CoV-2)</td>
<td>24</td>
<td>1.00</td>
<td>Highly Likely</td>
</tr>
<tr>
<td>Meningitis</td>
<td>7</td>
<td>0.29</td>
<td>Possible</td>
</tr>
<tr>
<td>Measles</td>
<td>6</td>
<td>0.25</td>
<td>Possible</td>
</tr>
<tr>
<td>Influenza (Including H1N1/ Swine Flu)</td>
<td>6</td>
<td>0.25</td>
<td>Possible</td>
</tr>
</tbody>
</table>
### Tuberculosis
- **Cases:** 5
- **Risk:** 0.21
- **Likelihood:** Possible

### Norovirus
- **Cases:** 4
- **Risk:** 0.17
- **Likelihood:** Possible

### Mumps
- **Cases:** 2
- **Risk:** 0.08
- **Likelihood:** Unlikely

### E. Coli
- **Cases:** 2
- **Risk:** 0.08
- **Likelihood:** Unlikely

### Sexually Transmitted Diseases (STDs)
- **Cases:** 2
- **Risk:** 0.08
- **Likelihood:** Unlikely

Source: Interviews with staff at CSU campuses and at the CSU Chancellor’s Office.

### Vulnerability to the Hazard

Vulnerability to a communicable diseases hazard resides in the population of a given area – both human and animal – not in the infrastructure or physical assets. While CSU assets and infrastructure could be impacted indirectly by the communicable disease hazard, these impacts would be secondary to the impact that the communicable disease hazard would have on students, faculty, staff, and visitors at CSU-Fresno.

CSU campus settings are geographically diverse, with locations ranging from small towns to medium-sized cities to densely populated urban areas. Hundreds of thousands of people work, study, and/or pass through CSU campuses on any given day. (As of Fall 2019, the CSU System had 480,541 students and 53,763 faculty and staff.) Each of these persons (including Fresno State’s 24,139 students along with its faculty and staff) is vulnerable to communicable disease, particularly if it is a pathogen that individual has not been immunized against, or for which no immunization exists. Prolonged outbreaks could result in a loss of services, failure of infrastructure (from lack of operators or maintenance), and closure of facilities. This exact scenario has played out to some degree in the current COVID-19 pandemic on the Fresno State campus.

### Estimate of Potential Losses

**COVID-19 Pandemic Health Impact on CSU Campuses and Surrounding Communities**

The most prescient metric for estimating losses from COVID-19 is loss of life. The nationwide campus-related COVID-19 death rate of 0.02% remains well below the average COVID-19 death rate in the U.S. However, due to data limitations, there is no information on CSU-campus-specific deaths by COVID-19 or by any other communicable diseases. In fact, COVID-19 is the only communicable disease for which case reports have been readily available for CSU campuses.

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18 The California State University. Enrollment. Retrieved 05.03.2021 from: [https://www2.calstate.edu/csu-system/about-the-csu/facts-about-the-csu/enrollment/Pages/default.aspx](https://www2.calstate.edu/csu-system/about-the-csu/facts-about-the-csu/enrollment/Pages/default.aspx)

19 The California State University. Employee Head Count by Campus. Retrieved 05.03.2021 from: [https://www2.calstate.edu/csu-system/faculty-staff/employee-profile/csu-workforce/Pages/employee-headcount-by-campus.aspx](https://www2.calstate.edu/csu-system/faculty-staff/employee-profile/csu-workforce/Pages/employee-headcount-by-campus.aspx)
At some point in the future, CSU campuses will return to full capacity. Without adequate surveillance regarding campus access and student and employee interaction, CSU campuses (including CSU-Fresno) are at risk of developing an extreme incidence of COVID-19, and may become “super-spreaders” for adjacent communities. The emergence of more virulent COVID-19 variants would only add to the potential for high negative impacts on life safety, operations, and service delivery across the CSU system. (Other communicable diseases would also re-emerge, but with low to moderate negative impacts on life safety, operations, and service delivery.)

Economic Impact of COVID-19 Pandemic on CSU Financial Health

During the first few months of the COVID-19 pandemic in 2020, the CSU system suffered tremendous negative fiscal impacts. From March through July of 2020 alone, over $146 million worth of revenue losses were sustained across the CSU system due to refunds to students for parking, housing and dining service fees during Spring Semester, 2020. Several CSU campuses saw refund losses surpass $10 million. See Figure 9-4 below for the economic impact to the Fresno State campus).

Figure 9-3: CSU COVID-19 Cost Tracking Showing Revenue Refund Losses and Increased Costs

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Mitigative Relief from Federal Assistance

The $1.5 billion in total federal assistance sent to the CSU system will help relieve the losses of revenues from services like dorms, parking and dining services during a year of mainly empty campuses. (See Table 9-12.) However, because of staggering COVID-related revenue losses, the CSU system is planning for three (3) years of fiscal duress.

Table 9-8: Total Federal Assistance to CSU for COVID-19-Related Losses, 2020-2021.\(^{22}\) \(^{23}\) \(^{24}\)

<table>
<thead>
<tr>
<th>Institution</th>
<th>December, 2020 Stimulus</th>
<th>CARES Act</th>
<th>APLU Projection of HEERF Total ARP Act Funding Allocation</th>
<th>Total Estimated Federal COVID Relief Funding</th>
</tr>
</thead>
<tbody>
<tr>
<td>California Polytechnic State University</td>
<td>$20,752,799</td>
<td>$14,725,000</td>
<td>$37,000,928.0 7</td>
<td>$72,478,727.0 7</td>
</tr>
<tr>
<td>California State Polytechnic University, Pomona</td>
<td>$48,614,353</td>
<td>$31,102,000</td>
<td>$86,044,649.1 3</td>
<td>$165,761,002.13</td>
</tr>
<tr>
<td>California State University Channel Islands</td>
<td>$14,288,099</td>
<td>$8,512,000</td>
<td>$24,915,169.5 6</td>
<td>$47,715,268.5 6</td>
</tr>
<tr>
<td>California State University Maritime Academy</td>
<td>$1,381,700</td>
<td>$1,204,000</td>
<td>$2,472,622.24</td>
<td>$5,058,322.24</td>
</tr>
<tr>
<td>California State University - Sacramento</td>
<td>$59,891,260</td>
<td>$35,643,000</td>
<td>$104,900,133.21</td>
<td>$200,434,393.21</td>
</tr>
<tr>
<td>California State University, Bakersfield</td>
<td>$22,855,632</td>
<td>$12,483,000</td>
<td>$40,285,564.7 3</td>
<td>$75,624,196.7 3</td>
</tr>
<tr>
<td>California State University, Chico</td>
<td>$31,603,856</td>
<td>$20,019,000</td>
<td>$55,754,538.4 1</td>
<td>$107,377,394.41</td>
</tr>
<tr>
<td>California State University, Dominguez Hills</td>
<td>$31,843,563</td>
<td>$18,312,000</td>
<td>$55,915,410.3 1</td>
<td>$106,070,973.31</td>
</tr>
</tbody>
</table>


<table>
<thead>
<tr>
<th>Institution</th>
<th>Revenue</th>
<th>Exp.</th>
<th>Net Revenue</th>
<th>Net Revenue %</th>
</tr>
</thead>
<tbody>
<tr>
<td>California State University, East Bay</td>
<td>$24,243,652</td>
<td>$14,394,000</td>
<td>$42,929,208.3</td>
<td>0</td>
</tr>
<tr>
<td>California State University, Fresno</td>
<td>$52,725,317</td>
<td>$32,557,000</td>
<td>$82,926,594.1</td>
<td>0</td>
</tr>
<tr>
<td>California State University, Fullerton</td>
<td>$67,736,949</td>
<td>$41,088,000</td>
<td>$120,859,884.3</td>
<td>44</td>
</tr>
<tr>
<td>California State University, Long Beach</td>
<td>$67,421,424</td>
<td>$41,202,000</td>
<td>$119,508,329.4</td>
<td>38</td>
</tr>
<tr>
<td>California State University, Los Angeles</td>
<td>$61,905,561</td>
<td>$40,067,000</td>
<td>$108,543,671.6</td>
<td>63</td>
</tr>
<tr>
<td>California State University, Monterey Bay</td>
<td>$13,455,716</td>
<td>$8,705,000</td>
<td>$23,922,767.7</td>
<td>6</td>
</tr>
<tr>
<td>California State University, Northridge</td>
<td>$74,004,088</td>
<td>$47,458,000</td>
<td>$131,021,449.8</td>
<td>99</td>
</tr>
<tr>
<td>California State University, San Bernardino</td>
<td>$42,438,131</td>
<td>$27,924,000</td>
<td>$74,382,458.9</td>
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</tr>
<tr>
<td>California State University, San Marcos</td>
<td>$26,602,684</td>
<td>$15,542,000</td>
<td>$46,496,808.2</td>
<td>1</td>
</tr>
<tr>
<td>California State University, Stanislaus</td>
<td>$22,007,207</td>
<td>$12,928,000</td>
<td>$38,636,390.9</td>
<td>7</td>
</tr>
<tr>
<td>Humboldt State University</td>
<td>$16,130,016</td>
<td>$11,146,000</td>
<td>$28,831,619.1</td>
<td>0</td>
</tr>
<tr>
<td>San Diego State University</td>
<td>$45,914,127</td>
<td>$30,394,000</td>
<td>$80,592,384.5</td>
<td>9</td>
</tr>
<tr>
<td>San Francisco State University</td>
<td>$47,404,409</td>
<td>$30,000,000</td>
<td>$83,075,469.9</td>
<td>2</td>
</tr>
<tr>
<td>San Jose State University</td>
<td>$46,631,939</td>
<td>$30,977,000</td>
<td>$82,976,129.9</td>
<td>4</td>
</tr>
<tr>
<td>Sonoma State University</td>
<td>$13,980,795</td>
<td>$9,153,000</td>
<td>$24,732,994.3</td>
<td>3</td>
</tr>
<tr>
<td>CSU System-Wide Totals</td>
<td>$853,833,277</td>
<td>$535,535,000</td>
<td>$1,507,325,17</td>
<td>7.18</td>
</tr>
</tbody>
</table>

CSU System-Wide Totals: $2,896,693,45

9-21
Vulnerability Assessment Conclusions

Before the COVID-19 pandemic, populations at all CSU campuses and CSU-affiliated facilities were substantial. Collectively, as of Fall 2019, CSU campuses had 480,541 students and 53,763 faculty and staff. All were at risk from the communicable disease events, with 534,304 people being directly vulnerable. The COVID-19 pandemic has caused campus population numbers to plummet to a small fraction of full capacity.

At some point in the future, campus population numbers will return to their pre-pandemic levels, and students, faculty, and staff will again be vulnerable to the communicable disease hazard. If just 10% of the total CSU population were to become ill with a highly infective communicable disease like influenza or another strain of SARS, this would mean that approximately 53,430 people would be sick at the same time. This scenario would likely overwhelm available on-campus medical services could even overwhelm portions of the larger community’s medical resources – especially if there were large numbers of infected people with immune system compromises or other underlying health problems. See Table 9-13 (below) for the “10% outbreak scenario” projections both for each CSU campus and for the entire CSU system.

Table 9-9: Scenario of Communicable Disease Hazard Affecting 10% of the CSU Population

<table>
<thead>
<tr>
<th>CSU Campus</th>
<th>Approximate Enrollment Population (Fall 2019)</th>
<th>Approximate Total FT/PT Faculty/Staff Population (Fall 2019)</th>
<th>Total Combined Approximate Student and Faculty/Staff Population</th>
<th>10% Outbreak Scenario (Students and Faculty/Staff Combined)</th>
</tr>
</thead>
<tbody>
<tr>
<td>CSU Bakersfield</td>
<td>11,199</td>
<td>1,277</td>
<td>12,476</td>
<td>1,248</td>
</tr>
<tr>
<td>CSU Channel Islands</td>
<td>7,093</td>
<td>994</td>
<td>8,087</td>
<td>809</td>
</tr>
<tr>
<td>Chico State</td>
<td>17,019</td>
<td>1,969</td>
<td>18,988</td>
<td>1,899</td>
</tr>
<tr>
<td>CSU Dominguez Hills</td>
<td>17,027</td>
<td>1,761</td>
<td>18,788</td>
<td>1,879</td>
</tr>
<tr>
<td>Cal State East Bay</td>
<td>14,705</td>
<td>1,764</td>
<td>16,469</td>
<td>1,647</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Institution</th>
<th>Spring Enrollment</th>
<th>Fall Enrollment</th>
<th>Summer Enrollment</th>
<th>Total Enrollment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fresno State</td>
<td>24,139</td>
<td>2,534</td>
<td>26,673</td>
<td>2,667</td>
</tr>
<tr>
<td>Cal State Fullerton</td>
<td>39,868</td>
<td>3,736</td>
<td>43,604</td>
<td>4,360</td>
</tr>
<tr>
<td>Humboldt State</td>
<td>6,983</td>
<td>1,171</td>
<td>8,154</td>
<td>815</td>
</tr>
<tr>
<td>Cal State Long Beach</td>
<td>38,074</td>
<td>4,004</td>
<td>42,078</td>
<td>4,208</td>
</tr>
<tr>
<td>Cal State LA</td>
<td>26,361</td>
<td>2,821</td>
<td>29,182</td>
<td>2,918</td>
</tr>
<tr>
<td>Cal Maritime</td>
<td>911</td>
<td>329</td>
<td>1,240</td>
<td>124</td>
</tr>
<tr>
<td>CSU Monterey Bay</td>
<td>7,123</td>
<td>1,059</td>
<td>8,182</td>
<td>818</td>
</tr>
<tr>
<td>CSUN (Northridge)</td>
<td>38,391</td>
<td>3,832</td>
<td>42,223</td>
<td>4,222</td>
</tr>
<tr>
<td>Cal Poly Pomona</td>
<td>27,914</td>
<td>2,650</td>
<td>30,564</td>
<td>3,056</td>
</tr>
<tr>
<td>Sacramento State</td>
<td>31,156</td>
<td>3,228</td>
<td>34,384</td>
<td>3,438</td>
</tr>
<tr>
<td>Cal State San Bernardino</td>
<td>20,311</td>
<td>2,118</td>
<td>22,429</td>
<td>2,243</td>
</tr>
<tr>
<td>San Diego State</td>
<td>35,081</td>
<td>3,702</td>
<td>38,783</td>
<td>3,878</td>
</tr>
<tr>
<td>San Francisco State</td>
<td>28,880</td>
<td>3,401</td>
<td>32,281</td>
<td>3,228</td>
</tr>
<tr>
<td>San José State</td>
<td>33,282</td>
<td>3,568</td>
<td>36,850</td>
<td>3,685</td>
</tr>
<tr>
<td>Cal Poly San Luis Obispo</td>
<td>21,242</td>
<td>2,871</td>
<td>24,113</td>
<td>2,411</td>
</tr>
<tr>
<td>CSU San Marcos</td>
<td>14,519</td>
<td>1,687</td>
<td>16,206</td>
<td>1,621</td>
</tr>
<tr>
<td>Sonoma State</td>
<td>8,649</td>
<td>1,338</td>
<td>9,987</td>
<td>999</td>
</tr>
<tr>
<td>Stanislaus State</td>
<td>10,614</td>
<td>1,276</td>
<td>11,890</td>
<td>1,189</td>
</tr>
<tr>
<td>Office of the Chancellor</td>
<td>0</td>
<td>673</td>
<td>673</td>
<td>67</td>
</tr>
</tbody>
</table>
Note: Enrollment figures do not include non-specific CSU campus International Programs (455 students) or CALStateTEACH Program (933 students)

While the case numbers of COVID-19 have been significantly lower (about 1% of the total CSU population) than those in the 10% scenario, the degree of virulence and resultant morbidity and mortality caused by COVID-19 have led to widespread campus shutdowns, educational disruption, and economic harm to the CSU system. In short, the real-time COVID-19 communicable disease outbreak scenario has proven far more devastating than the 10% simulated scenario.

Identified Data Limitations

There is a wealth of technical information available for communicable disease. However, there is also limited non-COVID-19 communicable disease data available regarding risk or vulnerability of specific populations throughout the CSU. Much of the data that does exist is protected by privacy policies, and therefore cannot be obtained for more specific populations. As a result, performing a detailed quantitative assessment for this hazard is difficult.

Data that could be collected prior to the next update in order to improve this methodology includes:

- Data regarding infection rates at the campus level and for specific populations;
- Data regarding communicable disease case numbers and outcomes, by CSU campus;
- Data regarding projected population changes;
- Data regarding absenteeism; and
- Data regarding increased operating costs as a result of absenteeism (i.e., temporary shifting of duties resulting in business interruption).
**Dam and Levee Failure**

Description of the Hazard

A dam failure represents the structural collapse of a dam that stores water in a reservoir behind the dam. These failures are typically the result of structural age, damage to the structure caused by earthquake or flooding, inadequate discharge or spillway capacity, inadequate maintenance, improper construction materials, or extreme inflow of water into the reservoir. Prolonged precipitation may result in overtopping of the dam resulting in structural compromise. The tremendous energy generated by a sudden breach of the dam will have significant downstream effects. Flood damage resulting from dam failures potentially will result in economic losses, environmental damage, destruction of agriculture, and human casualties. This type of incident is extremely dangerous as it can occur rapidly, with no warning resulting in an inability to effectively evacuate threatened communities.

A levee failure is similar to dam failures as the result will be a breach causing flooding on the dry side of the levee. Levees are embankments whose primary purpose is to furnish flood protection from seasonal high water or divert the flow of water. Most levees in California are intended to withstand peak water levels generated by heavy precipitation or rapid snowmelt in a watershed. Other levees are designed to withstand fluctuating water levels on a continuous basis such as those in the California Delta exposed to tidal influences. Levees routinely extend for lengthy distances immediately protecting communities. Levees can be found throughout the state but are most prominent in the Sacramento and San Joaquin Valleys.

Levee failures can vary from overtopping to small uncontrolled discharge to catastrophic failure. Areas downstream of the failure will be subject to inundation dependent on the volume of water released. These levee failures are also typically the result of structural age, damage to the structure caused by earthquake or flooding, slumping, seepage underneath the levee, high velocity flows eroding the levee, inadequate capacity, inadequate maintenance, improper construction materials, or extreme inflow of water into the system. Flood damage resulting from levee failures potentially will result in economic losses, environmental damage, destruction of agriculture, and human casualties.

A Dam or levee failure flooding will vary depending on a number of factors including the extent of the collapse or breach, the volume of water behind the structure, and the nature of the exposed downstream features. This unpredictable flooding presents a threat to life and property in addition to critical infrastructure. Lifelines and supply routes will likely be damaged or made impassible by flood erosion or standing water. Water quality and health concerns would likely be cascading effects of dam or levee failures.

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Location of the Hazard

Fresno County is home to a variety of flood control facilities and levee systems with most levees found in the east County and most dams found in the foothills and mountains. The San Joaquin River and Kings River drain the Sierra Nevada mountains in eastern Fresno County. Fresno sits between the San Joaquin and Kings Rivers. Dry Creek drains an area between the larger rivers and passing just east of the CSU Fresno campus.

Figure 9-4: Dams and Levees near CSU Fresno

Dry Creek is normally a dry creek providing flood control and drainage. The creek feeds into the Big Dry Creek Reservoir behind the Big Dry Creek Dam before extending through Fresno and eventually to the San Joaquin River east of Fresno. The Big Dry Creek is normally dry but fills during storms causing runoff and is 6 miles to the northeast from the CSU Fresno campus.

The San Joaquin River has a series of dams that are located upstream from the Fresno area. The largest being the Friant Dam holding Millerton Lake 13 miles north of the campus. The Kings River is regulated by the Pine Flat Dam 23 miles east of the campus. The inundation zones for neither of these dams come into proximity of the campus.
Levees have been constructed to protect sections of the banks of the Big Dry Creek Reservoir and sections upstream of Dry Creek. The flood protection areas for these levees are not in proximity to the CSU Fresno campus. There are no levees in the area surrounding the campus. The majority of levees in Fresno County are located in eastern Fresno County along the San Joaquin and Kings Rivers.

Extent of the Hazard

Dams are classified according to the hazard that they pose to life and property in the event of failure, rather than the likelihood of that failure.

- **High hazard potential dams** may result in loss of human life, and will likely result in economic, environmental, or lifeline losses.

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28 California Department of Water Resources, Dam Breach Inundation Map Publisher, https://fmds.water.ca.gov/webgis/?appid=dam_prototype_v2
- **Significant hazard potential dams** are not expected to result in loss of life, but are expected to cause economic, environmental, and lifeline losses.
- **Low hazard potential dams** are not expected to result in loss of life, and there is a low expectation of economic, environmental, or lifeline losses. What losses do occur are generally limited to the dam owner.

Dams classified as high hazard are required to have Emergency Action Plans (EAP). EAPS are formal documents that identify potential emergency conditions at the dam and specify preplanned actions to be followed in case of failure. An EAP is required for all high hazard dams and is recommended for all significant hazard dams.

Table 9-15: Fresno County Dams in Proximity to CSU Fresno

<table>
<thead>
<tr>
<th>River</th>
<th>Dam</th>
<th>Storage</th>
<th>Hazard Severity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dry Creek</td>
<td>Big Dry Creek</td>
<td>11,000af</td>
<td>High Hazard</td>
</tr>
<tr>
<td>Kings</td>
<td>Pine Flat</td>
<td>1,000,000af</td>
<td>High Hazard</td>
</tr>
<tr>
<td>San Joaquin</td>
<td>Millerton</td>
<td>520,500af</td>
<td>High Hazard</td>
</tr>
</tbody>
</table>

The CSU Fresno campus lies within the inundation zone of the Big Dry Creek Dam but is outside of the inundation zones of the Millerton and Pine Flat Dams. In the event of a catastrophic failure of the Big Dry Creek Dam, the CSU Fresno campus is expected to be within the inundation area except for the Save Mart Center. The inundation area is expected to spread water over a broad area of Fresno. However, there are multiple transportation corridors that lie within the dam inundation zone that would compromise access to and from the campus affecting the ability to evacuate, gain access to emergency services, and receive supplies. The roadways expected to become inundated in a dam breach scenario include East Shaw Avenue, North Cedar Avenue, East Barstow Avenue, and State Routes 168, 41, 180, and 99. Based on these conditions, the planning committee ranks the extent of the dam failure hazard as **Moderate**.

**Extent – Levee Failure**

Levees are used along numerous rivers, irrigation channels, and other waterways throughout Fresno County primarily along waterways in the eastern part of the County. The CSU Fresno campus does not lie within a levee flood protected area, although potentially, the campus community will be affected as a breach in other areas of Fresno may cause flooding and damages to the homes of students, faculty, and staff or to access/supply routes, utilities, or other critical services. Based on these conditions, the planning committee ranks the extent of the levee failure hazard on campus as **Low**.

**History of the Hazard**

There are no records of dam or levee failures in areas that present a threat to the CSU Fresno campus. Fresno County has experienced the following dam and levee incidents:
Table 9-10: Fresno County Dam Failures

<table>
<thead>
<tr>
<th>Date</th>
<th>Facility</th>
<th>Release</th>
<th>Damage</th>
</tr>
</thead>
<tbody>
<tr>
<td>1986</td>
<td>Friant Dam</td>
<td>3,000cfs</td>
<td>Minimal, gate locked open</td>
</tr>
<tr>
<td>2/18/2017</td>
<td>Fresno Slough Levee</td>
<td>Unknown</td>
<td>Minimal, Small breaks, evacuations</td>
</tr>
<tr>
<td>6/22/2017</td>
<td>Kings River Levee</td>
<td>Unknown</td>
<td>15’ wide breach, evacuations</td>
</tr>
</tbody>
</table>

Potential Impacts of the Hazard

Dam Failure Impacts - Water that is released due to a dam that has failed generates tremendous energy and force causing a flood that will be catastrophic to life and property. Water levels from the failed dam could be significantly higher than those experienced in worst case scenario flood events. Areas closer to the failed dam will be more likely to experience complete devastation while other areas within the inundation zone will see varying levels of flood waters. The extent of the impacts of a failed dam would vary based on a number of factors such as the volume of water released, the base flow of the river, the time of the failure, the amount of warning provided, and the distance from the dam. Impacts resulting from a dam failure include:

- Loss of life
- Property destruction or damage
- Loss of property contents
- Infrastructure damage
- Flooded or destroyed lifelines/supply routes
- Damaged or destroyed utilities
- Loss of community economic base
- Employment losses
- Agricultural (crops and livestock) damages or destruction
- Environmental damage
- Floods generating threats to public health
- Flood generated debris
- Damage or destruction of academic materials, fine arts, and research
- Damage or destruction of university computer systems and networks
- Water inundation of campus police department, campus chiller and boiler facilities, plant operations, all academic buildings, support facilities, and residence halls
- Water inundation of transportation routes into and out of the campus
- Damaged university infrastructure
- Reduced or eliminated student engagement with academic programs

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29 Fresno County Multi-Hazard Mitigation Plan, April 2018
Reductions in campus revenues

Levee Failure Impacts

A levee failure may result in substantial amounts of water to enter into developed areas protected by the levee. The force and volume of water that is generated by a levee failure may cause extensive structural damage in close proximity to the breach and effects of flooding spreading well beyond the point of the failure. The extent of the impacts would vary based on a number of factors such as the volume of water released, the time of the failure, the amount of warning provided, the location of the breach, elevation, and distance from the breach. Potential impacts resulting from a levee failure include:

- Loss of life
- Property destruction or damage
- Loss of property contents
- Infrastructure damage
- Public health hazards resulting from mold, mildew, and disease due to flood water
- Flooded or destroyed lifelines/supply routes
- Damaged or destroyed utilities
- Loss of community economic base
- Employment losses
- Agricultural (crops and livestock) damages or destruction
- Environmental damage
- Prolonged periods of necessary dewatering
- Disruptions to education delivery to community
- Damage or destruction of academic materials, fine arts, and research
- Damage or destruction of university computer systems and networks
- Damaged university infrastructure
- Reduced or eliminated student engagement with academic programs
- Reductions in campus revenues
Probability of Future Occurrence of the Hazard

The Fresno County Multi-Hazard Mitigation Plan indicates that Fresno County remains at risk from dam and levee failure, however, there have not been any failures of any major facilities. The location of the CSU Fresno campus downstream from the Big Dry Creek Reservoir demonstrates that the potential exists for future dam related failures. The entire campus with the exception of the Save Mart Center resides within the dam inundation zone for the Big Dry Creek Reservoir. There are no identified levees in proximity to the campus and thus the campus is outside of any levee protected zone. There are no official recurrence intervals that have been calculated for dam or levee failures. Based on historical experience and occurrences, along with dam and levee inspection and maintenance protocols, the probability of future occurrence for both dam and levee failures is **Unlikely**.

Vulnerability to the Hazard

The CSU Fresno campus is subject to the effects of flooding resulting from compromised dams and levees. The Big Dry Creek Dam upstream from the campus presents the potential for significant flooding and damage through much of the Fresno and Clovis area. The Dry Creek and extending irrigation channels are channelized drainages intended to protect the surrounding areas from rises in water level. In the case of dam failure, the amount of time to respond to the needs of the campus community prior to inundation will be limited.

Similarly, any breach along a levee is impossible to predict where a failure may occur. It is likely that response action will not be fully implemented until the incident situational intelligence provides adequate information as to compromised locations. These variables place all those working and living within the dam inundation and flood protection zones in vulnerable locations.

The dam inundation zone covers an area 3 miles wide through Fresno and extends downstream towards the CSU Fresno campus. Everyone downstream of the dam in the inundation zone will be vulnerable to the effects of floods and forces of moving water. Additionally, the access routes into campus are inside the inundation zone. The CSU Fresno campus lies outside of areas protected by levees. However, the distributed placement of levees, most near development may expose significant vulnerabilities to other areas of the region even if the campus is unaffected. The potential for flood damaged structures being left uninhabitable including campus residence halls will result in numerous displaced individuals and households. The lack of flood insurance will cause extreme financial burdens on those affected.

Some areas of particular vulnerability on the campus includes:

- Flowing water from the northeast
- Hazardous materials, biological contaminants, agricultural materials, and other contaminant spread by flood waters introduced to the campus.
- Inundated academic buildings
- Chemicals, bottled gases, radioactive materials, biological materials, and explosive compounds stored in campus science labs, chemical storage facilities, Facilities Maintenance Shops, and Engineering Labs
- The Joyce M Huggins Early Education Center (childcare center) is located in the Kremen School of Education and Human Development Building is below grade lower in elevation than street level
- Inundated residence halls
- Inundation to the Equestrian Center, Sheep Unit, Animal Science Pavilion, Horse and Cattle facilities, Swine, and Poultry facilities
- Inundated Mail Services, Mail Center, Shipping and Receiving, and Printing Services on north side of campus
- Inundated University High School

Vulnerability to a dam or levee failure on the CSU Fresno campus will vary depending on the degree of breach or structural failure and when the breach or failure were to occur. The risk to the campus population will be lessened during periods when classes are not in session or during periods of breaks. Conversely, during the days and hours that classes are in session and staff are at their workplaces, the human vulnerability increases. However, in region-wide events this vulnerability may be shared with the homes and workplaces of members of the campus community and their families.

Certain campus populations will experience greater challenges to a post-flood / failure environment. Vulnerable populations will likely need to navigate through flood generated debris, face extreme health safety issues from flood waters, experience extreme stresses of a disaster, an inability to communicate to or gain access to support networks, and find difficulty in accessing equipment or supplies to aid in a specific need.

Estimate of Potential Losses

Estimates of potential losses will be influenced by a variety of factors. The volume and force of the water will determine the scale of damages affecting campus infrastructure, equipment, and other impacted features. The proximity to the failure and elevation above flood waters will affect the level of damage and individuals exposed. The time of the academic year, the day of week, and hour in which the failure was to occur will influence the number of people on campus and potential casualties. Losses will be generated by the physical damages, the loss of revenue, loss of academic research, loss of building contents, and community wide economic reductions.

Based on estimate replacement costs of facilities and structures on campus, the total replacement costs due to earthquake are $395,965,157. However, it is unlikely for a dam or levee failure event to cause catastrophic destruction at CSU Fresno.

Vulnerability Assessment Conclusions

While the occurrence of dam and levee failures have not been historically relevant near the CSU Fresno campus, the potential for hazards related to the region’s levees and dams still exist. However, the presence of earthquake faults in proximity to the existing dam
and levee structures presents a valid danger to downstream locations in the event of an earthquake. The consequences of a dam failure would generate catastrophic results to downstream communities. The potential for dam or levee failure further generates the added potential for a number of cascading effects such as disruptions to the local economy, utility failures, disruptions to providing for the needs of the community, and development of public health hazards. These effects would be exacerbated by effects of seasonal flooding, ongoing heavy precipitation, or excessive run-off from the watershed contributing to the river system. The potential for widespread flooding and damage of structures due to the force of water has exponentially powerful impacts on particular populations among the campus community including those with access or functional needs, international students, the homeless, and students residing in the residence halls.

**Identified Data Limitations**

Missing campus structural replacement costs and complete inventory of building construction features or mitigation efforts to lessen the impact due to flood inundation.
Drought

Description of the Hazard

Drought is defined as a condition where moisture levels fall significantly below normal for an extended period of time over a large area that adversely affects plants, animal life, and humans. Drought is a gradual phenomenon. Although droughts are sometimes characterized as emergencies, they differ from typical emergency events. Most natural disasters, such as floods or forest fires, occur relatively rapidly and afford little time for preparing for disaster response. Droughts occur slowly, over a multi-year period, and it is often not obvious or easy to quantify when a drought begins and ends.

Throughout California, one dry year does not normally constitute a drought. California’s extensive system of water supply infrastructure (reservoirs, groundwater basins, and conveyance assets) mitigates the effect of short-term dry periods for most water users. Defining when a drought begins is a function of drought impacts to water users. Drought in one location may not constitute a drought for all water users, as some users in relative proximity may have a different water supply. For example, individual water suppliers may use a combination of sources such as rainfall/runoff, water in storage, or expected supply from a water wholesaler to define their water supply conditions.

Drought can be characterized as one or more of the four following types:

- **Meteorological drought** is defined on the basis of the degree of dryness (in comparison to some “normal” or average amount) and the duration of the dry period. A meteorological drought must be considered as region-specific since the atmospheric conditions that result in deficiencies of precipitation are highly variable from region to region.

- **Hydrological drought** is associated with the effects of periods of precipitation (including snowfall) shortfalls on surface or subsurface water supply (e.g., streamflow, reservoir and lake levels, ground water). The frequency and severity of hydrological drought is often defined on a watershed or river basin scale. Although all droughts originate with a deficiency of precipitation, hydrologists are more concerned with how this deficiency plays out through the hydrologic system. Hydrological droughts are usually out of phase with or lag the occurrence of meteorological and agricultural droughts. It takes longer for precipitation deficiencies to show up in components of the hydrological system such as soil moisture, streamflow, and ground water and reservoir levels. As a result, these impacts are out of phase with impacts in other economic sectors.

- **Agricultural drought** focus is on soil moisture deficiencies, differences between actual and potential evaporation, reduced ground water or reservoir levels, and so forth. Plant water demand depends on prevailing weather conditions, biological characteristics of the specific plant, its stage of growth, and the physical and biological properties of the soil.
- **Socioeconomic drought** refers to when physical water shortage begins to affect health, well-being, and quality of life of people, or when the drought starts to affect the supply and demand of an economic product that relies on water.

The drought issue in California is further compounded by water rights. The central challenge is how to prioritize water usage among a broad variety of contexts. It is for this reason that water is a commodity possessed and utilized under a variety of legal doctrines. As such, many competing sets of interests create a dynamic prioritization process between, for example, farming and federally protected fish habitats and water supply for municipal/public use (including usage for Fresno State versus water usage for wildfire abatement or natural resource protection.

**Location of the Hazard**

Drought conditions have been identified in Fresno, CA and the surrounding region including the Fresno State campus. Drought is not a location-specific hazard and affects the entire planning area equally. Drought location is not isolated to each campus footprint but occurs as a geographic sub-set of drought conditions occurring at larger scales. From 2000-2020, drought conditions existed continuously somewhere in the state, with 80-100% of the state impacted for 12 of the last 20 years.\(^30\)

**Extent of the Hazard**

Given the historical occurrence of severe drought impacts throughout the system-wide CSU planning area and across the state and the potential future impact exacerbated by climate change, the CSU Planning Committee recognizes that drought will continue to pose a high degree of risk, potentially impacting crops, livestock, water resources, the natural environment at large, buildings and infrastructure (from land subsidence), and local economies. In addition, although drought affects the entire planning equally, the potential impacts may be variable and specific to each campus/jurisdiction, depending on contextual factors such as the degree of assets and activities, historically impacted by drought within each jurisdiction. In addition, land subsidence has occurred and will continue in areas where the groundwater basin has been subject to overdraft and long-term recharge is inadequate to maintain the water table elevation, leaving underground voids. Subsidence levels have been measured up to 30-feet in California with subsidence bowls covering hundreds of square miles. As such, drought-related subsidence may result in serious structural damage to buildings, roads, irrigation ditches, underground utilities, and pipelines. Although such effects have not been reported on the Fresno campus, they remain issues of concern for the campus over the long term.\(^31\)

The U.S. Drought Monitor developed tables of impacts reported during past droughts in California in order to depict the extent of drought risk for each level of drought on the

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U.S. These possible extent conditions for California complement the general impacts column of the U.S. Drought Monitor Classification Scheme.

Table 9-11: Impacts of Drought Levels as Determined by US Drought Monitor

<table>
<thead>
<tr>
<th>Category</th>
<th>Impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>D0</td>
<td>Soil is dry; irrigation delivery begins early</td>
</tr>
<tr>
<td></td>
<td>Dryland crop germination is stunted</td>
</tr>
<tr>
<td></td>
<td>Active fire season begins</td>
</tr>
<tr>
<td></td>
<td>Winter resort visitation is low; snowpack is minimal</td>
</tr>
<tr>
<td>D1</td>
<td>Dryland pasture growth is stunted; producers give supplemental feed to cattle</td>
</tr>
<tr>
<td></td>
<td>Landscaping and gardens need irrigation earlier; wildlife patterns begin to change</td>
</tr>
<tr>
<td></td>
<td>Stock ponds and creeks are lower than usual</td>
</tr>
<tr>
<td>D2</td>
<td>Grazing land is inadequate</td>
</tr>
<tr>
<td></td>
<td>Producers increase water efficiency methods and drought-resistant crops</td>
</tr>
<tr>
<td></td>
<td>Fire season is longer, with high burn intensity, dry fuels, and large fire spatial extent; more fire crews are on staff</td>
</tr>
<tr>
<td></td>
<td>Wine country tourism increases; lake- and river-based tourism declines; boat ramps close</td>
</tr>
<tr>
<td></td>
<td>Trees are stressed; plants increase reproductive mechanisms; wildlife diseases increase</td>
</tr>
<tr>
<td></td>
<td>Water temperature increases; programs to divert water to protect fish begin</td>
</tr>
<tr>
<td></td>
<td>River flows decrease; reservoir levels are low and banks are exposed</td>
</tr>
<tr>
<td>D3</td>
<td>Livestock need expensive supplemental feed, cattle and horses are sold; little pasture remains, producers find it difficult to maintain organic meat requirements</td>
</tr>
<tr>
<td></td>
<td>Fruit trees bud early; producers begin irrigating in the winter</td>
</tr>
<tr>
<td></td>
<td>Federal water is not adequate to meet irrigation contracts; extracting supplemental groundwater is expensive</td>
</tr>
<tr>
<td></td>
<td>Dairy operations close</td>
</tr>
<tr>
<td></td>
<td>Marijuana growers illegally tap water out of rivers</td>
</tr>
</tbody>
</table>

Fire season lasts year-round; fires occur in typically wet parts of state; burn bans are implemented

Ski and rafting business is low, mountain communities suffer

Orchard removal and well drilling company business increase; panning for gold increases

Low river levels impede fish migration and cause lower survival rates

Wildlife encroach on developed areas; little native food and water is available for bears, which hibernate less

Water sanitation is a concern, reservoir levels drop significantly, surface water is nearly dry, flows are very low; water theft occurs

Wells and aquifer levels decrease; homeowners drill new wells

Water conservation rebate programs increase; water use restrictions are implemented; water transfers increase

Water is inadequate for agriculture, wildlife, and urban needs; reservoirs are extremely low; hydropower is restricted

Fields are left fallow; orchards are removed; vegetable yields are low; honey harvest is small

Fire season is very costly; number of fires and area burned are extensive

Many recreational activities are affected

Fish rescue and relocation begins; pine beetle infestation occurs; forest mortality is high; wetlands dry up; survival of native plants and animals is low; fewer wildflowers bloom; wildlife death is widespread; algae blooms appear

Policy change; agriculture unemployment is high, food aid is needed

Poor air quality affects health; greenhouse gas emissions increase as hydropower production decreases; West Nile Virus outbreaks rise

Water shortages are widespread; surface water is depleted; federal irrigation water deliveries are extremely low; junior water rights are curtailed; water prices are extremely high; wells are dry, more and deeper wells are drilled; water quality is poor;

### History of the Hazard

Historically, drought has been so prevalent in California that its presence is almost continuous, including the Fresno State footprint. According to the US Drought Monitor, Time Series data, Fresno County (which surrounds the campus) has experienced numerous periods of drought covering about 15 years from 2000-2021, including the severe statewide event from 2012-2019.
According to the National Drought Mitigation Center, over 3,500 reports and publications covering 370 drought-related events took place across the state (many of which were statewide events) between 2000-2020. In addition, the National Center for Environmental Information (NCEI) reports more than 500 events statewide during this same time period. These events produced a comprehensive range of impacts to water supply, regulations and allocations to businesses and municipalities, budgets and resources for firefighting, water law and policy, and physical impacts to built and natural environments. As such, data records of previous occurrences can be viewed as separate time and event demarcations for a hazard almost continuously in effect across the state with cascading impact potential.

According to the Department of Water Resources, droughts exceeding three years are relatively common in Southern California, but relatively rare in Northern California - the region is the geographic source of much of the state’s developed water supply. The 1929-34 drought established the criteria commonly used in designing storage capacity and yield of large Northern California reservoirs.

According to the US Drought Monitor’s time series data, from 2000-2021 (with the exception of a 2–3-month period in 2000 and 2011), some degree of drought conditions has been continuously in effect somewhere in California. In fact, 80% - 100% of the state has been subjected to drought conditions for 12 of the last 20 years, with the most severe drought being the 100% state-wide event from 2012-2017.

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Given the extent of the drought risk in California, the following drought event was selected as an exemplar due to its broad and significant impacts on the state and in Fresno County, including the Fresno State campus planning area:

**2012 – 2017** – Drought produced severe impacts to water wells throughout the state of California, with a high number of wells running dry. Land subsidence due to increased groundwater pumping also occurred in numerous areas of the state such as the San Joaquin and Central Valleys. Crop damage was widespread as well. Water allotments were drastically reduced in many towns and water agencies, with extremely high costs for procuring water. In addition, job loss occurred with many families requiring food supply assistance, and water supply assistance provided to home-owners with dry wells. According to a report released by UC Davis Center for Watershed Sciences, the 2014-2017 period of the California drought cost the state’s agriculture industry about $1 billion in lost revenue, with a total statewide economic cost of the drought calculated to be $2.2 billion. The report says, “it is responsible for the greatest water loss ever seen in California agriculture - about one third less than normal”. The report calls the groundwater situation in California "a slow-moving train wreck." Spring snowpack at Donner Summit reached record low levels in 2014, exceeded in 2015 by a remarkable April 1 snow-water-equivalent value of only 5% of average. Decreased precipitation since contributed to near-record low levels in the Shasta Reservoir. The ongoing drought has contributed to declines in crop values across the state. For example, crops including cotton, corn silage and barley (the field crop category) fell by 42 percent.

**Potential Impacts of the Hazard**

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Drought impacts are wide-reaching and may be economic, environmental, and/or societal. This assessment of its impact recognizes that historic occurrences of drought throughout the planning area are a sub-set of larger and inter-connected local and regional droughts, and that the (related) historic impacts provide a sound basis for understanding potential (future) impacts.

The most significant impact associated with drought across the Fresno State campus planning area is both the historic and potential reduction in water availability for the municipal area tied to the campus. In fact, on campus water use reductions and recycled water use has taken place and continues to be. Other impacts include crop loss and damage to trees and other natural resources (See Tree Mortality below). The footprint of Fresno State to some extent includes these vulnerable resources based on the campus landscape (trees) and the presence (and footprint size) of agricultural research crops and field stations.

As a secondary impact of drought, wildfire is directly attributable to dry atmospheric conditions. Wildfires almost always coincide with drought in California, though not limited to such.\textsuperscript{40} However, the wildfire hazard is analyzed separately in this plan. See wildfire section later in this section.

In reviewing the occurrences of drought for Fresno County, the City of Fresno and Fresno State campus. the US Drought Monitor and the National Drought Mitigation Center report that tens of millions of trees died during the (2014-2017) state-wide drought disaster. Though data sources do not provide data for tree mortality specific to Fresno State the broad geographic extent of the impact includes Fresno County and the Central valley and makes it likely that tree mortality occurred to some degree on the campus. Due to the lasting and ongoing effects of drought on the landscape, trees will continue to be impacted within the municipalities, counties and regions wherein lies the CSU campus system as long as drought conditions continue to occur in the future.

Given the absence of data, in order for the CSU Committee to assess the impact of tree mortality, it is useful to view it as a risk sub-set to the probability, location, extent, severity and duration of the drought hazard within each campus-located municipality, county and region. Regarding potential impacts, standing dead trees could fall, posing a risk to people, buildings, power lines, roads and other infrastructure. In addition, drought-impacted trees become susceptible to diseases and insect infestations (bark beetle) further adding to the risk of tree mortality and related potential impacts. No data is currently available for tree mortality on campus, however, the CSU Planning Team will pursue data on this issue in the future.

As a potential tertiary impact, prolonged and repeated drought conditions over time can produce land subsidence and the risk of damage to building foundations and infrastructure on campus resulting from ground instability and collapse. Land subsidence is defined as the vertical sinking of the land over manmade or natural underground voids.

\textsuperscript{40} CAL FIRE Fire and Resource Assessment Program (FRAP). \textit{2017 Assessment}. Print. Retrieved 05.05.2021 from: \url{https://frap.fire.ca.gov/assessment/}
Subsidence is often the direct result of groundwater over-extraction in response to drought conditions, as well as oil and gas extraction. Weight can accelerate the process of subsidence resulting from surface development and infrastructure such as roads and buildings, vibrations from construction blasting and heavy truck or train traffic. For example, the State Water Project’s 444-mile-long California Aqueduct has required repairs such as the raising of canal linings, bridges, and water control structures on the Aqueduct – in the Central Valley a five-mile reach of the Eastside Bypass was impacted by subsidence, and the Department of Water Resources estimated that it may cost in the range of $250 million to acquire flowage easements and levee improvements to restore the design capacity of the subsided area.  

At present, drought related damage to campus buildings and infrastructure at Fresno State has not been reported, but the potential for such impacts is possible. With regard to overall potential impact, water supply/availability for Fresno State is ultimately tied to broader inter-dependent, and more intensive modes of water use at local and regional scales such as agriculture and ranching, wildfire protection, larger metropolitan/municipal usage, manufacturing and commerce, tourism, recreation, and wildlife preservation. During drought periods, the State of California’s regulated water allocations are modified and often reduced, which can result in reduced water availability for all usage contexts, including Fresno State. A reduction of electric power generation and water quality deterioration are also potential impact factors.

Table 9-12: Summary of Drought Impacts on Water Resources

<table>
<thead>
<tr>
<th>Resource</th>
<th>Type of Impact</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sea Level</td>
<td>Direct</td>
<td>Sea level is rising and will likely impact coastal areas</td>
</tr>
<tr>
<td>Soil Moisture</td>
<td>Direct</td>
<td>Prolonged dry seasons can lead to decreases in soil moisture; drier vegetation</td>
</tr>
<tr>
<td>Vegetation</td>
<td>Indirect</td>
<td>Longer and more intense fire season with increased extent of area burned</td>
</tr>
<tr>
<td>Stream Conditions</td>
<td>Direct</td>
<td>Increases in water temperature; potential effects on fish</td>
</tr>
<tr>
<td>Snowpack</td>
<td>Indirect</td>
<td>Increases in temperature will lead to decreases in snowpack</td>
</tr>
</tbody>
</table>


Runoff | Direct | Warmer temperatures are likely to lead to a shift in peak runoff from spring to winter and a likely decrease in summer base flow
---|---|---
Hydropower | Indirect | Decreased summer flows resulting from earlier snowmelt and a shift in peak runoff could affect hydropower generation during summer months
Precipitation | Direct | Warmer winter temperatures will result in a greater percentage of precipitation falling as rain rather than as snow
Groundwater | Indirect | Reduction in snowpack and extended periods of drought are likely to increase dependency on groundwater

Probability of Future Occurrence of the Hazard

**Highly Likely** — The US Drought Monitor’s time series data (2000-2020) indicates that some degree of drought has nearly a 100% probability of occurrence somewhere in the state in any given year. Given that Fresno State lies within a drought impacted region, it is prudent to extend this likelihood of occurrence to the planning area.

Vulnerability to the Hazard

In California, rising temperatures are projected to increase the average lowest elevation at which snow falls, reducing water storage in the snowpack, particularly at those lower mountain elevations which are now on the margins of reliable snowpack accumulation. Higher spring temperatures will also result in earlier melting of the snowpack. The shift in snow melt to earlier in the season is critical for California’s water supply because flood control rules require that water be allowed to flow downstream and that water cannot be stored in reservoirs for use in the dry season. As such, state-level drought risk factors that have led to drought’s state-wide severity and extent, and potential impacts also create drought vulnerabilities at the level of the Fresno State campus.

Moreover, climate change will likely adversely impact the vulnerability of watersheds and ecosystems in their ability to deliver important ecosystem services. These changes may limit the natural capacity of healthy forests to capture water and regulate stream flows. Sierra Nevada mountain winters and springs are warming, and on average, precipitation as snowfall relative to rain is decreasing. A warming climate with reduced snowpack will result in earlier snowmelt and will subsequently reduce downstream water availability during summer and early fall.

As such, the state and the Fresno State planning area stakeholders potentially have less capacity to address future drought risks due to projected temperature increases and shortages in water; ground-water withdrawals have been occurring at a deficit rate of 1 – 2-million-acre feet per year, where the impacts of drought include decreased availability.
of water for agriculture and environmental uses. In forested and other vegetated areas, prolonged drought decreases the moisture content of forest fuels and increases the risk of high severity wildfires.

It should be pointed out that California is the single most productive agricultural state and its agricultural industry relies heavily on reservoir water supplied by snowmelt and rainfall runoff. Yearly variations in snowpack depths have implications for water availability as snowmelt from the winter snowpack feeds a network of reservoirs. Spring snowpack at Donner Summit reached record low levels in 2014, exceeded in 2015 by a remarkable April 1 snow-water-equivalent value of only 5% of average. Decreased precipitation since 2011 has contributed to near-record low levels in the Shasta Reservoir.

Vulnerability of Populations

The historical and potential impacts of drought on California’s population include agricultural sector job loss, secondary economic losses to local businesses and public recreational resources, increased cost to local and state government for large-scale water acquisition and delivery, and water rationing and water wells running dry for individuals and families. As drought is often accompanied by prolonged periods of extreme heat, negative health impacts such as dehydration can also occur, where children and elderly are most susceptible. Air quality often declines in times of drought which can affect those with respiratory ailments. These same vulnerabilities apply to the students, faculty and staff of the CSU - Fresno campus.

Property Vulnerability

The historical and potential vulnerabilities to drought include crop loss, injury and death of livestock and pets, and damage to infrastructure, homes and other buildings resulting from the secondary drought impact of land subsidence. The related drought impacts of tree mortality and land subsidence pose risks to vulnerable critical infrastructure and property. These same vulnerabilities apply to the properties of the Fresno State campus.

Natural Environment Vulnerability

Drought vulnerabilities in the natural environment are widespread throughout public and private lands within the state, including tree mortality, impacts to all flora and fauna, and destabilization (subsidence) of land along streams and rivers, and within watersheds. The core issue shaping drought vulnerabilities throughout California is water supply and demand. Several factors play into the issue including groundwater basins, surface water run-off, public and agricultural demand, and surface water storage water sheds. A USGS led analysis was first conducted in 2010 through the Forest and Rangeland Assessment

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and ongoing through the USGS Forest and Rangeland Ecosystem Science Center to identify threats and assets where water supply would benefit from environmental management designed to protect or enhance water resources, the key effort which, in part, both defines and mitigates the severity of drought risk and vulnerabilities.

With regard to overall threat and asset findings shaping the potential severity of drought, the watersheds in the Sierra region contribute most greatly to the state’s water supply, but are under threat from climate change, wildfire and development. In addition, groundwater basins in the San Joaquin Valley and Sacramento Valley bioregions are an abundant resource that is heavily threatened by over pumping.

**Critical Facilities Vulnerabilities**

Drought vulnerabilities for Fresno State’s critical facilities include water shortfalls for facility operations and critical functions, and potential structural destabilization and damage resulting from land subsidence.

**Estimate of Potential Losses**

An estimate of potential losses from drought has not been calculated for the campus or the CSU system as a whole. However, drought related losses to the city and county of Fresno, and the surrounding region such as crop loss and cost increases for water resources have re-occurred over time. Please consult city and county level government, and/or state agricultural agencies and other stakeholders for data on the financial impacts from drought.

**Vulnerability Assessment Conclusions**

The CSU Planning Committee understands that the high degree of vulnerability posed by drought will be exacerbated by greater climate variation in the future and therefore greater variation and uncertainty regarding the availability of water supplies which are already under tremendous stress. In response to such vulnerability, state legislation passed in 2014 requires local governments to regulate pumping and recharge to better manage groundwater supplies, and groundwater-dependent regions are required to halt overdraft and bring basins into sustainable levels of pumping and recharge by the early 2040s. That said, the Committee will continue to work with local, regional and state partners and stakeholders to explore solutions for mitigating the drought hazard on its campuses by accessing the best available data and resources on climate change and its relationship to drought.

**Identified Data Limitations**

Data is limited concerning campus-related agricultural assets as well as data on campus tree mortality.
Earthquake

Description of the Hazard

An earthquake is a sudden motion or shaking caused by the release of pressure accumulated along the edge of tectonic plates covering the earth. These huge plates are constantly moving and move ever so slowly under, over, or by passing one another. This movement is gradual however the plates may lock together accumulating enormous amounts of energy. When this energy builds, stress develops, and the adjoining plates will eventually break free and result in ground shaking – an earthquake.

Large earthquakes may result in fissuring, ground settlement, and/or vertical or horizontal displacement. Earthquakes occur without warning and can result in extensive damages and human casualties. Damages associated to earthquake generated ground shaking is normally confined to a narrow area along fault trend from the earthquake epicenter. However, seismic waves may generate ground shaking resulting in damages in areas outside of the fault trend.

In addition to ground motion, there are several secondary hazards that can result from an earthquake including:

Fault Rupture – The rupture of faults is the differential movement of the two sides of the earth’s plates at the point of the fault. Horizontal or vertical displacement may be significant and occur over great distances. The movement and energy that occurs along a fault is released in waves resulting in ground shaking. The intensity of ground shaking varies based on the magnitude of the earthquake, the proximity to the earthquake epicenter, the composition of the ground sediment or rock the waves travel through, and the depth of the earthquake.

Liquefaction – In addition to the primary fault rupture that occurs right along a fault during an earthquake, the ground many miles away can also fail during intense shaking. As seismic waves travel through saturated granular soil; the soil begins to liquefy and act as a fluid. Soil strength and stability is lost causing the effects of ground shaking to intensify and for ground deformation to occur. These water saturated soils when shaken quickly lose the ability to support buildings, bridges, utilities, and other structures. Areas susceptible to liquefaction include places where sandy sediments have been deposited by rivers along their course or by wave action along beaches. The greater the magnitude of an earthquake and longer duration of strong ground shaking will result in an enhanced potential for liquefaction to occur. Settlement can cause damage when the amount settlement varies significantly across the length of a structure. Lateral spreading occurs when liquefaction occurs on gently sloping ground and the liquefied material at depth allows the area to slide, often toward a vertical discontinuity or “free face” such as a creek or stream channel. Liquefaction can occur in susceptible soils below bodies of water, and settlement and lateral spreading can damage structures built on or adjacent to these areas. Transportation bridges across water bodies, wharves, piers and other structures at ports and harbors, and underwater utility lines can be severely damaged by this hidden hazard.
**Subsidence** - Changes in the local environment that cause subsidence or sinkholes are called triggering mechanisms. Water is the primary factor that affects the local environment and causes subsidence. Water level decline, changes in groundwater flow, increased loading, and deterioration (such as abandoned mines) are all triggering mechanisms. Water level decline may occur naturally, or it may be the result of human action. Factors that lead to water decline are pumping (from wells), localized drainage (for construction activities), dewatering, or drought. Changes in groundwater flow can result from an increase in the velocity of groundwater movement, and increase in the frequency of water table fluctuations, and changes in discharge (either increase or decrease). Increased loading can cause pressure in the soil, leading to the failure of underground cavities and space, such as caves. Vibrations from earthquakes, heavy machinery, and blasting may result in structural collapse, followed by surface resettlement.

**Location of the Hazard**

The State of California is particularly vulnerable to earthquake activity due to California’s location residing between two large tectonic plates. Fresno is located in the center of the San Joaquin Valley along the eastern edge at the base of the Sierra Nevada Mountains. In general, fault systems occur to the west and east of Fresno. Throughout the valley the ground is saturated with sediment eroded from the mountains and foothills via multiple stream and river channels.

The Pacific Plate and the North American Plate come together at the San Andreas Fault 75 miles west of the CSU Fresno campus. In addition to the San Andreas Fault, Fresno County is home to or near additional fault systems with the potential to generate strong ground shaking. The Great Valley Fault traverses along the eastern base of the Coastal Range 50 miles east of the CSU Fresno campus. The Ortigalita Fault extends approximately 50 miles in length along the Coastal Range 80 miles east of the CSU Fresno campus. There are additional faults in the Sierra Nevada Mountains east of Fresno. These faults are at least 75 miles from the campus on the opposite side of the mountains.
Extent of the Hazard

The extent or severity of earthquake damage is expressed in terms of magnitude, intensity and duration. The amount of energy released during an earthquake is normally conveyed as a magnitude measured from a seismogram. Magnitude is expressed in numbers and decimals representing the physical size of the earthquake. The strength and effect of the shaking on the surface of the earth is classified as the intensity. Intensity is further defined from the effects the earthquake has on people, structures, and the natural environment. The intensity of an earthquake in terms of measuring magnitude and evaluating its effects is generally expressed using the Modified Mercalli (MM) Intensity Scale. Duration is the length of time the earthquake’s energy is released.

The Richter magnitude scale (Table 9-18 below) was developed in 1935 by Charles F. Richter of the California Institute of Technology as a mathematical device to compare the size of earthquakes. The Richter Scale is the best-known scale for measuring the magnitude of earthquakes. The magnitude value is proportional to the logarithm of the amplitude of the strongest wave during an earthquake. A recording of 7, for example, indicates a disturbance with ground motion 10 times as large as a recording of 6. The
energy released by an earthquake increases by a factor of 31 for every unit increase in the Richter scale.

Table 9-13: Earthquake Intensity and Frequency Comparisons

<table>
<thead>
<tr>
<th>Magnitude</th>
<th>Mercalli Intensity</th>
<th>Potential Damage</th>
<th>Global Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 2.0</td>
<td>I</td>
<td>None</td>
<td>Continually</td>
</tr>
<tr>
<td>2.0 - 2.9</td>
<td>I to II</td>
<td>None</td>
<td>&gt; IM per year</td>
</tr>
<tr>
<td>3.0 - 3.9</td>
<td>II to IV</td>
<td>None</td>
<td>&gt; 100,000 per year</td>
</tr>
<tr>
<td>4.0 - 4.9</td>
<td>IV to VII</td>
<td>Light</td>
<td>10K to 15 K per year</td>
</tr>
<tr>
<td>5.0 - 5.9</td>
<td>VI to VII</td>
<td>Moderate</td>
<td>1K to 1,500 per year</td>
</tr>
<tr>
<td>6.0 - 6.9</td>
<td>VII to X</td>
<td>Heavy</td>
<td>100 to 150 per year</td>
</tr>
<tr>
<td>7.0 - 7.9</td>
<td>VII &lt;</td>
<td>Very Heavy</td>
<td>10 - 20 per year</td>
</tr>
<tr>
<td>8.0 - 8.9</td>
<td>VII &lt;</td>
<td></td>
<td>1 per year</td>
</tr>
<tr>
<td>&gt; 9.0</td>
<td>VII &lt;</td>
<td></td>
<td>1 per 10-50 years</td>
</tr>
</tbody>
</table>

The Modified Mercalli Intensity Scale provides descriptive values of earthquake intensity that may provide greater meaning to the broader population as the description of intensity refers to the effects actually experienced. This scale uses an arbitrary ranking based on observed earthquake effects. The scale is composed of increasing levels of intensity ranging from shaking that is not recognizable to intense shaking resulting in catastrophic damages and casualties. The Modified Mercalli Intensity Scale is demonstrated below:

Table 9-14: Modified Mercalli Intensity Scale

<table>
<thead>
<tr>
<th>Intensity</th>
<th>Shaking</th>
<th>Description / Damage</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Not felt</td>
<td>Not felt except by a very few under especially favorable conditions.</td>
</tr>
<tr>
<td>II</td>
<td>Weak</td>
<td>Felt only by a few persons at rest, especially on upper floors of buildings.</td>
</tr>
<tr>
<td>III</td>
<td>Weak</td>
<td>Felt quite noticeably by persons indoors, especially on upper floors of buildings. Many people do not recognize it as an earthquake. Standing motor cars may rock slightly. Vibrations similar to the passing of a truck. Duration estimated.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Magnitude</th>
<th>Intensity</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>IV</td>
<td>Light</td>
<td>Felt indoors by many, outdoors by few during the day. At night, some awakened. Dishes, windows, doors disturbed; walls make cracking sound. Sensation like heavy truck striking building. Standing motor cars rocked noticeably.</td>
</tr>
<tr>
<td>V</td>
<td>Moderate</td>
<td>Felt by nearly everyone; many awakened. Some dishes, windows broken. Unstable objects overturned. Pendulum clocks may stop.</td>
</tr>
<tr>
<td>VI</td>
<td>Strong</td>
<td>Felt by all, many frightened. Some heavy furniture moved; a few instances of fallen plaster. Damage slight.</td>
</tr>
<tr>
<td>VII</td>
<td>Very strong</td>
<td>Damage negligible in buildings of good design and construction; slight to moderate in well-built ordinary structures; considerable damage in poorly built or badly designed structures; some chimneys broken.</td>
</tr>
<tr>
<td>VIII</td>
<td>Severe</td>
<td>Damage slight in specially designed structures; considerable damage in ordinary substantial buildings with partial collapse. Damage great in poorly built structures. Fall of chimneys, factory stacks, columns, monuments, walls. Heavy furniture overturned.</td>
</tr>
<tr>
<td>IX</td>
<td>Violent</td>
<td>Damage considerable in specially designed structures; well-designed frame structures thrown out of plumb. Damage great in substantial buildings, with partial collapse. Buildings shifted off foundations.</td>
</tr>
<tr>
<td>X</td>
<td>Extreme</td>
<td>Some well-built wooden structures destroyed; most masonry and frame structures destroyed with foundations. Rails bent.</td>
</tr>
</tbody>
</table>

The graph below illustrates the increasing intensity of energy that is released and as the measured magnitude increases. While each whole number increases in magnitude represents a tenfold increase in the measured amplitude, it represents an increasing rate of 32 times more energy released in the same increase in magnitude. As the magnitude of an earthquake is measured higher, the intensity of the earthquake worsens progressively from one category to the next.
Based on the limited occurrence of earthquakes in the Fresno area, and the location of the campus relatively far from fault systems, the potential for severe impacts still exists due to the presence of 5 active faults, one of which (San Andreas fault) has a 32% probability of occurrence of a 6.7 or greater magnitude event over the next 30 years. As such, the planning committee ranks the extent of the hazard as **Low-Moderate**.

**History of the Hazard**

The State of California has a long history of chronic and destructive earthquakes throughout the state. On average, earthquakes strong enough to result in structural damages occur three to four times a year in California, while earthquakes Magnitude 6.0 to 6.9 occur once every two to three years. Fresno County also has history of earthquake activity especially on the western side. Fresno County has a limited history of significant earthquakes occurring in the central part of the County including where CSU Fresno is located.

Table 9-15: Historic Earthquakes Near Fresno, CA

<table>
<thead>
<tr>
<th>Date</th>
<th>Location</th>
<th>Magnitude</th>
<th>Damages</th>
</tr>
</thead>
<tbody>
<tr>
<td>6/27/1966</td>
<td>Parkfield</td>
<td>6.0</td>
<td>Minor</td>
</tr>
</tbody>
</table>

---


47. Fresno County Multi-Hazard Mitigation Plan, April 2018
The May 2, 1983 Coalinga Earthquake caused extensive damage to buildings, bridges, water systems, and critical facilities in Coalinga. Damage caused by the earthquake included 800 buildings destroyed, the commercial sector of Coalinga receiving heavy damage, and schools and hospitals with minor damages. 1,000 people were left homeless and 47 were injured. State and federal disaster declarations were declared (DR-682-CA).

Potential Impacts of the Hazard

The shaking of the ground from earthquakes can result in building collapse, bridge failure, utility disruptions and other structural collapse. Large earthquakes can additionally cause natural gas lines to break resulting in structure fires. A major earthquake in the Fresno area would likely result in region-wide social disruptions in addition to structural damages. The region-wide structural damages may disrupt lifelines and supply chain routes limiting the campus from effective evacuation routes and receiving necessary supplies or equipment.

Most injuries resulting from earthquakes are from collapsing walls, flying glass, or other objects moved by ground shaking. The lack of warning allows individuals minimal time to react and find areas of safety. A moderate earthquake occurring near Fresno could cause injuries or fatalities to members of the campus community or support networks the campus relies on. Older construction methods may enhance the impacts that damages have on buildings and other infrastructure. These earthquake effects might be aggravated by collateral incidents such as fire, flooding, hazardous material spills, dam/levee compromises, and other cascading events. A catastrophic earthquake near Fresno could result in extensive casualties, expansive structural damages, panic, widespread utility outages, communication failures, and secondary emergencies such as fire. A catastrophic earthquake would certainly affect the broader Fresno County region limiting immediate assistance that the campus may normally expect.

Local impacts to CSU Fresno campus caused by an earthquake could include:

- Potential hazardous material releases on and off campus
- Infrastructure damage to regional freeway system
- Structural damage to bridges over waterways and flood control channels
- Potential isolation of campus from community
- Potential isolation among on-campus residents
- Structural damage to Dry Creek levees and Big Dry Creek Dam facilities
- Structural damage to campus academic and support buildings
- Structural damage to residence halls resulting in displaced student populations
- Structural damage to nearby residences
Community members arriving on campus for refuge from damaged homes
- Damaged university communications, computer systems, and networks
- Considerable stress and fear among community
- Closure or reduction of service to campus operations
- Reduction of campus revenue

**Probability of Future Occurrence of the Hazard**

The Working Group on California Earthquake Probabilities (WGCEP), a collaboration between the United States Geological Survey (USGS), the Southern California Earthquake Center (SCEC), and the California Geological Survey (CGS) develops Uniform California Earthquake Forecasts (UCERFs) using the best currently available science and technology. The UCERF version 3 provides a three-dimensional view of the likelihood a region in California will experience a Magnitude 6.7 or greater earthquake in the next 30 years. The likelihood for the Fresno County fault systems surrounding the Fresno core is included in the following table.

Table 9-16: Major Potentially Active Faults in Proximity to CSU Fresno

<table>
<thead>
<tr>
<th>Fault Zone</th>
<th>Recurrence</th>
<th>UCERF3 Likelihood</th>
</tr>
</thead>
<tbody>
<tr>
<td>San Andreas</td>
<td>Varies: 20-300 years</td>
<td>32%</td>
</tr>
<tr>
<td>Alcalde Hills</td>
<td>Historic: 200-3,000 years</td>
<td>3%</td>
</tr>
<tr>
<td>Ortigalita Peak</td>
<td>Historic: Unknown</td>
<td>3%</td>
</tr>
<tr>
<td>Great Valley</td>
<td>Historic: Unknown</td>
<td>3%</td>
</tr>
<tr>
<td>Coalinga</td>
<td>Historic: Unknown</td>
<td>3%</td>
</tr>
</tbody>
</table>

Based on the earthquake shaking potential in the Fresno area, the proximity fault systems to the west and east of Fresno County, the probability of seismic ground shaking generating damage is considered **Possible**.

**Vulnerability to the Hazard**

A considerable challenge regarding earthquakes is they generally occur without warning. The fault systems surrounding the region tend to remain to the west along the Coastal Ranges of east in the Sierra Nevada Mountains. Many of these cross major transportation routes potentially reducing the availability of access and the supply chain. However, Fresno likely less vulnerable to the direct effects of earthquake as known fault systems are removed from the area. The geographic location of Fresno sits at the base of river systems that have deposited sediment from the surrounding mountains. In many cases,

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48 Fresno County Multi-Hazard Mitigation Plan, April 2018
these sediment-based soils are loose and expose the potential for liquefaction. The soils of the area surrounding the campus are described by the Local Hazard Mitigation Plan as generally being not conducive to significant liquefaction due to a high clay content.

The known fault systems generating the threat to Fresno generally exist to the east and west of the city but do not cross into the city including the CSU Fresno campus. The distance and to these surrounding systems help mitigate significant vulnerabilities in the event a seismic event were to occur on those systems. In the event of an earthquake occurring in the region on an unknown system, the potential for earthquake damaged structures being left uninhabitable including campus residence halls will result in numerous displaced individuals and households. The lack of earthquake insurance will cause extreme financial burdens on those affected. Campus buildings and equipment would be vulnerable to damages from building, seismic shaking, secondary fires, and secondary building floods from broken pipes.

Elements of the vulnerability to a major earthquake on the CSU Fresno campus will vary depending on when the earthquake were to strike. The primary basis of vulnerability is based on the population affected and the built environment exposed. In general, newer construction will be more earthquake resistant than older buildings as building codes and construction technology have improved. A locally centered earthquake, even from moderate events, would have the potential for more damaging results when associated with the moderate liquefaction zones of the city. This would particularly be seen with greater damages to unreinforced masonry buildings.

The risk to the campus population will be lessened during periods when classes are not in session or during periods of breaks. Conversely, during the days and hours that classes are in session and staff are at their workplaces, the human vulnerability increases.

Generally, people are safer when at home in wood frame structures as earthquakes tend to generate less structural damage to wood construction than in commercial or industrial facilities. The greater number of people on campus at the time of an earthquake will result in more people being exposed to effects from damaged campus facilities or equipment and require greater evacuation assistance. However, in region-wide events this vulnerability may simply shift to the homes and workplaces of members of the campus community and their families.

The aftermath of a major earthquake will likely result in widespread search and rescue operations for trapped and injured individuals. The demand on emergency services will be great, potentially requiring the campus community to be prepared for these scenarios and initiate response actions as needed. There will be needs for emergency medical care, shelter, water, and food for individuals who have been displaced by the earthquake. In earthquakes causing significant damages, there may be a necessity to provide assistance with sheltering and care of those unable or unwilling to return to their homes. Damages to the homes of the members of the campus community may place greater demands on campus resources and capabilities in the short-term period following a seismic event.

There may be a need to evacuate members of the campus community from the campus and to other locations that are deemed to be safer locations. Certain campus populations
will experience greater challenges to a post-earthquake environment. Vulnerable populations including those that rely on specific services, require electrical power, homeless students, experience disabilities, non-English speakers, those whose age make evacuating difficult, and others will be most affected. These individuals will likely need to navigate through earthquake generated debris, extreme stresses of a disaster, an inability to communicate to or gain access to support networks, and find difficulty in accessing equipment or supplies to aid in a specific need.

Estimate of Potential Losses

Estimates of potential losses will be influenced by a variety of factors. The intensity of the earthquake will determine what scale of damages affecting campus infrastructure, equipment, and other impacted features. Losses will be generated by the physical damages, the loss of revenue, loss of academic research, loss of building contents, and community wide economic reductions.

Based on estimate replacement costs of facilities and structures on campus, the maximum total replacement costs due to earthquake are $395,965,157.

Table 9-17: HAZUS Peak Ground Acceleration Zone (PGA) Estimated Losses

<table>
<thead>
<tr>
<th>PGA Zone Designation</th>
<th>Intensity</th>
<th>No of Buildings</th>
<th>Maximum Replacement Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Extreme</td>
<td>X+</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Violent</td>
<td>IX</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Severe</td>
<td>VIII</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Very Strong</td>
<td>VII</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Strong</td>
<td>VI</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Moderate</td>
<td>V</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Light</td>
<td>IV</td>
<td>116</td>
<td>$395,965,157</td>
</tr>
<tr>
<td>Weak</td>
<td>II-III</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Not Felt</td>
<td>I</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>NA</td>
<td>NA</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>No Building Value Data Provided*</td>
<td>NA</td>
<td>9</td>
<td>Unknown</td>
</tr>
</tbody>
</table>

*Buildings with no value defined are also included in the respective Zones they are found in.

Vulnerability Assessment Conclusions

It is difficult to predict the severity of casualties, property, and cascading impacts generated by future seismic events affecting the Fresno County region and the CSU Fresno campus. Each of the earthquake generated effects will vary widely based on the
intensity of the earthquake, location of the epicenter, proximity to people and development, time of day and year, the soil composition under the impacted structures, building construction, among others. In any case, however unlikely, the potential for a major earthquake exists affecting the campus and causing extensive challenges to the CSU Fresno campus and community.

In the event that a major earthquake was to strike along the fault systems surrounding Fresno, the effects could be significant to the campus community and campus operations. The widespread impacts generated by a major earthquake would extend the effects of casualties, damages, and other impacts to the broader Fresno County region creating large-scale regionwide needs for critical assistance and a heavy demand on limited emergency resources. The threat and impacts presented to the campus will be shared with the campus community from their homes and places of work. The campus will likely be required to address critical needs independently during early phases of the disaster.

Campus infrastructure is vulnerable to severe shaking particularly in areas where the ground is loose or susceptible to liquefaction. Specifically older buildings, masonry constructed buildings, and other structures susceptible to shaking related damage are the most vulnerable. Communication systems, computer networks, and other electronic systems may be vulnerable when overwhelmed by increased demand during emergencies or by shaking related damages.

The campus population is vulnerable to the effects of major ground shaking that are far reaching. The psychological and social impacts a major earthquake will give rise to will potentially harm individuals and cause tremendous fear. The willingness to return indoors may be hampered especially as after-shocks continue. These effects are magnified for populations having specific vulnerabilities or access limitations. Populations having various limitations or specific needs may be vulnerable to reduced or eliminated access to essential services that have been rendered incapable to respond.

Identified Data Limitations

Missing campus structural replacement costs and an inventory of building construction types to include status of earthquake retrofitting. HAZUS generated analysis is focused on the broader community level versus finetuning the analysis to the micro-level for facilities such as a university campus.

**Erosion**

Description of the Hazard

The US Geological Survey (USGS) defines erosion as “the process whereby materials of the earth’s crust are loosened, dissolved, or worn away and simultaneously moved from one place to another”. Erosion may occur in areas of streams and rivers, along bluffs, around immovable objects (such as buildings or bridge abutments), or as a cascading

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result of other natural hazards, such as earthquakes or wildfires. When erosion occurs along bodies of water, the removal of material causes the shore to move further landward.

Forces such as sea level rise and changes in sediment supply impact erosion gradually and can be difficult to recognize. In contrast, the impacts of short-term events, such as storms and flooding, can be severe and are immediately recognizable.

Location of the Hazard

Erosion is a relatively non-spatial hazard that can occur in any location with conducive soil structure and a source of movement such as water or wind. An area’s potential for erosion is determined by several factors, including rainfall, topography, soil characteristics, and vegetative cover. Streambank and bluff erosion can occur near any riverine area. For the purpose of this campus-level analysis, the erosion hazard poses a consistent risk across those areas of the campus with erosion-prone characteristics. For example, erosion has occurred on construction sites and surrounding parking lots and roadways.

Extent of the Hazard

There is no published scale of severity or extent for this geologic hazard. While erosion in the valley area is typically not problematic, erosion hazards are present on steep slopes in the Sierra Nevada mountains and foothills. If conditions are favorable on campus, erosion is likely to occur. However, given some historical occurrence of erosion on campus, the planning committee ranks the extent of this hazard as Moderate.

History of the Hazard

The campus has experienced erosion on construction sites and surrounding parking lots and roadways. The Fresno County Multi-Jurisdictional Hazard Mitigation Plan states that there have been no significant erosion events within the county.51

Potential Impacts of the Hazard

Erosion causes instability in soil. During high-intensity rain events, for example, eroded areas will continue to erode, resulting in additional loss of soil and ground stability in the area. This removal of sediment can result in damage to infrastructure, public health, and safety. On campus, areas of erosion can create pedestrian and transportation hazards, and structures may become unsafe if erosion is not controlled.

In agricultural areas, the erosion of soil degrades the quality of the soil, which can lead to reduced crop yields.52 At the Paul L. Byrne Memorial University Farm, soil erosion can

51 County of Fresno Office of Emergency Services. Retrieved 2.7.21 from: https://www.co.fresno.ca.us/home/showdocument?id=35154
create significant concerns for agriculture and research. Eroded test plots can negatively impact experiments and tests, resulting in a loss of knowledge and data.

**Probability of Future Occurrence of the Hazard**
Erosion is an on-going and dynamic process that occurs regularly. As climate change induces more frequent and intense weather events, such as wildfires and flooding, erosion may generally become more widespread or severe. These events can cause erosion or exacerbate areas already experiencing erosion. As a result, and in consideration of the potential extent of erosion, the probability of at least a limited degree of erosion taking place somewhere on campus in the future is **High** over the long term.

**Vulnerability to the Hazard**
Topography, soil structure, land use, and precipitation are all factors of erosion. CSU Fresno infrastructure, buildings, and agriculture located on steep slopes, in areas with little vegetation, or in areas with conducive soil types are more vulnerable to erosion. CSU leadership would consider performing an analysis on specific at-risk buildings, slopes and soil types in the future.

In the wider Fresno community, erosion vulnerabilities include agricultural sector job loss, degradation of riverine ecosystems, and loss of water quality.

**Estimate of Potential Losses**
The historic and potential impacts of erosion on property statewide include reduced agricultural productivity, lower surface water quality, and damaged drainage networks.

Current modeling is not precise enough to allow for an assessment of potential losses to buildings and infrastructure on campus.

**Vulnerability Assessment Conclusions**
While the ability to predict future erosion on the CSU Fresno campus is limited, the core issues shaping erosion vulnerability on campus are flora and landscaping. If left unchecked, erosion can cause significant damage to campus infrastructure and the surrounding environment.

**Identified Data Limitations**
The complex interactions between soil erosion factors make predictive modeling, determination of hazard areas, and quantification of loss difficult. Localized data on this hazard is also limited, resulting in more generalized findings.

*Extreme Temperatures (Includes Extreme Cold and Extreme Heat)*

**Heat**

**Description of the Hazard**
What is considered an excessively hot temperature varies according to the normal climate for that region. However, when temperatures are extremely high, people are at
higher risk for heat-related illnesses, such as dehydration, heat exhaustion, heat stroke, and in severe cases, death.\textsuperscript{53}

Hazards from extreme heat are made worse when high temperatures are accompanied by high levels of humidity, which is defined as the amount of moisture in the air.\textsuperscript{54} As the temperature climbs, the air is able to hold more moisture. High humidity prevents the human body from cooling down naturally, which leads people to perceive that the temperatures “feel” hotter. The combination of temperature and humidity is known as the heat index.\textsuperscript{55}

Heat stroke, the most serious heat-related illness, occurs when the body is unable to control its temperature. Body temperature rises rapidly, the sweating mechanism fails, and the body cannot cool down.\textsuperscript{56} In extreme causes, heat stroke can cause confusion and unconsciousness, so the victim is unable to seek treatment without assistance.

There are several groups of people who are uniquely vulnerable to the effects of extreme heat, such as infants and children, older adults aged 65 and up, athletes and outdoor workers, low-income households, and individuals with certain chronic medical conditions.\textsuperscript{57}

Location of the Hazard

Extreme heat events are a non-spatial hazard, and may occur anywhere at the Fresno State campus.

Extent of the Hazard

Extreme heat has a wide range of extent and severity markers and characteristics. Monthly average maximum temperatures in June through October range approximately from the low 90s to the high 90s in the City of Fresno. According to data from the National Climatic Data Center (NCDC), the highest daily temperature recorded in Fresno was 113\textdegree{} F on three successive days in 2006: July 23, July 24, and July 25. This was part of a record-breaking heat wave that affected much of California between July 16 and July 26, 2006. Numerous daily maximum temperature records were set and an all-time record for statewide energy consumption was also reached on July 24 with 50,270 megawatts. More than 100 heat-related deaths were recorded in the state.\textsuperscript{58}

\footnotesize
\textsuperscript{55} Ibid.
Based on average maximum temperatures in the 90’s, five extreme heat events in Fresno from 2006 – present, and on the potential impacts, the planning committee ranks the extent of the hazard as Low to Moderate.

The National Weather Service issues a Heat Advisory when the heat index value is expected to reach 100° – 104° F within the next 12 to 24 hours. Excessive Heat Warnings are issued when there is an anticipated heat index of 105° F or greater that will last for two (2) or more hours. Excessive Heat Warnings are issued by the county when any location in the county is expected to reach that criteria. In anticipation of an Excessive Heat Warning, an Excessive Heat Watch may be issued 1 to 2 days in advance, when the Heat Warning criteria is 50 – 79% likely to occur.

Figure 9-10 (following) depicts the National Weather Service’s methodology for determining the heat index, using the % humidity and the actual temperature.

Figure 9-10: Methodology for Determining Heat Index.

As the heat index rises, so does the potential danger to people and animals. The following table shows the health hazards associated with extreme heat.

Table 9-18: Health Risks Associated with Heat Index

<table>
<thead>
<tr>
<th>Category</th>
<th>Heat Index</th>
<th>Health Hazards</th>
</tr>
</thead>
</table>

Extreme Danger | 130° F or higher | Heat stroke / sunstroke is likely with continued exposure.
---|---|---
Danger | 105° – 129° F | Sunstroke, heat cramps, and/or heat exhaustion is likely with prolonged exposure and/or physical activity.
Extreme Caution | 90° – 104° F | Sunstroke, heat cramps, and/or heat exhaustion is possible with prolonged exposure and/or physical activity.
Caution | 80° – 89° F | Fatigue is possible with prolonged exposure and/or physical activity.

Based on the record of four extreme heat events in Fresno (2008-present), although Fresno County maintains established protocols of providing the public with advanced notice of heat events with directives for mitigating impacts, the planning committee ranks the extent of this hazard as **Moderate**.

**History of the Hazard**

In addition to the 3 days of record high temperatures in 2006 (NCDC data), data gathered from the National Centers for Environmental Information (NCEI) Storm Events Database, there have been four additional excessive heat events in Fresno County since 2008.

**July 9, 2008:** This was part of a widespread heat wave that affected much of the state. In Northern California, the heat exacerbated wildfires burning in the region, where hundreds of thousands of acres had already burned.

**September 1, 2017:** Much of the Southwest experienced extreme heat in late August continuing into early September, with many metro areas experiencing record-breaking temperatures.

**June 10, 2019:** This event occurred during one of the hottest heat waves to ever hit California, with temperatures breaking records across the state and much of the Southwest.

**May 26, 2020:** The month of May ranked as one of the hottest on record for multiple cities in California, with average temperatures ranging approximately 2.5 to 5 degrees above normal.

**Potential Impacts of the Hazard**

Fresno State may experience impacts from extreme heat due to cancelled classes or postponed outdoor events in order to protect students, faculty, and staff from the weather.

In addition to the threat extreme heat poses to humans, high temperatures also pose a threat to utility production, which in turn threaten facilities and operations that rely on utilities. As temperatures rise, more people stay indoors, increasing the demand for air conditioning, fans, and other electronics. This puts a strain on the electrical grid, which
can cause temporary outages. These outages can impact operations throughout campus, resulting in interruptions and delays in service. Outages may also negatively impact research efforts on campus, as the inability to maintain a steady, constant temperature may impact research specimens and experimental results.

Probability of Future Occurrence of the Hazard

Two extreme heat events have occurred in Fresno County in the past two years, but just five events since 2006. Therefore, it is Somewhat Likely that the hazard will occur annually, given upward trends due to climate change.

Vulnerability to the Hazard

When dealing with an extreme heat event, the most common impacts are those generally felt by the people living in the targeted area. For people in particular, heat can kill when the body is pushed beyond its limits. Most heat disorders occur because the victim has been overexposed to heat. As discussed, the major human risks associated with extreme heat include dehydration, sunburn, fatigue, heat exhaustion, heat stroke, and in severe cases, death.

Some portions of the population are more at risk to the effects of extreme heat. The very young, the elderly, and certain groups with chronic medical conditions (such as asthma or other pulmonary illnesses, heart disease, poor blood circulation, neurological illnesses, and obesity) are generally more vulnerable to the effects of extreme heat, and are more likely to suffer illness or death as a result.61 This is especially true if exposure is extended for a period of time and preventative measures are not taken immediately.

CSU Fresno experiences several hot days each summer, with the potential for extreme heat events. Fall athletic teams may be exposed to extreme heat during summer training and early season games. The campus takes precautions to make cooling and water stations available for athletes and spectators during fall football games when needed. The campus also sponsors training and information on heat stroke and heat exhaustion.

When it comes to staff safety, CSU Fresno allows employees who work outdoors to take more breaks inside or switch to indoor work if available. They are also subject to frequent checks by supervisors to ensure their safety and wellbeing.

Therefore, while this is a hazard that the campus may experience with regularity, the campus has ample familiarity with in order to handle the risks and vulnerabilities.

Estimate of Potential Losses

Based on the previous historical occurrences, annualized losses are considered to be negligible. In an extreme heat event, loss of human life or health impacts are a greater concern than is property damage.

Vulnerability Assessment Conclusions

While the ability to predict future heat events at the CSU Fresno campus is limited, the effects of climate change may provide some information. According to the Environmental Protection Agency (EPA), central California has warmed about two degrees on average over the last century, with less rainfall. This may lead to stronger heat events, drought, and an increased risk of wildfires.62

Cold

Description of the Hazard

What is considered an excessively cold temperature varies according to the normal climate for that region. However, when temperatures are far below normal, with higher wind speeds, heat leaves the human body more rapidly, which increases the possibility of negative effects from these extreme temperatures.63

The greatest danger from extreme cold is to people, as prolonged exposure can cause frostbite or hypothermia, and can become life threatening. When someone is suffering from hypothermia, body temperatures can become so low that they affect the brain, making it difficult for the victim to think clearly or move well. In the case of frostbite, the frozen tissue becomes numb and the victim may be unaware that anything is wrong until someone else notices.64 This makes hazards from extreme cold particularly dangerous, as people may not understand what is happening to them or what to do about it.

The primary hazards from extreme cold are frostbite and hypothermia. Frostbite is caused by freezing of the skin and underly tissue. It causes a loss of feeling and color in the affected areas of the body, and most often affects the nose, chin, fingers, or toes.65 It can be permanently damaging if not treated promptly and can lead to infection, nerve damage, or amputation in severe cases.66 The risk of frostbite is increased in people with preexisting conditions, the elderly, people with reduced blood circulation, and people who are not dressed warmly enough for the conditions.

Hypothermia occurs when the body loses heat faster than it can produce heat, causing a dangerously low body temperature. A normal body temperature is around 98.6° F. Hypothermia occurs when your body temperature falls below 95° F.67 As this happens,

66 Ibid.
the heart and other essential organs cannot work properly. If hypothermia is not treated, it can lead to heart failure, respiratory failure, and eventually to death.

Excessive or extreme cold can accompany severe winter weather, or it can occur without severe weather. For this reason, extreme cold is a separate hazard from severe winter storms.

Location of the Hazard

Extreme cold events are a non-spatial hazard, and may occur throughout the Fresno State campus.

Extent of the Hazard

Extreme cold has a wide range of extent and severity markers and characteristics. Average nighttime winter temperatures in the City of Fresno typically range from the high 30s to low 40s. According to data from the National Climatic Data Center (NCDC), the lowest daily temperature recorded in Fresno was 18° F on December 23, 1990. Based on hundreds of frost/freeze events and multiple cold/wind chill events as well as five extreme cold/wind chill events from 1996 – present, the planning committee ranks the extent of the hazard as Moderate.

The National Weather Service issues Extreme Cold Warnings when the temperature feels like it is -30° F or colder across a wide area for a period of at least several hours. When possible, these advisories are issued a day or two in advance of the conditions. Although Fresno County has experienced frequent frost/freeze events, and five events defined locally as extreme. Although it has not experienced an extreme cold event as defined by the NWS (above, based on the regional climate and its relationship to the economy, frost/freeze events represent a consistently impactful hazard to the county’s agricultural sector, utility services and the local economy in general. Therefore, the planning committee ranks the extent of the hazard as Moderate to High.

The most common extent/severity marker for extreme cold is the Wind Chill scale. Figure 9-11 (following) depicts the National Weather Service’s methodology for determining the wind chill, using wind speed and actual temperature. Although wind chill is not necessarily related to extreme cold as a single cause, the advisory system that the NWS currently uses relies on wind chill to relay warning and advisory information to the public. Extreme cold severity is a function of wind chill and other factors, such as precipitation amount (rain, sleet, ice, and/or snow).

In 2011, the National Weather Service introduced an experimental program that issued warnings for extreme cold events, independent of other severe weather warnings. The test areas included North and South Dakota and Minnesota. However, in 2012, after a single season of use, the program was abandoned, based on reports of confusion among test audiences.69

History of the Hazard

Based on data gathered from the National Centers for Environmental Information (NCEI) Storm Events Database, Fresno County has had hundreds of frost/freeze events and multiple cold/wind chill events dating back to 2000. [Records for this hazard were first recorded in 1996]. The county has also had five extreme cold/wind chill events, all within the same two-week period in January-February of 2002.

January 16, 2002
January 22 – 23, 2002

January 29, 2002  

February 1, 2002  

Potential Impacts of the Hazard

Should an extreme cold event occur, Fresno State might experience impacts due to cancelled classes.

In addition to the threat posed to humans, extreme cold weather poses a significant threat to utility production, which in turn threatens facilities and operations that rely on utilities, specifically climate stabilization. As temperatures drop and stay low, increased demand for heating places a strain on the electrical grid, which can lead to temporary outages. These outages can impact operations throughout the campus, which can result in interruptions and delays in services. These outages may also negatively impact research efforts throughout the campus, as the inability to maintain a steady, constant temperature may result in unintended effects on research specimens.

Probability of Future Occurrence of the Hazard

The City of Fresno has experienced frequent cold/wind chill/freeze/frost events, and five extreme cold events in 2002. However, these extreme cold events were limited to a single period of time nearly two decades ago Therefore, the probability of freeze/frost events is Highly Likely annually, while more extreme cold events are only Possible on an infrequent basis.

Vulnerability to the Hazard

When dealing with an extreme cold event, the most common impacts are those generally felt by the people living in the targeted area. For people in particular, extreme cold can kill when the body is pushed beyond its limits. Most danger due to the cold is because the victim has been overexposed to low temperatures. As discussed, the major human risks associated with extreme cold include frostbite, hypothermia, and in severe cases, death.

Some portions of the population are more at risk to the effects of extreme cold. The elderly, those with certain preexisting conditions (hypothyroidism, diabetes, and high blood pressure, just to name a few), those with poor blood circulation, and people who are not dressed warmly enough for the cold are generally more vulnerable and are more likely to suffer illness or death as a result.\(^{70}\) This is especially true if exposure is extended for a period of time and preventative measures are not taken immediately.

CSU Fresno is aware of the potential for extreme cold events, and is one of the CSU campuses facing the greatest variance in temperatures.

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\(^{70}\) Cleveland Clinic. *Hypothermia Can Happen Both Indoors and Outdoors.* Retrieved from:  
https://health.clevelandclinic.org/hypothermia-can-happen-indoors-surprising-facts/  

9-65
Estimate of Potential Losses

Based on the previous historical occurrences of extreme cold events, annualized losses are considered to be negligible. In an extreme cold event, loss of human life or health impacts are a greater concern than is property damage.

Vulnerability Assessment Conclusions

While the ability to predict future extreme cold events at the CSU Fresno campus is limited, the effects of climate change may provide some information. According to the Environmental Protection Agency (EPA), areas in central California have warmed approximately 2 degrees on average over the last century, with less rainfall. This may lead to fewer frost/freeze events in the future.71

Identified Data Limitations

Numerous public and private actors conduct research, acquire data and disseminate meteorological information and forecasting to the general public, including the CSU university system. Currently, it is assumed that, apart from regular access to climate change models on changes to temperature extremes over time, the CSU community maintains sufficient access to the data needed to plan for, respond to, and mitigate the effects of extreme heat and cold.

Flood

Description of the Hazard

The incredible geographic diversity in California presents tremendous challenges for flood planning and response. The state is home to extensive mountain ranges such as the Sierra Nevada, Cascades, Klamath, Coastal Ranges, and the Southern California Transverse Range all creating tremendous watersheds. Large river systems drain the mountains traveling through populated communities including the Sacramento and San Joaquin Rivers draining into the California Delta. The state has a complex system of reservoirs, dams, and levees providing water storage and flood protection. Finally, California’s 840-mile coastline exposes the coastal regions to tidal influences.

Floods are characterized by the rising and overflowing of excess water from a water source such as a stream, river, lake, canal, or coastal body onto an area of normally dry floodplain. A floodplain is a lowland area downstream and adjacent to water bodies that are subject to flood events. Flooding is a naturally occurring event that become hazardous when populations and property are affected.

Flooding can result from excessive precipitation from weather systems generating prolonged rainfall, excessive snowmelt from watersheds upstream from the floodplain, infrastructure failure, exceeding the capacity of dams or levees, tidal influences, or a combination from any of the previous factors.

Floods represent one of the costliest and most frequent natural disasters that influences human suffering and economic impact in the United States. Flooding will likely result in significant damage to structures, infrastructure, utilities, landscapes, and the environment. Erosion of stream banks, roadways, other feature may result from the movement of flood waters. The saturated ground resulting from standing flood waters may cause ground instability, collapse, erosion, or other damages. Further, floods will often generate substantial debris that will accumulate and be deposited throughout the flooded areas.

Floods can be either slow-rise or rapid onset floods. With slow rise floods, there is often warning preceding water rise by hours or days before dangerous conditions present themselves. Slow rise floods that are expected to enter into populated areas generally allow for some time to initiate evacuation and sand bagging efforts. Flooding that occurs rapidly conversely are water events that present with extremely limited warning times and a limited ability to take response actions until flooding has already begun to occur.

Flooding may take on different forms:

- **Flash Flooding** – Flash flooding is typically characterized by a rapid rise, short duration, and large volume of water in a localized area. Heavy rainfall in areas that have limited drainage capacities often contribute to flash flooding conditions. These flooding events frequently occur with limited notice requiring immediate evacuation or rapid response efforts such as sand bagging. Flash flooding may arrive with fast moving water creating added hazardous conditions.

- **Riverine Flooding** – Riverine flooding is usually caused by prolonged rainfall or rainfall combined with heavy snowmelt. When soils are already saturated, the ability for the ground to absorb water is minimized. In a riverine flood, the water way exceeds channel capacity and extends into areas outside of the channel, often in developed communities. In California, riverine flooding is most likely to occur from November through April. The duration of riverine floods may vary from a period of hours to weeks.

- **Localized Flooding** – Localized flooding is commonly the result of stormwater drainage systems being overwhelmed by unusually heavy rainfall. These flooding events frequently occur in areas that are urbanized or developed with greater amounts of impervious surfaces not allowing ground absorption. This generates added runoff into the drainage systems and onto roadways creating backups.

- **Infrastructure Failure** – Failures of dams or levees presents a serious flooding concern for areas downstream from the compromised structure. This situation may result in a catastrophic flood with limited warning time and widespread areas affected.
Coastal Flooding – Coastal flooding can occur in multiple areas along the California coastline. Flooding may result from intense storms coming from the Pacific Ocean that generate elevated water levels or storm surge. The size, duration, winds generated, and intensity of the storm will influence the effect the waves will have on the shoreline. Periods of high tide can aggravate the conditions allowing greater wave impingement into coastal areas.

Atmospheric River

California, including the location of this campus, is subject to the effects of a phenomenon referred to as atmospheric rivers. These weather events consist of long, narrow regions in the atmosphere transporting tremendous amounts of water vapor from the tropics. These weather regions behave like rivers in the sky. They can carry heavy volumes of water vapor compared to the amount of water flow at the mouth of the Mississippi River. As these atmospheric rivers arrive into California they tend to generate significant rain and snow.

Atmospheric rivers can arrive in many different shapes and sizes. The larger events are able to generate extreme rainfall amounts resulting in flooding. They can stall over watersheds vulnerable to flooding, often saturated with heavy snow amounts. The atmospheric rivers known as a “Pineapple Express” coming from the tropics and arriving with warmer air may produce heavy rains that will melt ground snow adding to the water volume that will be added in the flood runoff.

These events can produce heavy amounts of precipitation creating extensive damages. However, these events may present as weaker systems that produce precipitation that is enough to be beneficial for the local water supply. At the higher elevations in the California mountains, these events have the potential to generate a tremendous snowpack providing a source of water during the dry summer months.

Figure 9-12: Science Behind Atmospheric Rivers

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72 National Oceanic and Atmospheric Administration, “What are atmospheric rivers?”, https://www.noaa.gov/stories/what-are-atmospheric-rivers
Location of the Hazard

Fresno lies in the heart of the San Joaquin Valley at the base of the Sierra Nevada Mountains. The San Joaquin River, Kings River, and creeks between the rivers have been identified as the primary flood sources for Fresno County. The eastern portions of Fresno County are primarily mountainous terrain of the Sierra Nevada Mountains. The San Joaquin River watershed encompasses 1,720 square miles of drainage above Friant Dam. The watershed receives the majority of its water from snowfall generating 1.86 million acre-feet of surface water fun-off into the San Joaquin River. The Kings River watershed drains an area of 1,544 square miles into the Kings River through southern Fresno County.
The CSU Fresno campus is located 4-5 miles south of the San Joaquin River. The Kings River lies 15 miles to the southeast of the campus. Dry Creek when filled with water drains into the Big Dry Creek Reservoir located 6 miles to the northeast of the campus. Dry Creek continues to drain into a channel that extends through Fresno and Clovis just east of the campus. The majority of the CSU Channel Islands campus sits within a Special Flood Hazard Area (SFHA) Zone X (0.2% of Annual Chance of Flood Hazard) designation on the Flood Insurance Rate Map. The Bob Bennett baseball stadium, Save Mart Center, the Student Recreation Center, and the Save Mart Center parking lot 2 reside in a Zone X: Area of Minimal Flood Risk.

Figure 9-13: Flood Hazard Zones Around CSU Fresno

Extent of the Hazard

The CSU Fresno campus is located mostly in a designated Zone X: 0.2% Annual Chance Flood Hazard. Portions of the eastern and western edges of the campus are located within

a Zone X: Area of Minimal Flood Risk. The access routes into and out of the campus servicing Fresno County locations are found mostly in areas designated as Zone X: 0.2% Annual Chance Flood Hazard. Although comprehensive campus-level flood data is not available, given that 12 Federally Declared flood disasters have occurred in Fresno County over the 31-year period from 1986 - 2017, along with minor annual flood events in winter months, the planning committee ranks the extent of the flood hazard on campus as Moderate.

Another consideration for the ranking is that the CSU Fresno campus lies outside of a levee flood protected area. Levees protect areas at the base of the foothills along the Big Dry Creek flood control system and along the San Joaquin and Kings River systems. This specific hazard does not substantially alter the ability of the campus to maintain operations as the distance to levee protected channels exceeds the protection zones.

In support of the NFIP, FEMA identifies those areas that are more vulnerable to flooding by producing Flood Hazard Boundary Maps (FHBM), Flood Insurance Rate Maps (FIRM), and Flood Boundary and Floodway Maps (FBFM). Several areas of flood hazards are commonly identified on these maps, including the 1% annual chance flood zone. Flood zones are further delineated by risk and are assigned a letter signifier. The flood zone designations are defined and described in the following table.

Table 9-19: Flood Zone Designations and Descriptions

<table>
<thead>
<tr>
<th>Zone Designation</th>
<th>Percent Annual Chance of Flood</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Zone V</td>
<td>1%</td>
<td>Areas along coasts subject to inundation by the 1% annual chance of flooding with additional hazards associated with storm-induced waves. Because hydraulic analyses have not been performed, no BFEs or flood depths are shown.</td>
</tr>
<tr>
<td>Zones VE and V1-30</td>
<td>1%</td>
<td>Areas along coasts subject to inundation by the 1% annual chance of flooding with additional hazards associated with storm-induced waves. BFEs derived from detailed hydraulic analyses are shown within these zones. (Zone VE is used on new and revised maps in place on Zones V1-30.)</td>
</tr>
<tr>
<td>Zone A</td>
<td>1%</td>
<td>Areas with a 1% annual chance of flooding and a 26% chance of flooding over the life of a 30-year mortgage. Because detailed analyses are not performed for such areas, no depths or base flood elevations are shown within these areas.</td>
</tr>
</tbody>
</table>
Zone AE 1% Areas with a 1% annual chance of flooding and a 26% chance of flooding over the life of a 30-year mortgage. In most instances, base flood elevations derived from detailed analyses are shown at selected intervals within these zones.

Zone AH 1% Areas with a 1% annual chance of flooding where shallow flooding (usually areas of ponding) can occur with average depths between one and three feet.

Zone AO 1% Areas with a 1% annual chance of flooding, where shallow flooding average depths are between one and three feet.

Zone X (shaded) 0.2% Represents areas between the limits of the 1% annual chance flooding and 0.2% chance flooding.

Zone X (unshaded) Undetermined Areas outside of the 1% annual chance floodplain and 0.2% annual chance floodplain, areas of 1% annual chance sheet flow flooding where average depths are less than one (1) foot, areas of 1% annual chance stream flooding where the contributing drainage area is less than one (1) square mile, or areas protected from the 1% annual chance flood by levees. No Base Flood Elevation or depths are shown within this zone.

History of the Hazard

Flooding in Fresno and the broader Fresno County region have typically occurred during the winter months when Pacific storms are more common. The occurrences of significant flooding typically have been the result of successive intense storms with heavy precipitation. The region has experienced flood events that have caused tens of millions of dollars in damages and numerous fatalities. The following provides insight into information of past flooding events that are significant to the CSU Fresno campus.
### Table 9-20: Historic Flooding Events in Fresno County

<table>
<thead>
<tr>
<th>Date</th>
<th>Event</th>
<th>Declaration</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>February 1986</td>
<td>Flood; Winter Storms</td>
<td>DR-758-CA</td>
<td>Countywide</td>
</tr>
<tr>
<td>January 1993</td>
<td>Flood; Winter Storms</td>
<td>DR-979-CA</td>
<td>Countywide</td>
</tr>
<tr>
<td>January 1995</td>
<td>Flood; Heavy Rains</td>
<td>State</td>
<td>Countywide</td>
</tr>
<tr>
<td>March 1995</td>
<td>Flood; Heavy Rains</td>
<td>DR-1046-CA</td>
<td>Countywide</td>
</tr>
<tr>
<td>January 1997</td>
<td>Flood</td>
<td>DR-1155-CA</td>
<td>Countywide</td>
</tr>
<tr>
<td>February 1998</td>
<td>Flood; Winter Storms</td>
<td>DR-1203-CA</td>
<td>Countywide</td>
</tr>
<tr>
<td>December 2005</td>
<td>Flood; Winter Storms</td>
<td>State</td>
<td>Countywide</td>
</tr>
<tr>
<td>April 2006</td>
<td>Flood; Heavy Rains; Snowmelt</td>
<td>State</td>
<td>Countywide</td>
</tr>
<tr>
<td>October 2007</td>
<td>Flood; Heavy Rains</td>
<td>Local</td>
<td>Fresno</td>
</tr>
<tr>
<td>December 2007</td>
<td>Heavy Rains; Winter Storms</td>
<td>Local</td>
<td>Fresno</td>
</tr>
<tr>
<td>December 2010</td>
<td>Flood; Heavy Rains</td>
<td>Local</td>
<td>Fresno</td>
</tr>
<tr>
<td>February 2017</td>
<td>Flood; Winter Storms</td>
<td>State</td>
<td>Countywide</td>
</tr>
</tbody>
</table>

### Potential Impacts of the Hazard

A flood will potentially result in extensive amounts of water entering onto developed areas. The force and volume of water that is generated by a flood may cause extensive structural damage in areas subject to standing or moving water. The effects of flooding may spread over significant distances covering large areas of land. The extent of the impacts would vary based on a number of factors such as the volume of water flooding, the time of the flood event, the amount of warning provided, the location and extent of the flood boundary, facility elevation, and distance from the flood source. Potential impacts resulting from flooding include:

- Injuries or loss of life
- Property destruction or damage
- Loss of property contents
- Infrastructure damage including roadways, bridges, other transportation means

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74 Fresno County Multi-Hazard Mitigation Plan, April 2018
- Public health hazards resulting from mold, mildew, and disease due to flood water
- Flooded or destroyed lifelines/supply routes
- Damaged or destroyed utilities
- Loss of community economic base
- Employment losses
- Agricultural (crops and livestock) damages or destruction
- Environmental damage
- Prolonged periods of necessary dewatering
- Flooding erosion may alter natural drainage channels
- Societal and community impacts
- Psychological impacts of impacted populations
- Disruptions to education delivery to community

Additionally, individuals who are unable to evacuate in time or refused to leave will likely need assistance or rescue from the flooded area. Remaining in or being trapped by flood waters places individuals in significant risk of injury or death. The impacts extend beyond the danger placed upon the affected individual and places greater resource demands on agencies and organizations making efforts to rescue trapped individuals.

**Probability of Future Occurrence of the Hazard**

Fresno County is determined to be at high risk of flooding for events less than 100-year flood events and moderate risk of 100-year flood events. However, the location of the CSU Fresno campus within a Zone X Flood Hazard Zone (Area of Minimal Flooding) demonstrates that the probability of future occurrence for flooding on campus is Unlikely on an annual basis, but Possible over the long term.

**Vulnerability to the Hazard**

The CSU Fresno campus is subject to the effects of small-scale, isolated flooding or ponding resulting primarily from localized flooding from excessive precipitation and isolated strong storms. There is a more remote potential for flooding and damage on campus and surrounding residential and commercial areas of Fresno due to overflow or damage to flood control systems such as the Big Dry Creek System. The flood control channels and drainage systems that surround the campus have limited storage or volume capacities.

Vulnerability to flooding on the CSU Fresno campus will vary depending on when the flood were to occur and the location of people or assets located within any low lying areas. The risk to the campus population will be lessened during periods when classes are not in session or during periods of breaks. Conversely, during the days and hours that classes are in session and staff are at their workplaces, the human vulnerability increases. Members of the campus community may become trapped on campus depending on the level of flooding occurring on surface streets. However, in region-wide events this
vulnerability may be extended to the homes and workplaces of members of the campus community and their families.

CSU Fresno is in proximity to agricultural facilities, including CSU Fresno operated facilities, supporting the planting of crops and management of livestock. When these facilities are inundated with flood water, the potential for release of contaminants, fertilizers, and other chemicals exists presenting possible exposures to individuals from the campus community. These facilities additionally surround the Fresno community as agriculture plays a dominant role in the region.

Some campus buildings and infrastructure in low lying areas might be vulnerable to large-scale flooding if it reaches the university. Campus utilities and communication capabilities could be impacted by flood waters rendering them disabled. A flood covering a large portion of the city might affect communication capabilities well beyond the boundaries of the campus. Remaining flood waters will leave behind molds and other health concerns in affected campus buildings and facilities likely requiring extensive restoration or demolishing. The residents of the on-campus residence halls, if located in low lying area, may have transportation limitations requiring evacuation and alternative housing procedures to be implemented if populated. In such areas, flood waters may result in damage to campus equipment, communication systems, protected documents, artwork, academic materials, computer systems, research, and other critical activities on lower levels of buildings.

Certain campus populations will experience greater challenges to a post-flood / failure environment. Vulnerable populations will likely need to navigate through flood generated debris, face extreme health safety issues from flood waters, experience extreme stresses of a disaster, an inability to communicate to or gain access to support networks, and find difficulty in accessing equipment or supplies to aid in a specific need.

Estimate of Potential Losses

Estimates of potential losses will be influenced by a variety of factors. The volume and force of the water will determine the scale of damages affecting campus infrastructure, equipment, and other impacted features. The location and elevation above flood waters will affect the level of damage and individuals exposed. The time of the academic year, the day of week, and hour in which the flooding was to occur will influence the number of people on campus and potential casualties. The severity of the storms producing precipitation, the speed of the storms moving across the area, the level of snowpack in the higher elevations, and amount of resulting snowmelt will produce varying effects on damages produced and costs incurred. Losses will be generated by the physical damages, the loss of revenue, loss of academic research, loss of building contents, and community wide economic reductions.

Based on estimate replacement costs of facilities and structures on campus, the maximum total replacement costs due to flood are $395,965,157. However, it is unlikely for flood to cause destructive losses to the entire campus.

Table 9-21: Special Flood Hazard Area (SFHA) Estimated Losses
<table>
<thead>
<tr>
<th>Zone Designation</th>
<th>No of Buildings</th>
<th>Maximum Replacement Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Zone V</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Zone VE &amp; V 1-30</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Zone A</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Zone AE</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Zone AH</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Zone AO</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Zone X .2%</td>
<td>113</td>
<td>$377,065,205</td>
</tr>
<tr>
<td>Zone X Minimal Risk</td>
<td>3</td>
<td>$18,899,952</td>
</tr>
<tr>
<td>Not in a SFHA</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>No Building Value Data Provided*</td>
<td>10</td>
<td>Unknown</td>
</tr>
</tbody>
</table>

*Buildings with no value defined are also included in the respective Zones they are found in.

Vulnerability Assessment Conclusions

While the campus is located in an area of minimal flood potential (Zone X), the primary vulnerabilities to flood on campus are people and assets in low lying areas exposed to mostly localized flooding and ponding from overflow of campus creeks or low probability, large-scale storms that produce heavy amounts of precipitation directly over the campus and surrounding neighborhoods. The proximity to the Dry Creek further presents an additional flood hazard risk factor for the campus.

As discussed above, those factors creating the potential for flooding on campus and in the surrounding area generates the potential for a number of cascading effects such as disruptions to the local economy, utility failures, disruptions to providing for the needs of the campus community, and development of public health hazards. These effects would be exacerbated by effects of seasonal flooding, ongoing heavy precipitation, or excessive run-off from the watershed contributing to the river system. The potential for widespread flooding and damage of structures due to the force of water, while unlikely, has exponentially powerful impacts on particular segments of the campus community including those with access or functional needs, international students, the homeless, and students residing in the residence halls.

Identified Data Limitations

Missing campus structural replacement costs and complete inventory of building construction features or mitigation efforts to lessen the impact due to flood inundation.
HAZUS generated analysis is focused on the broader community level versus finetuning the analysis to the micro-level for facilities such as a university campus.

**Hazardous Materials**

Description of the Hazard

A hazardous material is defined in California’s State Hazardous Materials Incident Contingency Plan (1991) as “a substance or combination of substances which, because of quantity, concentration, physical, chemical, or infectious characteristics may: cause, or significantly contribute to an increase in deaths or serious illnesses; and/or pose a substantial present or potential hazard to humans or the environment. Hazardous materials are one or more of the following: flammable, corrosive or an irritant, oxidizing, explosive, toxic (poisonous or infectious), thermally unstable or reactive, or radioactive. Hazardous materials are ubiquitous in modern society and may be found at all stages of production, consumption, and disposal.”

Federal and state laws permit the intentional release of some hazardous materials into the environment such that the risk to human health and the environment is thought to be acceptable. However, sometimes releases are unintentional, resulting from leaks, accidents, or natural hazards. This section focuses on such accidental releases and fall into the following key categories:

**Fixed Hazardous Materials Incident**

A fixed hazardous materials incident is the accidental release of chemical substances or mixtures during production or handling at a fixed facility.

**Transportation Hazardous Materials Incident**

A transportation hazardous materials incident is the accidental release of chemical substances or mixtures during highway, waterway or air transport. Populations, built and natural environments are potentially impacted.

**Pipeline Incident**

A pipeline transportation incident occurs when a break in a pipeline creates the potential for an explosion or leak of a dangerous substance (oil, gas, etc.) possibly requiring evacuation. An underground pipeline incident can be caused by environmental disruption, accidental damage, or sabotage. Incidents can range from a small, slow leak to a large rupture where an explosion is possible. Inspection and maintenance of the pipeline system along with marked gas line locations and an early warning and response procedure can lessen the risk to those near the pipelines.

Hazardous materials can also be classified according to worker safety and health. Information provided by California Division of Safety and Health includes guidelines related to:

75 2018 State of California Hazard Mitigation Plan, section 9.2
- **Safety hazards** (fire and fire byproducts, electricity, flammable gases, unstable structures, demolition, sharp or flying objects, excavations)
- **Health hazards** (carbon monoxide ash, soot and dust; asbestos; hazardous liquids; other hazardous substances; heat illness)

**Natural-Technological Incidents (Natechs)**

During the past two decades, increasing attention has been given to hazardous materials releases resulting from *Natechs* or a natural disaster event that triggers a technological hazard event. As pointed out by Lindell and Perry (1996), Young, Balluz, and Malilay (2004), and Steinburg, Sengul, and Cruz (2008), natechs are of particular concern for the following reasons:

- They can produce a simultaneous effect on many industrial facilities
- Can overwhelm response capacity
- Containment systems may fail
- May produce cascading disasters
- Response may be hindered by a disaster’s impact on the physical environment

**Location of the Hazard**

Hazardous materials and infrastructure such as fuel tanks, rail lines, chemicals, hazardous waste sites and gas pipelines to varying degrees are located within the CSU system and/or within its surrounding communities. The planning committee indicates that chemicals are located in the science lab, but otherwise no known hazardous materials are present on campus. At larger scales (beyond the campus planning area) hazardous materials and infrastructure are located throughout the city and county of Fresno, and reflect different types, configurations and scales dispersed across these geographic areas.

**Extent of the Hazard**

There is no comprehensive statewide vulnerability assessment available at this time. As such, the true extent of the hazardous materials risk in California and its communities is not known, meaning no overarching conclusions have been reached which have been able to integrate all qualitative and quantitative risk factors to produce a comprehensive measure of the extent of the hazard.

However, for the CSU – Fresno planning committee, although small chemical spills have taken place on campus, and hazardous materials are limited to chemicals in the science building, gas pipelines and hazardous waste sites are located close to the campus. Based on these factors along with the types and levels of hazardous materials in the larger community, it is prudent to rank the extent of the hazard for the CSU – Fresno campus as Moderate, and to consider worst case scenarios as the main driver of policy in order to fully mitigate all possible hazardous materials event outcomes.

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76 California Department of Industrial Relations. Worker Safety and Health During Fire Cleanup. Retrieved on 06.16.2021 from: [http://www.dir.ca.gov/dosh/wildfire/Worker-Health-and-Safety-During-Fire-Cleanup.html](http://www.dir.ca.gov/dosh/wildfire/Worker-Health-and-Safety-During-Fire-Cleanup.html)

77 2018 State of California Hazard Mitigation Plan, section 9.2
For example, according to the 2018 CA State Hazard Mitigation Plan, 400 hazardous materials problems are tied to 32 past earthquakes, including over 150 problems from the Loma Prieta Earthquake alone. That said, the plan indicates that it is likely that many such hazardous materials releases have received little attention in the past because public authorities, the media, and the public have overlooked them in the rush to address and recover from immediate disaster threats, and that responsible parties may have an incentive to understate the extent of releases or not to report them at all.

History of the Hazard

According to the CA Governor’s Office of Emergency Services’ Hazardous Materials Spill Report, the state experiences from 10 to 30 spill events daily. As of April 20th, 2021 already 2096 spill events had occurred. Such events have occurred in all the cities and/or counties where CSU campuses are located.78

According to the 2018 CA State Hazard Mitigation Plan, with regard to natural-technological hazard events (Natechs), 400 hazardous materials events are tied to 32 past earthquakes, including over 150 Natech events from the Loma Prieta Earthquake alone.

For more details on specific hazmat events, please refer to the local, county and/or multi-jurisdictional hazard mitigation plans where CSU campuses are located at: https://www.caloes.ca.gov/cal-oes-divisions/hazard-mitigation/hazard-mitigation-planning/local-hazard-mitigation-program

According to the campus planning committee, small chemical spills have taken place on the CSU – Fresno campus but did not result in the need for evacuation.

Potential Impact of the Hazard

A large hazardous materials release could affect an entire community or city under certain conditions related to direction of air flow (air-based chemical release) and population density or the contamination of a community’s main water supply. Either type of release could necessitate large scale evacuation. By contrast, in the rural unincorporated areas where population densities are low, even in the event of a large release, the number of homes that may need to be evacuated would be significantly lower than in an urban environment. The occurrence of a hazmat incident can also result in the shut-down of transportation corridors which can last for hours at a time while the impacted area is stabilized.

The release of some toxic gases may cause immediate death, disablement, or sickness if absorbed through the skin, injected, ingested, or inhaled. Contaminated water resources become unsafe and unusable, depending on the amount of contaminant. Some chemicals cause painful and damaging burns if they come in direct contact with skin.

Prolonged and concentrated exposure to such chemicals can produce severe long-term impacts to respiratory, endocrine and nervous systems, heart and brain health.

The potential impacts of chemicals and toxic gases discussed here also apply to the students, staff and environment on the CSU – Fresno campus.

With regard to the natural environment overall, contamination of air, ground, or water may result in harm to fish, wildlife, livestock, and crops. The release of hazardous materials into the environment may cause debilitation, disease, or birth defects over a long period of time. Loss of livestock and crops may lead to economic hardships within the community.

Recent California examples include the 2016 Aliso Canyon methane gas leak, which caused evacuation of nearby residents, many of whom experienced temporary health problems such as difficulty breathing and eye irritation; and the 2016 Fruitland metal recycle plant fire in Maywood, which released heavy metals such as lead, magnesium, copper, aluminum, antimony, calcium, iron, sulfur, tin, potassium, and zinc which pose severe risks to public health. Health effects from exposure to these metals included short-term symptoms such as irritation to the eyes, nose, throat, and lungs.

Potential Impact of the Hazard

Natural disasters, including earthquake, flood, and fire also pose risks to public health and the environment. For example, following the Northridge Earthquake, California State University (CSU) Northridge laboratories and chemical storage rooms experienced multiple chemical spills. Such incidents, triggered by a natural disaster, pose a significant risk to students, faculty, staff, and first responders. At a minimum, all CSU campuses with a science lab (including CSU – Fresno) is at risk of potential impact from a natural-technological (combined impact) event.

In a severe flood event, floodwaters are often contaminated with hazardous materials posing a threat to public and animal health, groundwater, and other parts of the environment. These hazardous materials may be released from damaged or flooded underground tank sites (e.g., gas stations or chemical storage facilities), propane tanks, manure or human waste handling facilities, fertilizer and pesticide storage, agricultural sites, and household hazardous waste.

In a fire event, (such as the October 2017 Northern California firestorms which destroyed approximately 6,000 residences) entire neighborhoods can be burned to the ground. Hazardous material release creates public health concerns which can delay the initial steps of fire recovery, including reopening burned areas to residents and initiating debris removal activities. The post-fire “toxic sweep” poses a risk of coming into contact with toxic substances due to the presence of synthetic and hazardous materials.

79 2018 California State Hazard Mitigation Plan, section 9.2.
80 2018 California State Hazard Mitigation Plan, section 9.2.
Probability of Future Occurrence of the Hazard

The probability of occurrence for a hazmat event on the CSU – Fresno campus can be viewed in two different ways: the history of occurrence serves as a sound predictor of future probability assuming current risk and vulnerability factors remain somewhat constant. For the purposes of the current estimate, no current data clearly indicates otherwise. As such, the probability of occurrence is Moderate because the CSU – Fresno campus has chemicals in the science lab, and it has experienced chemical spills in recent years. That said, hazmat occurrences are largely based on human error, and any changes in risk and vulnerability factors such as a decreased vigilance in materials oversight and handling practices or changes in the amount of chemicals or exposure will likely increase the probability on campus.

Vulnerability to the Hazard

Hazardous materials pose a risk to the CSU – Fresno campus. As identified by the campus planning committee and on the hazmat map, the following vulnerabilities are present on campus: chemicals are present in the science lab, and gas pipelines and hazardous waste sites are fairly close to the campus footprint. Gases and chemicals or hazardous waste, if spilled or released, could severely impact human health and campus operations.

Although it is quite difficult to produce a quantitative measure of vulnerability because (unlike natural hazards) the probability of occurrence is dependent on human error, which itself is variable based upon a fluctuating set of interrelated factors, some of which lack prediction or control, given the complexity of how all natural and built environments and hazmat risks factors interrelate at the local or campus level, it is prudent to assume for planning purposes that the campus’ vulnerability is a sub-set of the larger community’s vulnerability. As such, the CSU – Fresno leadership maintains vigilance to mitigate the campus’ vulnerabilities identified above at a minimum.

Estimate of Potential Losses

As discussed previously, it is difficult if not impossible to produce an accurate quantitative measure of vulnerability because of the variable nature of a hazardous materials spill. For example, the release of a toxic airborne chemical in a populated area has severe impact potential, whereas the impact potential of a small chemical spill in a remote or rural area is most likely limited to remediation of soil. And, in both cases, the probability of occurrence is dependent on human error, which itself is variable based upon a fluctuating set of interrelated factors, some of which lack prediction or control. In all cases, different types and amounts of hazardous materials interact with fluctuating combinations of human error to produce different event outcomes with variable impact costs.

Vulnerability Assessment Conclusions

It is well understood that with regards to hazmat vulnerability, each campus and its surrounding community (including CSU – Fresno) operates through a complex and dynamic interaction between industrial and commercial inputs and outputs and the
natural and built environment. Such activity produces hazardous materials that move through the environment along both convergent and divergent routes and across all levels of land-use from site to campus to city and county and beyond. It is also clear from a review of the Fresno County hazard mitigation plan and Cal OES’ records of hazardous material spills, that such events occur with great frequency and varying degrees of severity across jurisdictions statewide. As such, in assessing the vulnerability of the CSU – Fresno campus, campus-level risks and vulnerabilities are not discreet or isolated but can become exacerbated or augmented through connections to broader community-level hazmat risks and vulnerabilities.

Finally, in order to draw conclusions on vulnerability, it should be noted that any identified vulnerabilities at the campus level and/or community level are circumscribed and potentially reduced by targeted policy and program interventions. Numerous policies and programs have been established in recent years in response to California’s widespread and complex and integrated hazardous materials risks - California established the Unified Program which consolidates and integrates the administrative requirements, permits, inspections, and enforcement activities of the following environmental and emergency response programs: the Aboveground Petroleum Storage Act (APSA) Program, Area Plans for Hazardous Materials Emergencies, the California Accidental Release Prevention (CalARP) Program, the Hazardous Materials Release Response Plans and Inventories (Business Plans), Hazardous Material Management Plan (HMMP) and Hazardous Material Inventory Statement (HMIS) requirements (California Fire Code), the Hazardous Waste Generator and Onsite Hazardous Waste Treatment (tiered permitting) Programs, and the Underground Storage Tank Program.

Identified Data Limitations

The CSU – Fresno planning committee has provided information on campus-level hazmat materials and risks. Data limitations pertain to a comprehensive understanding of human activity and error related to materials control over the long term.

Landslide

Description of the Hazard

A landslide is a down-slope movement of soil, rock, or other debris, and can also be referred to as a mass movement or slope failure.81 These geological hazards can range in size from a few feet to over a mile in length and width and, when heavy and rapidly moving, can cause serious damage and loss of life.

Landslides are classified based on the type of material and type of movement involved. They can range from slow-moving earth flows to fast-moving debris flows, though many large slope failures involve more than one type of movement. The primary natural triggers of slope failures are water, seismic activity, and volcanic activity. Slope saturation

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by water can occur from intense rainfall, snowmelt, changes in ground-water levels, and surface-water level changes along coastlines. In winter months, El Nino storms or other high rainfall events may saturate soils and trigger slope failure.

**Deep-Seated Landslides**

Deep-seated landslides, ranging in depth from ten to several hundred feet, occur as a result of geologic and hydraulic changes, such as earthquakes or increased levels of groundwater. These landslides can move slowly or quickly and can cause extensive property damage, but rarely result in loss of life.

**Debris Flows Related to Shallow Landslides**

Shallow landslides may mobilize into rapidly moving debris flows and typically occur after sudden saturation of the ground. These types of debris flows are typically more dangerous because they move rapidly, causing both property damage and loss of life. Debris flows may also occur as a result of post-fire conditions, where wildfires have left barren ground exposed to heavy rainfall. Intense rainfall, generally greater than .5 inch per hour, has the potential to trigger a post-fire debris flow. These landslides may impact lives and properties within the deposition zone and can result in downstream flooding. Post-fire debris flows often occur during the fall and winter following major summer fires.

**Location of the Hazard**

The susceptibility of an area to landslides depends on several variables, including magnitude of slope gradients, water content, ground cover, presence of erosion, and slope material and structure. However, landslides are most prevalent in terrain with weak material and steep slopes, and the highest risk is found in areas with high rainfall or high earthquake potential. Slope failures are also most likely to occur in areas where they have occurred in the past. In California, the most landslide-prone areas are found along the coast and in the northern Franciscan Formation.

General landslide vulnerability can be estimated from the distribution of weak rocks and steep slopes as seen in Figure 9-15. Based on Figure 9-15 (below), the Fresno State campus is located in an area with a very low degree of susceptibility to landslide.

Figure 9-14: CSU-Fresno Landslide Susceptibility

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### Extent of the Hazard

The geographic extent of landslide hazards is limited to foothill and mountain areas and areas where inadequate ground cover accelerates erosion. Those areas have limited population and landslides are not likely to occur in the valley due to its flat topography. However, small slides may occur along steep streambanks in the valley. Additionally, the indirect impacts of landslides in the region may cover a larger geographical extent. Based on the campus’ location in a low-risk landslide hazard zone, and no history of impacts on or near the campus, the planning committee ranks the extent of the landslide hazard for the campus as **Low**.

### History of the Hazard

FEMA declared two major disasters involving landslides, mudslides, or mud flows in Fresno County in 1993 and 1995. NOAA recorded 24 occurrences of debris flow in Fresno County from 2005 to 2019. Several of these occurred in the Southern Sierra Nevada foothills. No landslides have occurred on the campus.

### Potential Impacts of the Hazard
CSU Fresno may be impacted by the disruption of services as a result of landslides in the region. Landslides can result in physical damage to buildings and property and have the potential to significantly affect infrastructure. As a landslide moves, it distresses structural foundations by settlement, cracking, and tilting. Fast-moving flows can remove entire structures in one instance, while other types of flows can cause damage gradually.

Transportation and utility infrastructure are particularly vulnerable to landslides, since the failure of any component can disrupt service over a large area. The loss of power and communication and disruption of transportation can have cascading effects throughout an area, including impaired disposal of sewage, contamination of water supplies, and the release of flammable fuels. Transportation routes are also often expensive to clean up, and prolonged obstruction can disrupt the movement of people and goods for long periods of time.

**Probability of Future Occurrence of the Hazard**

Slope failures are also often triggered by other natural hazards such as heavy rainfall or earthquakes, so landslide frequency is somewhat related to the frequency of these other hazards. As climate change impacts the frequency and intensity of triggers such as rain events, fires, and coastal erosion, landslides may generally occur more often. Historically, landslides have occurred infrequently in the City Fresno and, therefore, are not likely to occur in the future. Given the location of the campus in a low-risk zone, landslide zone, and the infrequent occurrence of landslides in Fresno, the planning committee ranks the probability of the landslide hazard for the campus as **Unlikely**.

**Vulnerability to the Hazard**

The vulnerability of the built environment to landslides depends on exposure and is more likely to incur damage as a result of proximity, rather than inferior structural design. The structures most vulnerable to landslides are buildings and utility/transportation lifelines, which can be impacted by either impact or ground deformation. Utilities and transportation infrastructure are particularly vulnerable, due to their geographic extent and susceptibility to physical distress. The Fresno State campus exhibits very few, if any, building and infrastructure or transportation route vulnerabilities due to its location. See the landslide location map in relation to the campus along with landslide severity zones identified.

Any population proximal to a landslide when it occurs is vulnerable to its impacts.

**Estimate of Potential Losses**

There are no current models for estimating potential losses from a landslide directly impacting the campus.

Although the economic impact of landslide damage can exceed that of the direct repair costs, there are currently no applicable methods for estimating indirect costs related to CSU Fresno.

**Vulnerability Assessment Conclusions**
Landslides are not likely to impact the campus, though indirect impacts to campus transportation and utilities are possible. Utility outages can impact health, particularly for vulnerable populations, and can cause interruptions in operations. Interruptions may impact student and employee’s ability to travel to campus and the delivery of classes and events.

**Identified Data Limitations**

The ability to predict future landslides at the CSU Fresno campus is limited. However, the USGS estimates that climate change-induced shifts in weather will increase the frequency of post-wildfire landslides, which are expected to occur almost every year in California.84

**Power Outage**

**Description of the Hazard**

The City of Fresno is a large community located in Fresno County that lies at the center of the San Joaquin Valley, the southern region of the Central Valley of California. The city has become an economic hub of Fresno County and the San Joaquin Valley, with much of the surrounding areas in the Metropolitan Fresno region predominantly tied to large-scale agricultural production, much of which relies on electrical power.

Most aspects of modern life, rely on the near-continuous availability of utilities, such as electricity, water, and natural gas. Fresno State University is located in the fifth most populated city in California. An interruption in the supply or distribution of these services can leave highly populated areas, like Fresno, without basic services, such as electricity or sanitation. These interruptions can produce cascading effects from other hazards, such as major windstorms, leading to intentional disruptions of transmission lines due to safety concerns.

Fresno State can be affected by a power outage event and disrupt day-to-day operations of the campus, like in-person classes, impede or limit digital, telephonic or radio communications, create traffic jams around the campus’s thoroughfares and boulevards surrounding the campus. Additionally, impacts can occur to the surrounding campus community by forcing temporary closures of businesses and community resources.

Overall, a severe outage to Fresno County or the City of Fresno would directly affect the campus and the community creating social, economic and (potentially) health and safety impacts.

An electric power disruptions and outages fall into two categories: *intentional and unintentional*.

The four types of intentional disruptions:

- Planned: Some disruptions are intentional and can be scheduled based on maintenance or upgrading needs.
- Unscheduled: Some intentional disruptions must be done "on the spot" in response to an emergency.
- Demand-Side Management: Some customers (i.e., on the demand side) have entered into an agreement with their utility provider to curtail their demand for electricity during periods of peak system loads.
- Load Shedding: When the power system is under extreme stress due to heavy demand and/or failure of critical components, it is sometimes necessary to intentionally interrupt the service to selected customers to prevent the entire system from collapsing. These intentional interruptions result in rolling blackouts.

Unintentional or unplanned disruptions are outages that come with essentially no advance notice or warning. This type of disruption is the most problematic. The following are categories of unplanned disruptions:

- Accident by the utility, utility contractor, or others.
- Malfunction or equipment failure.
- Equipment overload (utility company or customer).
- Reduced capability (equipment that cannot operate within its design criteria).
- Tree contact other than from storms.
- Vandalism or intentional damage.
- Weather, including lightning, wind, earthquake, flood, and broken tree limbs taking down power lines.
- Wildfire that damages transmission lines.

Location of the Hazard

Although power outages can take place within a certain area, as a hazard, it has the potential to occur and affect the entire planning area equally.

Extent of the Hazard

In order to anticipate outage conditions and reduce impacts, campus facility managers and others keep track of conditions and data provided by the media, municipal utilities, and the California Independent System Operator (CAISO) is tasked with managing the power distribution grid that supplies most of California, except in areas served by municipal utilities. CAISO is thus the entity that coordinates statewide flow of electrical supply. CAISO uses a series of stage alerts to the media based on system conditions. The alerts are:

- Stage 1 - reserve margin falls below 7 percent.
- Stage 2 - reserve margin falls below 5 percent.
- Stage 3 - reserve margin falls below 1.5 percent.

Rotating blackouts become a possibility when Stage 3 is reached. Utility agencies aim to advise affected areas approximately 48 hours in advance of a potential PSPS event and will attempt notification again approximately 24 hours before power is shut off. Campus staff respond accordingly. Given the prevalence of rolling blackouts and other power outages in California, the campus maintains safety precautions, situational awareness, access to emergency power generators and other protocols for managing campus power outages. However, given that recorded outages have taken place on campus, the planning committee ranks the extent of the power outage hazard as **Moderate**.

**History of the Hazard**

Fresno State University has experienced power outages for various reasons. The university worked with the community’s local electric utility company to restore energy to the campus for its facilities, assets, resident halls, and classrooms. The following are examples of power outage events experienced over the last 8 years:

- **May 15, 2015;** Fresno State University experienced a power outage. Commencement ceremonies scheduled for that evening took place as scheduled at 6pm.
- **April 15, 2016;** A windstorm early in the morning caused power outages throughout the area, including Fresno State University. The campus remained open and continued to operate. The power outage affected multiple buildings on campus including Student Housing Complex, Chisholm Hall, Monterey Hall, Matador Bookstore, Klotz Student Health Center, Valley Performing Arts Center, Cypress Hall, Nordhoff Hall, Manzanita Hall, Santa Susana Hall, parking lots/structures B1, B2, B3, G3, as well as KCSN. Students in affected areas were able to report to class for further instruction, and employees report to their department.
- **October 6, 2016;** A power outage affected Sierra Hall, Redwood Hall, Manzanita Hall, and the Oviatt library. The power outage was not unique to the University. The Fresno community was affected by the power outage.
- **2013;** Power supply issue occurred over Winter Break. Campus only closed 1-day due to time of year. Vulnerable to rolling blackouts.

**Potential Impacts of the Hazard**

Residents, commerce, and government infrastructure rely on electricity for basic survival and operations. During a widespread power failure, it may take days to restore operations. Electrical power most likely is the only cooling source for many individuals around the campus and its community, and long-term outages can potentially put people’s health and life at risk. Disruptions in the supply of heating fuel may put people...
and property at risk during extremely cold weather if it relies on electric generation or heating mechanisms instead of gas. Additionally, many medical devices, communications devices, and security rely on power to maintain their functions.

**Climate Change and Energy Shortage**

Climate change is expected to bring more frequent and intense natural disasters. These changes have created a variability at a rate that makes historical data a poor predictor of future climate. For example, the warmest years on record in California occurred in 2014, 2015, and 2016. The 2016-2017 year broke the record as the wettest ever recorded in the northern Sierra Nevada Mountains.

Changes in temperatures, precipitation patterns, extreme events, and sea-level rise have the potential to decrease the efficiency of thermal power plants and substations, decrease the capacity of transmission lines, render hydropower less reliable, spur an increase in electricity demand, and put energy infrastructure at risk of flooding.

With climate warming, higher costs from increased demand for cooling in the summer are expected to outweigh the decreases in heating costs in the cooler seasons. Hotter temperatures in California will mean more energy (typically measured in “cooling-degree days”) needed to cool homes and businesses both during heat waves and on a daily basis, during the daytime peak of the diurnal temperature cycle. During future heat waves, historically cooler coastal cities (e.g., San Francisco and Los Angeles) are projected to experience greater relative increases in temperature, such that areas that never before relied on air conditioning will experience new cooling demands.

Secondary impacts of energy shortages are most often felt by vulnerable populations. For example, those who rely on electric power for life-saving medical equipment, such as respirators, are extremely vulnerable to power outages. Also, during periods of extreme heat emergencies, the elderly and the very young are more vulnerable to the loss of cooling systems requiring power sources.

**Probability of Future Occurrence of the Hazard**

The probability of California experiencing a power outage can be difficult to quantify but is a hazard that occurs yearly during the same seasonal periods of temperature variance throughout the calendar year. That said, 4 recorded power outage events took place on campus in eight years (2013-2021). As such, the probability ranking for the campus is **Likely**.

However, climate models suggest summer global temperatures are likely to increase while changes between temperature extremes would be more pronounced. As such, it is expected that power outages will occur more frequently in the future.

**Vulnerability to the Hazard**

Based on the data available, and in consideration of the increasing effects of climate change, the campus remains vulnerable to power outages in terms of impacts to people, power infrastructure and campus operations.
A power outage could affect the entire area of the campus, including the Fresno State athletic fields, classrooms resident halls, administrative offices, virtual, telephonic and radio communications, and loss of lighting in campus parking structures, creating a cascading hazard for commuters as they depart from or arrive to campus in the evening. Additionally, the university is located within proximity of highly utilized thoroughfares for the transportation of goods to Northeast California, Northern California and down to Southern within one of the busiest areas of the Valley. A power outage would create traffic hazards around the exterior of the campus and the Sierra National Forest via Highway 168, and Sequoia and Kings Canyon National Parks via Highway 180.

Nonetheless, as discussed campus leadership works to reduce vulnerabilities through consistent use of safety and operational protocols and emergency power sources to ensure it is able to mitigate an interruption to electrical power.

**Estimate of Potential Losses**

The data provided by Fresno State does not report any value for potential losses due to power outage.

**Vulnerability Assessment Conclusions**

The primary concern for campus leadership is that a loss of power can lead to potential hazards to students, faculty, and staff at Channel Islands. Safety and operations protocols center on the following “direct impact” set of concerns:

Elevators, entry ways, air filtration systems and lighting provide the campus community with the necessary infrastructure and systems to function and navigate through the campus and, to maintain a safe campus environment and visibility during nighttime hours. The vulnerable population (especially students with physical disabilities) may be the most heavily affected by loss of power as they rely on elevators, entry ways with automatic doors, and locks and lights may impede on a disabled student’s ability to travel and utilize the campus and its structures safely.

The use of communication devices, billing, records, and electrical tools may also become unusable due to a loss of electricity. Many records and billing items may have to revert to “by-hand” procedures and paper copies may be needed for continuity of operations. Additionally, classrooms may not be usable if lighting equipment is not functioning impacting a semester or quarter’s progress for the academic year.

**Identified Data Limitations**

Fresno State did not report any monetary or life losses due to a power outage. Also, the campus did not report any incidents involving a power outage directly affecting the campus community and operations.
**Volcano (Associated Air Quality)**

**Description of the Hazard**

The US Geological Service defines volcanoes as “openings or vents where lava, tephra (small rocks), and steam erupt on to the Earth’s surface. Through a series of cracks within and beneath the volcano, the vent connects to one or more linked storage areas of molten or partially molten rock (magma). This connection to fresh magma allows the volcano to erupt over and over again in the same location”.

A volcanic eruption occurs when magma, lighter than surrounding rock, is driven upwards by its buoyancy and by pressure from the dissolved gases contained within it. Gases are released from magma as it reaches the surface and pressure decreases. Magma can be erupted in several ways and violent eruptions typically cause tiny pieces of tephra (ash) to be carried away by the wind. This ash is hard, does not dissolve in water, is extremely abrasive and mildly corrosive, and conducts electricity when wet.

The gases released in an eruption include carbon dioxide, sulfur dioxide, hydrogen sulfide, and hydrogen halides. Depending on their concentration, these are potentially hazardous to people, animals, agriculture, and property.

**Location of the Hazard**

There are eight volcanic areas located throughout California. Seven of these - Medicine Lake Volcano, Mount Shasta, Lassen Volcanic Center, Clear Lake Volcanic Field, Long Valley Volcanic Region, Coso Volcanic Field, and Salton Buttes – are considered active volcanoes. A significant portion of Fresno County is located within a volcanic hazard zone.

**Extent of the Hazard**

Volcanic hazards are most severe within a few miles of the volcano vent and the severity generally decreases with distance. Ash impact zones can range from tens to hundreds of miles from the vent source. The US Geological Survey has estimated zones surrounding active volcanoes wherein 2 inches or more of ashfall following an eruption is possible. A significant portion of Fresno County is within the Long Valley volcanic hazard zone and ashfall may directly or indirectly impact CSU Fresno. As such, the planning committee ranks the extent of the hazard for the campus as **Moderate**.

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Volcano Hazard Zones in California
Dashed lines enclose areas where 2 inches or more of ashfall are possible. Hazard maps are dynamic and updated periodically as research adds new information.87

History of the Hazard
No historical eruption events in California have affected the campus. The most recent volcanic eruption in California occurred at Lassen Peak about 100 years ago. Historically, there have been few losses from volcanic eruptions in the state.

Potential Impacts of the Hazard
The specific impacts vary widely and depend on which type of volcano erupts, the style of explosion, the volume of lava, the eruption duration, and the local water conditions. As CSU Fresno is not proximal to an active volcano, only the potential impacts of ashfall and

gases have been detailed. While both these hazards can be widespread, their most severe impacts are generally seen closer to the volcanic source.

Although ashfall is typically a nonlethal volcanic hazard, it is the most widespread and disruptive. Falling ash can damage crops, electronics, and machinery. It can also impact human health by irritating the respiratory tract, eyes, and skin. The particles may enter drinking water and structures and may cause structure failure if it is thick and heavy enough. Even a fine layer of ash can disrupt utilities. A portion of California’s major electric transmission lines, aerial telecommunication lifelines, transportation corridors, and water storage and conveyance lie within the state’s volcano hazard zones. Impacts to any of these can impact operations at CSU Fresno.

The potential impacts of gases released during volcanic eruptions are as follows:

- Carbon dioxide typically becomes diluted very quickly and is not life threatening. However, it can become trapped in higher concentrations in low-lying areas and has the potential to be fatal.
- Sulfur dioxide can cause acid rain and air pollution downwind of a volcano.
- Hydrogen sulfide can cause irritation of the upper respiratory tract. At high concentrations it can cause unconsciousness and death.
- Hydrogen halides can coat ash particles and, once deposited, poison drinking water, agricultural crops, and grazing land.

Probability of Future Occurrence of the Hazard
The US Geological Survey, based on the record of volcanic activity in California, estimates that the probability of another small- to moderate-sized eruption in the next thirty years is about 16 percent. In any given year, the Long Valley volcanic region has a 1 percent chance of eruption. As such, the annual probability of future occurrence for the campus is ranked by the committee as Possible.

Vulnerability to the Hazard
Populations living near volcanoes are the most vulnerable to eruptions and lava flows. However, volcanic ash can travel and affect populations miles away. The location and thickness of ash in any given area is a function of the severity of the eruption and wind speed and direction. For CSU Fresno, there is low vulnerability to the immediate impacts of volcanic eruptions due to the limited area affected and remote potential of an eruption. In the event of a widespread ashfall event, the elderly, infants, and populations with existing respiratory disease will be at higher risk.

Estimate of Potential Losses

Impacts to critical infrastructure, agriculture, and property from ashfall have the potential to cause widespread disruption, damage, and economic loss throughout the state. In the event of a widespread ashfall event, impacts will be immediate.

Current modeling is not precise enough to allow for an assessment of potential losses from ashfall to structures or infrastructure on or surrounding the campus.

Vulnerability Assessment Conclusions

CSU Fresno is unlikely to experience the direct impacts of a volcanic event. While the campus may be indirectly impacted by ashfall elsewhere in the state, direct ashfall impacts are generally unlikely but possible in a widespread event. However, the likelihood of a future eruption in the Long Valley volcanic region is very low.

Identified Data Limitations

Not all active volcanoes in California have been zoned for hazards by the US Geological Survey. This, together with the infrequent occurrence of volcanic explosions and number of factors determining type and extent of impacts, make the quantification of potential loss difficult.

Wildfire

Description of the Hazard

While wildfires are a natural part of California’s ecosystem, wildfires in California represent a hazard that presents one of the greatest probabilities of destruction along with a demonstrated history of catastrophic fire events in recent years. The destructive fire seasons of 2017 to 2020 illustrated the destructive forces fire presents to communities across the state. Wildfires may result in the structural loss, infrastructure loss, dangerous air quality, environmental damages, economic impacts, injuries, and loss of life. In many communities throughout California, wildfire presents greatest risk to human life and property.

Wildfires have been defined as any free burning vegetation fire that initiates from an unplanned ignition, whether natural or human caused demanding fire suppression actions to contain.90 These fires are prone to become uncontrolled, spreading through vegetative fuels rapidly exposing people and structures to harm. Wildfires present a significant risk to communities across the state, as evidenced by increasing trends of structural losses from wildland fires. This risk is elevated in areas where development and community growth has intersected, also known as the wildland-urban interface (WUI). In the interface setting, development itself can provide additional fuel for large fires. Recent fires have also demonstrated the ability of fire to consume populated areas in extreme conditions.

90 State of California Hazard Mitigation Plan, September 2018
California’s Mediterranean climate in combination with its geography and vast population create a combination of factors that promotes an optimal environment for large fire growth and consequences. As there is great diversity of geographic characteristics across the state, the risks and potential consequences of wildfire must be assessed locally. The physical location, weather patterns, local fuel types and volume, extent of the WUI, topography, and additional factors will factor differently from part of the state to another.

The behavior of wildfires in California is significantly influenced by three distinct geographic factors. These factors will help shape the size, direction of spread, rate of combustion, fire intensity, and ability to pre-heat fuels. The physical factors contributing to wildfire behavior include:

- **Topography** – The rate in which wildfires spread increases with greater slopes in topography. The greater the slope will result in more pre-heating of fuel above the advancing fire. The direction that a slope faces will also influence fire behavior as south facing slopes receive greater solar radiation and thus drier vegetation that is more susceptible to combustion. Ridgetops often denote the end of fire spread as fire has greater difficulty spreading downhill.

- **Weather** – Weather factors substantially in influencing the behavior of wildfires. Wind, temperature, humidity, lightning, and lack of precipitation all contribute to a fire’s ability or inability to spread and intensify. California routinely experiences conditions in which these factors are in alignment to contribute to extreme fire behavior during the summer and fall seasons. High winds, low humidity, and high temperatures provide an environment promoting extreme fire activity.

- **Fuels** – Certain types of vegetation are increasingly prone to igniting and promote more intense burning. Areas with greater “fuel loading” (amount of fuel present in terms of weight of fuel per unit of area) increases the amount of fuel to fuel a fire. Greater volumes of dead or dry vegetation compared to live plants is a critical factor. Vegetation during drought conditions will experience decrease in moisture content increasing the conditions for combustion. Fuels close proximity to one another allows for rapid spread through contact or radiant exposures.

A risk assessment for wildfires should be implemented within a geospatial context focusing on the specific location features and incorporates the three components of the wildfire risk triangle – likelihood, intensity, and susceptibility.

**Location of the Hazard**

Substantial portions of the State of California are exceptionally vulnerable to wildfire activity or reside in a wildland-urban interface (WUI) area due to the vast open spaces, rangelands, forests and other lands with high susceptibility to fire occurring throughout the state. Fresno is located in the central portion of the San Joaquin Valley along the at the base of the southern Sierra Nevada Mountains. In general, areas considered to be within Fire Hazard Severity Zones defined by the Fire and Resource Assessment Program (FRAP) within the California Department of Forestry and Fire Protection (CalFire) occur to the east of Fresno. These areas surrounding the valley are topographically diverse,
contain heavier vegetative fuels, and often have residential development interspersed. The land in the San Joaquin Valley where the CSU Fresno campus is located, is largely agricultural, urban, or otherwise developed.

The CSU Fresno campus is located in the northwestern portion of the City of Fresno and next to the City of Clovis. The area immediately surrounding the campus is predominately developed with residential and commercial land uses. Agricultural fields exist to the north of the campus. The campus is established in 6 miles from downtown Fresno. Fire Hazard Severity Zones are found 6-8 miles to the north and east towards the foothills. High Fire Hazard Severity Zones are found along the length of the foothills to the Sierra Nevada Mountains. Agricultural areas with extensive crop and orchard production are located extensively north, west, and south of the city. There are no areas in proximity to the campus that present direct threats to wildfire.

However, the CSU Fresno campus is located in the Central Valley surrounded by the mountains and extensive areas of fire hazards. These mountain ranges host three national forests with extensive history of large fire development. The fires that burn in these areas have the potential to develop vast quantities of smoke that can fill the valley in the right weather conditions. The geography of the Central Valley creates a topography that captures air pollutants including smoke within the surrounding mountains and the development of inversion layers. The CSU Fresno campus is located in a region in which is vulnerable to wildfire smoke that can saturate the air around the campus.
Extent of the Hazard

The area immediately surrounding the CSU Fresno campus is not in proximity to fire hazard zones designated as a High Fire Hazard Severity Zones. The campus does not have a history of wildfire activity occurring within proximity to the campus. However, fires are likely to occur in areas close enough to the campus that generate substantial amounts of smoke that could envelop the campus in the right atmospheric conditions. This will especially be the case in weather conditions creating strong offshore winds. The potential for this impact has been demonstrated during the summers of 2018, 2019, and 2020 as fires burned across the state and spread smoke over vast distances. Fires burning

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outside of the Fresno County region have the potential to distribute smoke onto the CSU Fresno campus.

Given the (above) factors, and that Fresno County has a long history of wildfire activity primarily in the foothills and mountains of the Sierra Nevada and Coastal Range Mountains, the planning committee ranks the extent of the hazard as **Moderate**.

The National Fire Danger Rating System (NFDRS) is the current system in use for rating and classifying the potential danger of fire. The NFDRS tracks the effects of previous weather events on both dead and live fuel loads and adjusts accordingly based on future or predicted weather conditions. These complex relationships and equations are computed, and the outputs are expressed in terms that users can quickly and easily understand. The current NFDRS is used by all federal and most state agencies to assess fire danger conditions.

The following table depicts the NFDRS, from the US Forest Service’s Wildland Fire Assessment System.

**Table 9-22: National Fire Danger Rating System**

<table>
<thead>
<tr>
<th>Rating</th>
<th>Basic Description</th>
<th>Detailed Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>CLASS 1: Low Danger (L)</td>
<td>Fires not easily started</td>
<td>Fuels do not ignite readily from small firebrands. Fires in open or cured grassland may burn freely a few hours after rain, but wood fires spread slowly by creeping or smoldering and burn in irregular fingers. There is little danger of spotting.</td>
</tr>
<tr>
<td>COLOR CODE: Green</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CLASS 2: Moderate Danger (M)</td>
<td>Fires start easily and spread at a moderate rate</td>
<td>Fires can start from most accidental causes. Fires in open cured grassland will burn briskly and spread rapidly on windy days. Woods fires spread slowly to moderately fast. The average fire is of moderate intensity, although heavy concentrations of fuel -- especially draped fuel -- may burn hot. Short-distance spotting may occur but is not persistent. Fires are not likely to become serious and control is relatively easy.</td>
</tr>
<tr>
<td>COLOR CODE: Blue</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CLASS 3: High Danger (H)</td>
<td>Fires start easily and spread at a rapid rate</td>
<td>All fine dead fuels ignite readily, and fires start easily from most causes. Unattended brush and campfires are likely to escape. Fires spread rapidly and short-distance spotting is common. High intensity burning may develop on slopes</td>
</tr>
<tr>
<td>COLOR CODE: Yellow</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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or in concentrations of fine fuel. Fires may become serious and their control difficult, unless they are hit hard and fast while small.

<table>
<thead>
<tr>
<th>CLASS 4: Very High Danger (VH)</th>
<th>Fires start very easily and spread at a very fast rate</th>
<th>Fires start easily from all causes and immediately after ignition, spread rapidly and increase quickly in intensity. Spot fires are a constant danger. Fires burning in light fuels may quickly develop high-intensity characteristics - such as long-distance spotting - and fire whirlwinds when they burn into heavier fuels. Direct attack at the head of such fires is rarely possible after they have been burning more than a few minutes.</th>
</tr>
</thead>
<tbody>
<tr>
<td>COLOR CODE: <strong>Orange</strong></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>CLASS 5: Extreme (E)</th>
<th>Fire situation is explosive and can result in extensive property damage</th>
<th>Fires under extreme conditions start quickly, spread furiously, and burn intensely. All fires are potentially serious. Development into high intensity burning will usually be faster and occur from smaller fires than in the Very High Danger class (4). Direct attack is rarely possible and may be dangerous, except immediately after ignition. Fires that develop headway in heavy slash or in conifer stands may be unmanageable while the extreme burning condition lasts. Under these conditions, the only effective and safe control action is on the flanks, until the weather changes or the fuel supply lessens.</th>
</tr>
</thead>
<tbody>
<tr>
<td>COLOR CODE: <strong>Red</strong></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Due to the impacts of wildfires on public health, agencies across the nation have adopted the use of the Air Quality Index (AQI) to communicate and provide a consistent approach to air quality measurements and categorization. The AQI primarily focuses on the health effects caused by pollutants in the air such as smoke.

The goal of the AQI is to provide advisories to assist the public in determining when to reduce exposures to inhalation of air pollution as pollution levels rise.
History of the Hazard

The State of California has a long history of chronic and destructive wildfires throughout the state. On average, 8,300 wildfires have caused burnt 928,245 acres across the state over the 20-year period between 2000 and 2020. Fresno County also has a long history of wildfire activity primarily in the foothills and mountains of the Sierra Nevada and Coastal Range Mountains. Wildfires occurring in Fresno County have resulted in hundreds of thousands of acres burned and millions of dollars in damages.

The area immediately surrounding the CSU Fresno campus is not in proximity to fire hazard zones designated as a High Fire Hazard Severity Zones. The campus does not have a history of wildfire activity occurring within proximity to the campus. However, the County is surrounded by areas that are considered to be of high fire threat that would produce vast quantities of smoke and particulates into the air. The Fresno campus has experienced multiple days of poor air quality due to fires burning in the Sierra Nevada and Coastal Range Mountains. The 2017, 2018, and 2020 fire seasons in particular illustrated the increase in wildfire generated smoke saturating the air of communities throughout the state including Fresno County. CSU Fresno personnel reported the ongoing development of policies and procedures to address the response to poor air quality days.

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93 California Department of Forestry and Fire Protection, Stats and Events, https://www.fire.ca.gov/stats-events/
Table 9-23: Historic Large-Scale Fires Near CSU Fresno

<table>
<thead>
<tr>
<th>Date</th>
<th>Fire</th>
<th>Location</th>
<th>Declaration</th>
<th>Damages</th>
</tr>
</thead>
<tbody>
<tr>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
</tr>
</tbody>
</table>

Potential Impacts of the Hazard

The location of the CSU Fresno campus surrounded by areas of urban development removed from areas with a fire hazard places a minimal direct threat from wildfire to the campus. The potential impacts to wildfire exist with members of the campus community who reside or work in these fire hazard zones.

Potential impacts to the campus community resulting from wildfires include:

- Injuries or loss of life
- Campus property destruction or damage
- Residential property destruction or damage
- Commercial property destruction or damage
- Loss of property contents
- Infrastructure damage
- Damaged or destroyed lifelines/supply routes
- Damaged or destroyed utilities
- Damaged or destroyed critical facilities supporting campus emergency support needs
- Loss of community economic base
- Employment losses
- Loss to ground supporting vegetation on hillsides resulting in erosion or landslides in future precipitation events
- Agricultural (crops and livestock) damages or destruction
- Environmental damage
- Societal and community impacts
- Damage to organizations and facilities providing support services to vulnerable populations
- Greater evacuation challenges for those most vulnerable
- Psychological impacts of impacted populations
- Disruptions to education delivery to community

Potential impacts resulting from wildfire generated smoke include:

- Dangerous levels of air pollution
- Human Health Effects
  - Similar health impacts to pets

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94 Fresno County Multi-Hazard Mitigation Plan, April 2018
Air conditioning systems overwhelmed
Greater demands on air filtration systems
Greater demands on healthcare systems
Reduced outdoor work productivity
Closures of academic sessions

Additionally, there remains a number of secondary impacts from wildfires that could affect the campus community. Utilities feeding areas of Fresno County including the campus may be damaged resulting in power outages. Fire related damage in the watersheds will likely cause future landslides, degradation to plants supporting hillsides, and impact the hydroelectric power capabilities. Fires may present threats to areas of recreation, scenic value, and wildlife that are a part of the culture of the campus community. Finally, the campus may experience effects of evacuated individuals arriving on campus from other areas as a location of refuge.

Probability of Future Occurrence of the Hazard

Based on the wildfire threat potential in the area surrounding the CSU Fresno campus, including the distance to Fire Hazard Severity Zones and density of residential and commercial development, the probability of wildfire related damage is considered Unlikely.

Based on the wildfire threat potential in the area surrounding the Fresno region, including the volume of areas in elevated Fire Hazard Severity Zones surrounding the San Joaquin Valley, the probability of wildfire generated smoke impacts to air quality is considered Possible.

Vulnerability to the Hazard

The CSU Fresno campus is not likely to be subject to direct impact from wildfire due to the campus location in an urban/suburban area of Fresno. The vulnerabilities to the effects of wildfire would largely lie within the campus community who may reside or work in locations that are exposed to the Fire Hazard Severity Zones outside of Fresno. Wildfires occurring in other areas of the region may result in the displacement of large numbers of people. These effects may spill onto the campus in the form of evacuees or facility support to emergency resources.

Fire directly threatening the campus would likely take the form of localized fires involving single structures or small areas. Smaller vegetation fires are possible surrounding the campus in the urban forest or fields surrounding the city. These incidents would likely have little impact to the campus.

The primary basis of vulnerability is based on the population affected and the built environment exposed. In general, newer construction will be more fire resistant than older buildings as building and fire codes and construction technology have improved. Density of buildings and proximity of fuels to buildings or equipment at risk of combustion would additionally influence the fire’s ability to spread to structures.
Some areas of particular vulnerability on the campus includes:

- Students and staff engaging in outdoor activities when the air is determined to be unhealthy are vulnerable to adverse health effects.
- Buildings with ineffective HVAC or do not have HVAC will cause limitations in filtering of air during smoke filled days
- Air pollution effects to animals housed on the campus
- Power outages or brownouts during days with high levels of smoke will limit shelter in place options during heat events in summer.

The greater concerns regarding vulnerabilities to wildfire on CSU Fresno are related to the smoke that fires in the area would produce. The recent summer seasons have clearly demonstrated the reality of large wildfires producing enough smoke to fill the San Joaquin Valley even from substantial distances away. These recent fires have displayed how the effects of this smoke impact the general population and especially vulnerable populations. CSU Fresno students, faculty, and staff both on campus and off campus face these same vulnerabilities related to smoke filled air.

Smoke generated from large wildfires pose a threat in terms of diminished air quality that would be exposed to the population within the area of smoke distribution. Individuals with existing health problems such as respiratory or cardiac illnesses are increasingly vulnerable to wildfire generated smoke. Staff who work in roles requiring outdoor activity will be increasingly exposed during days where the air quality index is considered unhealthy or worse. Student athletes participating in outdoor sports and engaging in aerobic activities are increasingly vulnerable to the effects of wildfire.

The vulnerability to members of the campus community in which wildfire generated smoke on the CSU Fresno campus will vary depending on when the air quality was to reach unhealthy levels. The risk to the campus population will be lessened during periods when classes are not in session or during periods of breaks. Conversely, during the days and hours that classes are in session and staff are at their workplaces, the human vulnerability increases. However, in region-wide events this vulnerability may be shared with the homes and workplaces of members of the campus community and their families.

Vulnerable populations will likely face disproportionate health safety issues from smoke filled air, experience increased stresses, may require the need to remain away from the campus enclosed at home, and may find difficulty in accessing equipment or supplies to aid in a specific need.

**Estimate of Potential Losses**

Estimates of potential losses will be influenced by a variety of factors. Costs would also be likely to include mitigation or repairs of HVAC systems, sealing of doors and windows, and other methods of keeping smoke from entering buildings. Secondary costs would include lost academic days during campus closures, lost staff on campus productivity, and health and medical interventions for affected members of the campus community.
Based on estimate replacement costs of facilities and structures on campus, the maximum total replacement costs due to wildfire are $395,965,157. However due to the lack of a complete inventory of building and facility costs, the total replacement estimate is likely much higher.

Table 9-24: Wildfire Hazard Potential (WHP) Zone Estimated Losses

<table>
<thead>
<tr>
<th>WHP Zone</th>
<th>No of Buildings</th>
<th>Maximum Replacement Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Extreme</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Very High</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>High</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Moderate</td>
<td>8</td>
<td>$4,644,602</td>
</tr>
<tr>
<td>Low</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Very Low</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Non-Burnable</td>
<td>99</td>
<td>$391,320,555</td>
</tr>
<tr>
<td>No Building Value Data Provided*</td>
<td>9</td>
<td>Unknown</td>
</tr>
</tbody>
</table>

*Buildings with no value defined are also included in the respective Zones they are found in.

Vulnerability Assessment Conclusions

The occurrence of wildfires has been a frequent event in the mountains surrounding Fresno County; however, wildfire incidents do not pose a direct risk to the CSU Fresno campus. The suburban location of the CSU Fresno campus surrounded by densely developed residential and commercial land uses mitigates any vulnerabilities of wildfire hazards to the campus community or facilities.

Communities located within or near the Wildland Urban Interface may be subject to damaging fires. These same communities may be home to members of the campus community. The students, faculty, and staff of CSU Fresno who live or work in these hazard areas may experience vulnerabilities to the direct exposure to wildfire not likely at the campus. These effects may create tremendous challenges that could impact their ability to maintain engagement with university academic or professional activities. The potential for large-scale wildfires in the region further generates the added potential for a number of cascading effects such as disruptions to the local economy, utility failures, disruptions to providing for the needs of the community, and development of public health hazards.

Additionally, the topography and weather patterns of Central California often creates conditions that allows for smoke filled air to linger in the Central Valley with the potential for unhealthy air quality depending on wind conditions. Fires in surrounding mountains and forests some distance away that generate tremendous quantities of smoke present...
tremendous health related vulnerabilities to members of the campus community. The campus community exposed to these unhealthy air conditions are vulnerable to a variety of potential health related effects.

Identified Data Limitations

Missing campus structural replacement costs and an inventory of building construction types to include status of earthquake retrofitting. HAZUS generated analysis is focused on the broader community level versus finetuning the analysis to the micro-level for facilities such as a university campus.

Severe Weather (Wind, Tornado, Hail, Lightning)

Description of the Hazard

Severe weather can be described as a variety of weather or climate events that are beyond or near the ends of the range of observed weather patterns and behavior. These events can include high or extreme winds, storms, lightning, hail, tornadoes, heat waves, unusually cold temperatures, extreme rainfall, and flooding.\(^{95}\) According to the Intergovernmental Panel on Climate Change (IPCC), to be classified as severe (or extreme), the occurrence of each value of a climate or weather variable (e.g., wind, hail, lightning, tornado, etc.) must be “above (or below) a threshold value near the upper (or lower) ends of the range of observed values of the variable.”\(^{96}\)

Severe weather in California can be generated by local, regional, and/or global weather and climate influences. From the individual thunderstorm to the Santa Ana wind event to the strong El Niño, damaging weather elements that are produced by and accompany severe weather and climate phenomena (e.g., damaging winds, hail, lightning, and tornadoes) occur throughout California and the California State University (CSU) system.

Global Scale Influences on Severe Weather in California: El Niño, La Niña, and ENSO

The El Niño-Southern Oscillation (ENSO) is a recurring climate pattern involving changes in the temperature of waters in the central and eastern tropical Pacific Ocean. On periods ranging from about three (3) to seven (7) years, the surface waters across a large swath of the tropical Pacific Ocean warm or cool by anywhere from 1°C to 3°C, compared to


normal. This oscillating warming and cooling pattern, referred to as the ENSO cycle, directly affects rainfall distribution in the tropics and can have a strong influence on weather across the United States and other parts of the world.

El Niño and La Niña are extreme phases of the ENSO cycle, with a third phase occurring between them called the Neutral phase. The El Niño phase is characterized by unusually warm ocean temperatures and weaker-than-normal east winds in the Equatorial Pacific, while the La Niña phase is characterized by unusually cold ocean temperatures and stronger-than-normal east winds in the Equatorial Pacific. Both extreme ENSO phases lead to significant differences from the average ocean temperatures, winds, surface pressure, and rainfall across parts of the tropical Pacific. The Neutral phase indicates that conditions are near their long-term average.

The extreme ENSO phases affect the frequency and intensity of weather events across the world, including in California. On average, areas across California experience exceptionally stormy winters with increased precipitation under El Niño conditions, but experience less stormy and drier winters under La Niña conditions. This variability in storminess and precipitation brought on by El Niño and La Niña events affects the both the frequency and intensity of severe weather conditions experienced by all CSU campuses, including CSU Fresno.

**Regional Climate Influences on Severe Weather across California**

Most of the weather in California is influenced by the wet-winter/dry-summer Mediterranean climate pattern. In the summer months, Pacific storm tracks are deflected north due to the position of the Pacific High (i.e., a large-scale atmospheric circulation over the Northeast Pacific Ocean), preventing Pacific storms from reaching California. As a result, most summer storms are generated due to the incursion of moist air from the Gulf of Mexico or the Gulf of California, and occur as scattered, locally heavy showers in the desert and mountain regions of the state. In the winter months, the Pacific High decreases in intensity and moves south, permitting powerful Pacific storms to move into and across the state; these storms can produce extreme winds, heavy rains (including “atmospheric river” events), and widespread coastal and inland flooding. (Please see the Flood Hazard profile in this document for information on Floods.) As a result, storm events accompanied by precipitation in California are far more frequent in the winter months than they are in the summer months.
While the Mediterranean climate pattern influences the seasonal frequency, intensity, geographic spread, and type of some severe weather events CSU campuses experience (including CSU Fresno), other severe weather phenomena may occur in California at any time of the year. For example, near the coast and over the Central Valley, there appears to be no defined seasonality to thunderstorms, and these storms are usually light and infrequent. Thunderstorms are more intense and more frequent in the intermediate and higher elevations of the Sierra Nevada, and occur with greater frequency during the summer months.\textsuperscript{103}

**Types of Storms in California**

The 2018 California State Hazard Mitigation Plan (SHMP) defines a storm as a violent atmospheric disturbance occurring over land and/or water that is distinguished by its strength, characteristics, and the scale of the resulting damage.\textsuperscript{104} The SHMP also lists the following types of storms that produce hazardous conditions and potential damage throughout the state of California.\textsuperscript{105} These storms affect (in varying degrees) all CSU campuses, including CSU Fresno.

- **Thunderstorm**: A rain-bearing cloud that also produces lightning. Thunderstorms can produce some of nature’s most destructive and deadly weather including tornadoes, hail, strong winds, lightning and flooding.\textsuperscript{106} Thunderstorms are caused by an atmospheric imbalance from warm unstable air rising rapidly into the atmosphere. Lightning, which occurs during all thunderstorms, can strike anywhere.\textsuperscript{107} Thunderstorms can produce some of nature’s most destructive and deadly weather including tornadoes, hail, strong winds, lightning and flooding.\textsuperscript{108} **Severe thunderstorms** are more intense, violent, and dangerous thunderstorms. The National Oceanic and Atmospheric Administration (NOAA) defines a severe thunderstorm as any storm that produces one or more of the following elements: Damaging winds or speeds of 58 mph (50 knots) or greater, hail 1 inch in diameter or larger, and/or a tornado.\textsuperscript{109, 110}

\textsuperscript{103} Retrieved on 07.17.2021 from [https://wrcc.dri.edu/Climate/narrative_ca.php](https://wrcc.dri.edu/Climate/narrative_ca.php)
\textsuperscript{106} Retrieved on 07.14.2021 from [https://www.weather.gov/phi/ThunderstormDefinition](https://www.weather.gov/phi/ThunderstormDefinition)
\textsuperscript{109} Retrieved on 07.15.2021 from [https://www.noaa.gov/explainers/severe-storms](https://www.noaa.gov/explainers/severe-storms)
\textsuperscript{110} Retrieved on 07.15.2021 from [https://www.weather.gov/safety/thunderstorm](https://www.weather.gov/safety/thunderstorm)
- **Hailstorm**: a type of storm that precipitates round chunks of ice. Hailstorms usually occur during regular thunderstorms.111

- **Wind storm**: marked by high wind with little or no precipitation.112

- **Winter storm**: A storm that can produce a combination of freezing rain, sleet, heavy snow, and/or strong winds.113

- **Coastal storm**: large wind-driven waves and/or storm surge that strike the coastal zone.114

- **Ice storm**: Ice storms are one of the most dangerous forms of winter storms. When surface temperatures are below freezing, but a thick layer of above-freezing air remains aloft, rain can fall into the freezing layer and freeze upon impact into a glaze of ice. In general, 8 millimeters (0.31 inch) of accumulation is all that is required, especially in combination with breezy conditions, to start downing power lines as well as tree limbs. Ice storms also make unheated road surfaces too slick to drive on. Ice storms can vary in time range from hours to days and can cripple small towns and large urban centers alike.115

- **Snowstorm**: A heavy fall of snow accumulating at a rate of more than 5 centimeters (2 inches) per hour that lasts several hours. Snowstorms, especially ones with a high liquid equivalent and breezy conditions, can down tree limbs, cut off power, and paralyze travel over a large region.116

**Severe Weather Hazard Elements: Wind Hazards, Hail, and Lightning**

This hazard profile concentrates on the following types of severe weather hazards: *wind hazards* (including **tornadoes**), **hail**, and **lightning**. These hazards are produced by a variety of weather phenomena, including thunderstorms, coastal storms, winter storms, and topographically-enhanced downslope winds. While storm and downslope wind hazards are responsible for severe weather events across the CSU system, only the wind,

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tornado, hail, and lightning elements generated by these hazards are covered in this profile. (Storm-related hazards such as flooding and extreme temperatures are covered in other sections of this document.)

**Wind Hazards**

**Wind** is the horizontal movement of air past any given point. Wind begins with differences in air pressures; pressure that is higher at one point than another sets up a force, pushing the high towards the low pressure.\(^{117}\) Wind gusts are defined as “rapid fluctuations in the wind speed with a variation of 10 knots or more between peaks and lulls.”\(^{118}\)

Wind hazards in California take several forms: High Wind, Strong Winds, Thunderstorm Winds, Mountain-Valley (Downslope) Winds, and Tornadoes. These hazards are encountered across California, and have the potential to cause harm to or loss of life and/or property throughout California and the CSU system (including CSU Fresno).

**High Winds, Strong Winds, and Thunderstorm Winds**

The National Weather Service reports three (3) types of wind events that occur areas over land: High Winds, Strong Winds, and Thunderstorm Winds. Collectively, these reports are used to determine the frequency with which wind hazard events have affected areas across the U.S., including California.

**High Winds**

High winds are defined as sustained non-convective winds of 35 knots (40 mph) or greater lasting for 1 hour or longer, or gusts of 50 knots (58 mph) or greater for any duration (or otherwise locally/regionally defined). In some mountainous areas, the above numerical values are 43 knots (50 mph) and 65 knots (75 mph), respectively.\(^{119}\)

**Strong Winds**

Strong winds are defined as non-convective winds gusting less than 50 knots (58 mph), or sustained winds less than 35 knots (40 mph), resulting in a fatality, injury, or damage.\(^{120}\)

**Thunderstorm Winds**

Thunderstorm winds are winds that arise from thunderstorm convection (occurring within 30 minutes of lightning being observed or detected), with speeds of at least 50


\(^{118}\) Retrieved on 07.15.2021 from https://forecast.weather.gov/glossary.php?word=wind%20gust


\(^{120}\) Retrieved on 07.17.2021 from https://www.nws.noaa.gov/directives/sym/pd01016005curr.pdf
knots (58 mph). They can also be winds of any speed (non-severe thunderstorm winds below 50 knots (58 mph)) producing a fatality, injury, or damage.\textsuperscript{121}

Please note: \textbf{Straight-line wind} is a term used to define any thunderstorm wind that is not associated with rotation. It is used mainly to differentiate from the rotational winds found in tornado-producing storms.\textsuperscript{122} However, it is not a term used in the NCEI Storm Events Database, and therefore cannot be used to determine severe weather history of or potential impacts to CSU campuses.

\textbf{Tornadoes}

A tornado is an extreme severe weather wind hazard. A tornado is a rapidly rotating column of air extending from a thunderstorm to the surface of the Earth.\textsuperscript{123} This column extends between cloud and the Earth’s surface. The damage from tornadoes comes from the strong winds they contain and the flying debris they create. It is generally believed that rotational wind speeds can be as high as 300 mph in the most violent tornadoes.\textsuperscript{124} On a local scale, tornadoes are the most violent and most destructive of all atmospheric phenomena.\textsuperscript{125}

\textbf{Mountain-Valley (Downslope) Wind Systems: Santa Ana, Diablo, and Sundowner Winds.}

\textbf{Santa Ana Winds}. A type of wind hazard that is peculiar to Southern California is called a \textit{Santa Ana Wind}. Santa Ana winds are strong, topographically-enhanced, extremely dry downslope winds that originate inland and affect coastal southern California and northern Baja California (Mexico).\textsuperscript{126} They occur when air from a region of high pressure over the dry, desert region of the southwestern U.S. flows westward towards low pressure located off the California coast. This creates dry winds that flow east to west through the mountain passages in Southern California. These winds have a strong seasonal component; they are most common during the cooler months of the year, occurring from September through May. Santa Ana winds typically feel warm (or even hot) because as the cool desert air moves down the side of the mountain, it is compressed, which causes the temperature of the air to rise. If strong enough, Santa Ana winds can cause major property damage, and may present difficulties for airborne and seagoing transportation. They also may increase wildfire risk because of the dryness of the winds and the speed at which they can spread a flame across the landscape.\textsuperscript{127} (Note: The Wildfire hazard is profiled elsewhere in this document.)

\textsuperscript{122} Retrieved on 07.15.2021 from https://www.nssl.noaa.gov/education/svrwx101/wind/types/
\textsuperscript{123} Retrieved on 07.15.2021 from https://www.earthnetworks.com/tornado/
\textsuperscript{124} Retrieved on 07.15.2021 from https://www.nssl.noaa.gov/education/svrwx101/tornadoes/faq/
\textsuperscript{125} Retrieved on 07.15.2021 from https://www.weather.gov/bgm/severedefinitions
Figure below illustrates the mechanisms involved in the generation of Santa Ana winds across Southern California.

Figure 9-18: What Drives a Santa Ana Wind?  

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**Diablo Winds.** The Diablo wind is another type of topographically-enhanced downslope wind phenomenon that occurs in the North-Central areas of California. Diablo winds are offshore wind events that flow northeasterly over Northern California’s Coast Ranges, often creating high wind speeds downwind of major canyons and over ridges, and extreme fire danger for the San Francisco Bay Area. Diablo winds are driven by a surface pressure gradient that forms in response to an inverted pressure trough that develops over California.  

**Sundowner Winds.** Sundowner winds are significant and potentially damaging downslope wind and warming events that periodically occur along a short segment of the southern California coast in the vicinity of Santa Barbara, CA. The unique topography of
this coastal region promotes the development of Sundowner wind events: over a length of about 100 km, the coastline is oriented approximately west–east, with the adjoining narrow coastal plain bounded by a steeply rising (to elevations greater than 1200 m) and coast-parallel mountain range. Called Sundowner winds because they often begin in the late afternoon or early evening, their onset is typically associated with a rapid rise in temperature and decrease in relative humidity, and the winds tend to blow from the north from the Santa Ynez Mountains to the coast of Santa Barbara County, California. During the more intense Sundowner wind events, wind speeds can be of gale force 39-54 miles per hour or higher, and can even reach hurricane force (≥ 74 miles per hour) in the most extreme cases. Temperatures over the coastal plain, and even at the coast itself, can rise significantly above 37.8°C (100°F). Seasonally, Sundowner winds peak in March, April, and May, with a minimum during summer and a secondary peak in winter that often corresponds with Santa Ana winds. In addition to causing a dramatic change from the more typical marine-influenced local weather conditions, Sundowner wind episodes have produced significant wind-related property and agricultural damage, as well as conditions of extreme fire danger.130 131 132

Hail

Hail is a form of precipitation consisting of solid ice that forms inside thunderstorm updrafts.133 It is roughly round in shape and at least 0.2’ in diameter. Hail develops in the upper atmosphere as ice crystals that are bounced about by high velocity updraft winds; the ice crystals accumulate frozen droplets and fall after developing enough weight. The size of hailstones varies and is a direct consequence of the severity and size of the storm that produces them – the higher the temperatures at the Earth’s surface, the greater the strength of the updrafts and the amount of time hailstones are suspended, and therefore the greater the size of the hailstone.134

Lightning

Lightning is an electrical discharge produced by a thunderstorm. Lightning rapidly heats the air in its immediate vicinity to about 50,000°F - about five times the temperature of the surface of the sun. This compresses the surrounding air and creates a supersonic shock wave, which decays to an acoustic wave that is heard as thunder.135

The discharge may occur within or between clouds, between the cloud and air, between a
cloud and the ground, or between the ground and a cloud.\textsuperscript{136} Lightning that is produced
from thunderstorms in which precipitation evaporates before reaching the ground is
called “dry lightning.”

\textbf{Location of the Hazard}
Severe weather is a non-spatial hazard, and can occur anywhere in the CSU system,
including on the CSU Fresno campus. No one area of the campus – or of the surrounding
community – is subject to experiencing severe weather more than any other area.

There is geographic variability among the different types of mountain and valley wind
events (as a sub-category of the severe weather hazard). Santa Ana winds occur in
Southern California, Diablo winds occur in North-Central California, and Sundowner
winds occur almost exclusively in Santa Barbara County, California.

\textbf{Extent of the Hazard}
Severe weather hazards are non-spatial hazards that potentially affect all CSU Fresno
campus areas equally. However, the smallest geographic unit of measurement for almost
all official severe weather event data is at the county level. Because the severe weather
data used do not exist at the campus level, it is assumed that the same (or similar) severe
weather risks to CSU Fresno reflect those of the surrounding community and County. As
a result, all assets and people at CSU Fresno are at risk from the effects of severe weather
and can expect to experience at least some (or the complete range of) endemic severe
weather hazards. In consideration of the campus’ design, layout, and operations, the
severe weather history and degree of severity in the Fresno area, and the history and
degree of severity of each severe weather sub-type identified by the extent scales
(below), the campus planning committee ranks the overall extent of the Severe Weather
hazard as \textbf{MODERATE}. See each sub-hazard below for the planning committee’s sub-type
extent ranking.

\textit{Wind Hazard: Non-Rotational}

The Beaufort Scale is an empirical measure that relates wind speed to observed
conditions at sea or on land. Its full name is the Beaufort wind force scale.\textsuperscript{137} First
developed in 1805, it is still used today to estimate wind strengths.\textsuperscript{138}

\textsuperscript{137} Retrieved on 07.15.2021 from https://www.rmets.org/resource/beaufort-scale
\textsuperscript{138} Retrieved on 07.15.2021 from https://www.weather.gov/mfl/beaufort
<table>
<thead>
<tr>
<th>Force</th>
<th>Speed (mph)</th>
<th>Speed (knots)</th>
<th>Description</th>
<th>Specifications for use at sea</th>
<th>Specifications for use on land</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0-1</td>
<td>0-1</td>
<td>Calm</td>
<td>Sea like a mirror.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Calm; smoke rises vertically.</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>1-3</td>
<td>1-3</td>
<td>Light Air</td>
<td>Ripples with the appearance of scales are formed, but without foam crests.</td>
<td>Direction of wind shown by smoke drift, but not by wind vanes.</td>
</tr>
<tr>
<td>2</td>
<td>4-7</td>
<td>4-6</td>
<td>Light Breeze</td>
<td>Small wavelets, still short, but more pronounced. Crests have a glassy appearance and do not break.</td>
<td>Wind felt on face; leaves rustle; ordinary vanes moved by wind.</td>
</tr>
<tr>
<td>3</td>
<td>8-12</td>
<td>7-10</td>
<td>Gentle Breeze</td>
<td>Large wavelets. Crests begin to break. Foam of glassy appearance. Perhaps scattered white horses.</td>
<td>Leaves and small twigs in constant motion; wind extends light flag.</td>
</tr>
<tr>
<td>4</td>
<td>13-18</td>
<td>11-16</td>
<td>Moderate Breeze</td>
<td>Small waves, becoming larger; fairly frequent white horses.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Raises dust and loose paper; small branches are moved.</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>19-24</td>
<td>17-21</td>
<td>Fresh Breeze</td>
<td>Moderate waves, taking a more pronounced long form; many white horses are formed.</td>
<td>Small trees in leaf begin to sway; crested wavelets form on inland waters.</td>
</tr>
<tr>
<td>6</td>
<td>25-31</td>
<td>22-27</td>
<td>Strong Breeze</td>
<td>Large waves begin to form; the white foam crests are more extensive everywhere.</td>
<td>Large branches in motion; whistling heard in telegraph wires; umbrellas used with difficulty.</td>
</tr>
<tr>
<td>7</td>
<td>32-38</td>
<td>28-33</td>
<td>Near Gale</td>
<td>Sea heaps up and white foam from breaking waves begins to be blown in streaks along the direction of the wind.</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>39-46</td>
<td>34-40</td>
<td>Gale</td>
<td>Whole trees in motion; inconvenience felt when walking against the wind.</td>
<td></td>
</tr>
<tr>
<td>----</td>
<td>-------</td>
<td>-------</td>
<td>---------------</td>
<td>--------------------------------------------------------------------------</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Moderately high waves of greater length; edges of crests begin to break into spindrift. The foam is blown in well-marked streaks along the direction of the wind.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Breaks twigs off trees; generally impedes progress.</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>47-54</td>
<td>41-47</td>
<td>Severe Gale</td>
<td>High waves. Dense streaks of foam along the direction of the wind. Crests of waves begin to topple, tumble and roll over. Spray may affect visibility</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Slight structural damage occurs (chimney-pots and slates removed)</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>55-63</td>
<td>48-55</td>
<td>Storm</td>
<td>Very high waves with long overhanging crests. The resulting foam, in great patches, is blown in dense white streaks along the direction of the wind. On the whole the surface of the sea takes on a white appearance. The tumbling of the sea becomes heavy and shock-like. Visibility affected.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Seldom experienced inland; trees uprooted; considerable structural damage occurs.</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>64-72</td>
<td>56-63</td>
<td>Violent Storm</td>
<td>Exceptionally high waves (small and medium-size ships might be for a time lost to view behind the waves). The sea is completely covered with long white patches of foam lying along the direction of the wind. Everywhere the edges of the wave crests are blown into froth. Visibility affected.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Very rarely experienced; accompanied by widespread damage.</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>73+</td>
<td>64+</td>
<td>Hurricane</td>
<td>The air is filled with foam and spray. Sea completely white with driving spray; visibility very seriously affected.</td>
<td></td>
</tr>
</tbody>
</table>

Based on those extent ranking factors identified (above), the planning committee ranks the extent of non-rotational wind hazards as **MODERATE**.
**Extent: Tornado**

Tornadoes have their own severity/extent scale. Until 2007, tornadoes were measured and described according to the Fujita Scale.¹⁴⁰

In February 2007, use of the Fujita Scale was discontinued. In its place, the Enhanced Fujita (EF) Scale is used. The Enhanced Fujita scale considers how most structures are designed and is thought to be a much more accurate representation of the surface wind speeds in the most violent tornadoes. Like the original Fujita scale, the Enhanced Fujita scale is a set of wind estimates (not measurements) based on damage.

It is important to note the **date** that a tornado occurred. Tornadoes that occurred prior to February, 2007 are classified using the original Fujita scale and will not be converted to the Enhanced Fujita Scale.

Table below illustrates the Fujita Scale in use prior to February 2007.

Table 9-26: Fujita Tornado Scale (Pre-February 2007) ¹⁴¹

<table>
<thead>
<tr>
<th>F-Scale Number</th>
<th>Intensity Phrase</th>
<th>Wind Speed</th>
<th>Type of Damage</th>
</tr>
</thead>
<tbody>
<tr>
<td>F0</td>
<td>Gale tornado</td>
<td>40-72 mph</td>
<td>Some damage to chimneys; breaks branches off trees; pushes over shallow-rooted trees; damages sign boards.</td>
</tr>
<tr>
<td>F1</td>
<td>Moderate tornado</td>
<td>73-112 mph</td>
<td>The lower limit is the beginning of hurricane wind speed; peels surface off roofs; mobile homes pushed off foundations or overturned; moving autos pushed off the roads; attached garages may be destroyed.</td>
</tr>
<tr>
<td>F2</td>
<td>Significant tornado</td>
<td>113-157 mph</td>
<td>Considerable damage. Roofs torn off frame houses; mobile homes demolished; boxcars pushed over; large trees snapped or uprooted; light object missiles generated.</td>
</tr>
<tr>
<td>F3</td>
<td>Severe tornado</td>
<td>158-206 mph</td>
<td>Roof and some walls torn off well-constructed houses; trains overturned; most trees in forest uprooted.</td>
</tr>
</tbody>
</table>

¹⁴⁰ Retrieved on 07.19.2021 from [https://www.weather.gov/tae/ef_scale](https://www.weather.gov/tae/ef_scale)

<table>
<thead>
<tr>
<th></th>
<th>Devastating tornado</th>
<th>Well-constructed houses leveled; structures with weak foundations blown off some distance; cars thrown and large missiles generated.</th>
</tr>
</thead>
<tbody>
<tr>
<td>F4</td>
<td></td>
<td>207-260 mph</td>
</tr>
<tr>
<td>F5</td>
<td>Incredible tornado</td>
<td>261-318 mph</td>
</tr>
<tr>
<td>F6</td>
<td>Inconceivable tornado</td>
<td>319-379 mph</td>
</tr>
</tbody>
</table>

Table below illustrates the Enhanced Fujita (EF) Scale, currently in use. Tornadoes that have occurred since February, 2007 are classified using the Enhanced Fujita Scale.
Table 9-27: Enhanced Fujita Scale (February 2007 and Later)\(^{142}\)

<table>
<thead>
<tr>
<th>Enhanced Fujita Category</th>
<th>Wind Speed</th>
<th>Potential Damage</th>
</tr>
</thead>
<tbody>
<tr>
<td>EF0</td>
<td>65-85 mph</td>
<td>Light damage. Peels surface off some roofs; some damage to gutters or siding; branches broken off trees; shallow-rooted trees pushed over.</td>
</tr>
<tr>
<td>EF1</td>
<td>86-110 mph</td>
<td>Moderate damage. Roofs severely stripped; mobile homes overturned or badly damaged; loss of exterior doors; windows and other glass broken.</td>
</tr>
<tr>
<td>EF2</td>
<td>111-135 mph</td>
<td>Considerable damage. Roofs torn off well-constructed houses; foundations of frame homes shifted; mobile homes completely destroyed; large trees snapped or uprooted; light-object missiles generated; cars lifted off ground.</td>
</tr>
<tr>
<td>EF3</td>
<td>136-165 mph</td>
<td>Severe damage. Entire stories of well-constructed houses destroyed; severe damage to large buildings such as shopping malls; trains overturned; trees debarked; heavy cars lifted off the ground and thrown; structures with weak foundations blown away some distance.</td>
</tr>
<tr>
<td>EF4</td>
<td>166-200 mph</td>
<td>Devastating damage. Well-constructed houses and whole frame houses completely leveled; cars thrown and small missiles generated.</td>
</tr>
<tr>
<td>EF5</td>
<td>&gt;200 mph</td>
<td>Incredible damage. Strong frame houses leveled off foundations and swept away; automobile-sized missiles fly through the air in excess of 100 m (107 yd); high-rise buildings have significant structural deformation; incredible phenomena will occur.</td>
</tr>
</tbody>
</table>

Based on the extent ranking factors identified (above), the planning committee ranks the extent of tornados as **LOW**.

**Extent: Hail**

The National Oceanic and Atmospheric Administration and the Tornado and Storm Research Organization (TORRO) have combined efforts to create the Hailstorm Intensity Scale. Table below provides details of this scale.

Table 9-28: Combined NOAA/TORRO Hailstorm Intensity Scale\(^\text{143}\)

<table>
<thead>
<tr>
<th>Size Code</th>
<th>Intensity Category</th>
<th>Typical Hail Diameter</th>
<th>Approximate Size</th>
<th>Typical Damage Impacts</th>
</tr>
</thead>
<tbody>
<tr>
<td>H0</td>
<td>Hard Hail</td>
<td>Up to 0.33”</td>
<td>Pea</td>
<td>No damage</td>
</tr>
<tr>
<td>H1</td>
<td>Potentially Damaging</td>
<td>0.33” – 0.60”</td>
<td>Marble or Mothball</td>
<td>Slight damage to plants and crops</td>
</tr>
<tr>
<td>H2</td>
<td>Potentially Damaging</td>
<td>0.60” – 0.80”</td>
<td>Dime or grape</td>
<td>Significant damage to fruit, crops, and vegetation</td>
</tr>
<tr>
<td>H3</td>
<td>Severe</td>
<td>0.80” – 1.20”</td>
<td>Nickel to Quarter</td>
<td>Severe damage to fruit and crops, damage to glass and plastic structures, paint and wood scored</td>
</tr>
</tbody>
</table>

---

<table>
<thead>
<tr>
<th>Extent</th>
<th>Size Range</th>
<th>Size Comparison</th>
<th>Damage Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>H4</td>
<td>Severe</td>
<td>1.20” – 1.60”</td>
<td>Half Dollar to Ping Pong Ball</td>
</tr>
<tr>
<td>H5</td>
<td>Destructive</td>
<td>1.60” – 2.0”</td>
<td>Silver Dollar to Golf Ball</td>
</tr>
<tr>
<td>H6</td>
<td>Destructive</td>
<td>2.0” – 2.4”</td>
<td>Lime or Egg</td>
</tr>
<tr>
<td>H7</td>
<td>Very Destructive</td>
<td>2.4” – 3.0”</td>
<td>Tennis Ball</td>
</tr>
<tr>
<td>H8</td>
<td>Very Destructive</td>
<td>3.0” – 3.5”</td>
<td>Baseball to Orange</td>
</tr>
<tr>
<td>H9</td>
<td>Super Hailstorms</td>
<td>3.5” – 4.0”</td>
<td>Grapefruit</td>
</tr>
</tbody>
</table>

Based on those extent ranking factors identified (above), the planning committee ranks the extent of the hail hazard as **LOW**.
**Extent: Lightning**

The National Weather Service (NWS) uses a Lightning Activity Level (LAL) scale to indicate the frequency and character of cloud-to-ground (C/G) lightning. The scale uses a range of 1 – 6, with 6 being the high end of the scale. Table 9-XX provides details of the LAL scale.

Table 9-29: Lightning Activity Level (LAL) Scale

<table>
<thead>
<tr>
<th>Rank</th>
<th>Cloud and Storm Development</th>
<th>Areal Coverage</th>
<th>Counts C/G per 5 Minutes</th>
<th>Counts C/G per 15 Minutes</th>
<th>Average C/G per Minute</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>No Thunderstorms</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>2</td>
<td>Cumulus clouds are common but only a few reaches the towering stage. A single thunderstorm must be confirmed in the rating area. The clouds mostly produce virga, but light rain will occasionally reach ground. Lightning is very infrequent.</td>
<td>&lt;15%</td>
<td>1-5</td>
<td>1-8</td>
<td>&lt;1</td>
</tr>
<tr>
<td>3</td>
<td>Cumulus clouds are common. Swelling and towering cumulus cover less than 2/10 of the sky. Thunderstorms are few, but 2 to 3 occur within the observation area. Light to moderate rain will reach the ground, and lightning is infrequent.</td>
<td>15% to 24%</td>
<td>6-10</td>
<td>9-15</td>
<td>1-2</td>
</tr>
</tbody>
</table>

---

<table>
<thead>
<tr>
<th>Rank</th>
<th>Cloud and Storm Development</th>
<th>Areal Coverage</th>
<th>Counts C/G per 5 Minutes</th>
<th>Counts C/G per 15 Minutes</th>
<th>Average C/G per Minute</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>Swelling cumulus and towering cumulus cover 2-3/10 of the sky. Thunderstorms are scattered but more than three must occur within the observation area. Moderate rain is commonly produced, and lightning is frequent.</td>
<td>25% to 50%</td>
<td>11-15</td>
<td>16-25</td>
<td>2-3</td>
</tr>
<tr>
<td>5</td>
<td>Towering cumulus and thunderstorms are numerous. They cover more than 3/10 and occasionally obscure the sky. Rain is moderate to heavy, and lightning is frequent and intense.</td>
<td>&gt;50%</td>
<td>&gt;15</td>
<td>&gt;25</td>
<td>&gt;3</td>
</tr>
<tr>
<td>6</td>
<td>Dry lightning outbreak. (LAL of 3 or greater with majority of storms producing little or no rainfall.)</td>
<td>&gt;15%</td>
<td>None</td>
<td>None</td>
<td>None</td>
</tr>
</tbody>
</table>

Based on those extent ranking factors identified (above), the planning committee ranks the extent of the lightning hazard as **LOW**.

**Extent: Thunderstorms that Generate Wind, Tornado, Hail, and Lightning Hazard Events**

Thunderstorms are not explicitly identified as a severe weather category for this hazard profile. However, they are responsible for most tornado, lightning, and hail hazard events – as well as a significant number of wind hazard events – across California and the CSU system. While individual thunderstorms affect relatively small areas, there are many instances in which thunderstorms can cluster together and/or travel in a line over long distances, producing significant damage over large geographic areas.

A thunderstorm is classified as “severe” when certain meteorological parameters within the thunderstorm are reached (i.e., damaging winds or speeds of 58 mph (50 knots) or greater, hail 1 inch in diameter or larger, and/or a tornado). However, there is currently no
established, objective severity scale for thunderstorms. That said, according to the *Glossary of Meteorology* published by the American Meteorological Society (AMS), a thunderstorm is reported as *light*, *medium*, or *heavy* according to following five (5) characteristics:

- the nature of the lightning and thunder;
- the type and intensity of the precipitation, if any;
- the speed and gustiness of the wind;
- the appearance of the clouds; and
- the effect upon surface temperature.

A thunderstorm may also be classified by the nature of the overall weather situation in which the thunderstorm is produced, including:

- **Airmass Thunderstorm**: A thunderstorm produced by local convection within an unstable air mass;

- **Frontal Thunderstorm**: An individual thunderstorm the initiation of which results from rising motion associated with a front, or a thunderstorm within a convective system generated and organized by frontal rising motion;

- **Squall-line Thunderstorm**: An individual thunderstorm included within a squall line (i.e., a continuous or broken line of active deep moist convection frequently associated with thunder).

Based on the extent ranking factors identified (above) in relation to campus layout and operations, and past event low degree of severity, the planning committee ranks the extent of the thunderstorm hazard as **LOW**.

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145 Retrieved on 07.15.2021 from [https://www.noaa.gov/explainers/severe-storms](https://www.noaa.gov/explainers/severe-storms)

146 Retrieved on 07.15.2021 from [https://www.weather.gov/safety/thunderstorm](https://www.weather.gov/safety/thunderstorm)


History of the Hazard

Severe weather hazards have been an annual occurrence in Fresno County and on the CSU Fresno campus. Historical data for these hazards are presented below.

Historical Storm Data Collection: NCEI Storm Events Database

Historical information regarding severe weather hazards can be found using The National Centers for Environmental Information (NCEI) Storm Events Database. The Storm Events Database contains searchable, archived National Weather Service (NWS) storm data from January 1950 to April 2021, as entered by NOAA’s National Weather Service (NWS). Due to changes in the data collection and processing procedures over time, there are unique periods of record available depending on the event type.152 For example, from 1950 through 1954, only tornado events were recorded; from 1955 through 1995, only tornado, thunderstorm wind, and hail events were introduced into the database; from 1996 to present, 45 additional event types are recorded, including high wind, strong wind, and lightning events.153 To obtain the most accurate portrayal of severe weather event frequency, searches of the Storm Events Database are conducted using data collected since 01/01/1996. As a reminder, all official severe weather event data is at the county level. Severe weather data do not exist at the campus level. That said, it may be the case that the campus to some degree experiences the severe weather events reported for the surrounding community and County.

Wind Hazards (excluding Tornadoes)

Information obtained from the NCEI Storm Event Database website shows the number of events (or occurrences) of wind hazard events in Fresno County since 1996.154 Here, wind hazard events include all “High Wind,” “Strong Wind,” and “Thunderstorm Wind” storm reports.155

- **High Wind:** at least 102 events, or approximately 4.03 events per year156

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**Strong Wind:** at least 194 events, or 7.66 events per year\(^{157}\)

**Thunderstorm Wind:** at least 49 events, or approximately 1.93 events per year\(^{158}\)

**All Wind Hazard events** (excluding Tornadoes): at least 343 events, or approximately 13.5 events per year.\(^{159}\) (Note: This was determined by conducting a simultaneous search of the component wind hazards of high wind, strong wind and thunderstorm wind.)

Overall, in Fresno County, there have been at least 343 wind hazard events since 1996, excluding tornadoes.\(^{160}\) That translates to an approximate average historical frequency of occurrence of **13.54** wind hazard events per year.

Please note: Differences between the sums of individual component severe weather hazard event Database searches (i.e., 345 events) and simultaneous Database searches of all severe weather hazard events (i.e., 343 events) may be due to the following factors: (1) multiple event types are in the same record (e.g., "Thunderstorm Wind/Hail" or "Hail/Tornado;" and/or (2) severe weather hazard events such as “Thunderstorm Wind” or “Hail” that are reported for Fresno County have actually taken place hundreds of miles away, but are erroneously recorded as events that have occurred in the County.\(^{161}\) When such a discrepancy arises, the more conservative aggregate hazard wind event value (i.e., 343 events) is used to determine the historical frequency of occurrence for the severe weather hazard. The origin of this discrepancy is unknown at this time.

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\(^{157}\) National Climatic Data Center. Storm Events Database. Retrieved on 07.29.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28Z%29+Strong+Wind&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=30&endDate_dd=30&endDate_yyyy=2021&county=FRESNO%3A19&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA

\(^{158}\) National Climatic Data Center. Storm Events Database. Retrieved on 07.29.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Thunderstorm+Wind&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=30&endDate_dd=30&endDate_yyyy=2021&county=FRESNO%3A19&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA

\(^{159}\) National Climatic Data Center. Storm Events Database. Retrieved on 07.29.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28Z%29+High+Wind&eventType=%28Z%29+Strong+Wind&eventType=%28C%29+Thunderstorm+Wind&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=30&endDate_dd=30&endDate_yyyy=2021&county=FRESNO%3A19&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA

\(^{160}\) National Climatic Data Center. Storm Events Database. Retrieved on 07.19.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28Z%29+High+Wind&eventType=%28Z%29+Strong+Wind&eventType=%28C%29+Thunderstorm+Wind&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=30&endDate_dd=30&endDate_yyyy=2021&county=FRESNO%3A19&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA

**Historical Wind Hazard Losses for Fresno County since 1996**

According to the NCEI Storm Events Database, the wind hazard events that Fresno County has experienced since 1996 have been costly. There have been 1 death and 20 injuries, and property and crop damage estimates have totaled approximately $217,636,000 and $2,751,000, respectively.162

**Tornado Wind Hazards**

Information from the NCEI Storm Events Database indicates that since 1996, there have been 17 reported events of tornadoes in Fresno County, which translates to approximately 0.67 tornado events per year.163

The vast majority of tornado reports in Fresno County since 1996 have been of tornadoes with a severity rating of F0/EF0. Three (3) of the tornadoes reported in has been rated F1/EF1 or higher (they were all F1/EF1 tornadoes); that translates to approximately 0.12 events of F1/EF1 tornadoes that have occurred per year in Fresno County.164

**Historical Tornado Hazard Losses for Fresno County since 1996**

According to the NCEI Storm Events Database, the tornado hazard events that Fresno County has experienced since 1996 have been costly. While there have been no deaths or injuries, property damage estimates have totaled approximately $781,000; crop damage estimates of $26,000 have also been reported.165 (Note: Two (2) of the F1/EF1 tornado events that occurred in Fresno County caused approximately $600,000 in property losses.)

**Hail**

162 National Climatic Data Center. Storm Events Database. Retrieved on 07.29.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28Z%29%2BHigh%2BWind&eventType=%28Z%29%2BStrong%2BWind&eventType=%28C%29%2BThunderstorm%2BWind&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=FRESNO%3A19&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA

163 National Climatic Data Center. Storm Events Database. Retrieved on 07.29.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29&Tornado&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=FRESNO%3A19&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA

164 National Climatic Data Center. Storm Events Database. Retrieved on 07.29.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29&Tornado&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=FRESNO%3A19&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA

165 National Climatic Data Center. Storm Events Database. Retrieved on 07.29.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29&Tornado&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=FRESNO%3A19&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA
Information from the NCEI Storm Events Database indicates that since 1996, there have been 78 reported events of hail in Fresno County, which translates to approximately **3.08** hail events per year.\(^{166}\) (Note: The NCEI Storm Event Database search results for hail indicate that there has been a total of 79 reports of hail since 1996. However, one (1) entry is for a hail event in San Diego County, hundreds of miles away from Fresno County. The origin of this discrepancy is unknown at this time.)

**Historical Hail Hazard Losses for Fresno County since 1996**

According to the NCEI Storm Events Database, the hail hazard events that Fresno County has experienced since 1996 have been costly. While there have been no deaths, there have been 13 injuries, and property damage estimates have totaled approximately **$60,500.**\(^ {167}\) Hail hazard events have been especially costly to Fresno County’s agricultural sector, generating **$95,385,000** in estimated crop damages since 1996.\(^ {168}\) (Note: The San Diego County hail event that was included erroneously in the search results for hail events in Fresno County accounted for five (5) injuries and a comparatively small amount (approximately 3.15%) of the total crop damage estimates presented in the search results for Fresno County.)

**Lightning**

Information from the NCEI Storm Events Database indicates that since 1996, there have been 34 reported event(s) of lightning in Fresno County, which translates to approximately **1.34** lightning hazard events per year.\(^ {169}\)

**Historical Lightning Hazard Losses for Fresno County since 1996**

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\(^{166}\) National Climatic Data Center. Storm Events Database. Retrieved on 07.29.2021 from [https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Hail&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=FRESNO%3A19&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA](https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Hail&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=FRESNO%3A19&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA)

\(^{167}\) National Climatic Data Center. Storm Events Database. Retrieved on 07.29.2021 from [https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Hail&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=FRESNO%3A19&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA](https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Hail&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=FRESNO%3A19&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA)

\(^{168}\) National Climatic Data Center. Storm Events Database. Retrieved on 07.29.2021 from [https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Hail&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=FRESNO%3A19&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA](https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Hail&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=FRESNO%3A19&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA)

\(^{169}\) National Climatic Data Center. Storm Events Database. Retrieved on 07.29.2021 from [https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Lightning&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=FRESNO%3A19&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA](https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Lightning&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=FRESNO%3A19&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA)
According to the NCEI Storm Events Database, the lightning hazard events that Fresno County has experienced since 1996 have been costly. While there have been no deaths there have been 3 injuries, and property and crop damage estimates have totaled approximately $1,768,000 and $300,000, respectively.\textsuperscript{170}

**All Severe Weather Hazard Events Recorded by the NCEI Storm Events Database**

Information obtained from the NCEI Storm Events Database indicates that there have been 472 occurrences of the severe weather hazard in Fresno County. This translates to \textbf{18.63} severe weather hazard occurrences per year.\textsuperscript{171}

Please note: Differences between the sums of individual component severe weather hazard event Database searches (i.e., 473 events) and simultaneous Database searches of all severe weather hazard events (i.e., 472 events) may be due to the following factors: (1) multiple event types are in the same record (e.g., "Thunderstorm Wind/Hail" or "Hail/Tornado;" and/or (2) severe weather hazard events such as “Thunderstorm Wind” or “Hail” that are reported for Fresno County have actually taken place hundreds of miles away, but are erroneously recorded as events that have occurred in the County.\textsuperscript{172} When such a discrepancy arises, the more conservative aggregate hazard wind event value (i.e., 472 events) is used to determine the historical frequency of occurrence for the severe weather hazard. The origin of this discrepancy is unknown at this time.

**Historical, Aggregated Severe Hazard Losses for Fresno County since 1996**

According to the NCEI Storm Events Database, the severe weather events that Fresno County has experienced since 1996 have been costly. There have been 1 death and 31 injuries, and property and crop damage estimates have totaled approximately $220,245,000 and $98,162,000, respectively.\textsuperscript{173} \textit{It is important to note that for all Fresno County severe weather hazard events recorded on the Storm Events Database, both wind and hail hazard events have accounted for all death and injuries. Wind hazard events have accounted for almost all (i.e., 98.8%) reported property damage, while hail hazard events have accounted for almost all (i.e., 97.2%) crop losses.}

**Wind Hazards Not Included in the NCEI Storm Events Database**

\textit{Santa Ana Winds}

\textsuperscript{170} National Climatic Data Center. Storm Events Database. Retrieved on 07.29.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Lightning&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=RESNO%3A19&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA

\textsuperscript{171} National Climatic Data Center. Storm Events Database. Retrieved on 07.29.2021 from


\textsuperscript{173} National Climatic Data Center. Storm Events Database. Retrieved on 07.29.2021 from
Santa Ana wind events occur at least twice per month from October through April.\textsuperscript{174} From 1948 to 2012, total of 2056 events on the 65-year record were recorded in the Southern California region, yielding an average of \textit{32 occurrences per year}. Typical Santa Ana wind events last 1–2 days and represent 27\% of the occurrences, with events lasting up to 6 days accounting for 90\% of all occurrences. The remaining 10\% are made up almost entirely of events lasting between 7 and 12 days.\textsuperscript{175 176}

Figure below shows the mean monthly frequency per season of Santa Ana Wind events detected from 1948 to 2012. Extreme Santa Ana wind events are shown in dark red, and are defined as those events that are above the 90th percentile of all events on record.

Diablo Winds

Diablo wind events occur approximately **2.5 events per year**. These events are most frequent during the fall and early winter seasons, with the highest frequency of events occurring in October. As a result, the highest risk of Diablo-wind-related damage is in the fall and early winter.  

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Figure below shows the monthly frequency of Diablo winds (along with average live fuel moisture content). The Diablo Wind data are derived from a 17-year climatology of San Francisco Bay Area regional surface weather stations.\textsuperscript{180}

Figure 9-20: Monthly Frequency of Diablo Winds and Average Live Fuel Moisture Content (Dashed Line)\textsuperscript{181}

**Sundowner Winds**

Strong sundowner wind events occur approximately \textbf{2-3 times per year}. These events can create sharp temperature rises, local gale force winds, and significant weather-related problems. Rare, “explosive” types of sundowner wind events occur about 6 times per century that present dangerous weather situations, generating extremely strong and hot winds that can reach gale force or higher speeds.\textsuperscript{182}

**Historical Frequency of All Severe Weather Hazards**

Table below shows the average historical frequency of severe weather hazard events for Fresno County since 1996.)

\textsuperscript{180} Retrieved on 07.15.2021 from https://www.fireweather.org/diablo-winds
\textsuperscript{181} Retrieved on 07.13.2021 from https://www.fireweather.org/diablo-winds
Table 9-30: Severe Weather Hazard Event

Frequencies for Fresno County since 1996.

<table>
<thead>
<tr>
<th>Severe Weather Hazard Category</th>
<th>Average Number of Hazard Events Per Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wind (Includes High, Strong and Thunderstorm Winds ONLY)</td>
<td>13.54</td>
</tr>
<tr>
<td>Tornado</td>
<td>0.67</td>
</tr>
<tr>
<td>Hail</td>
<td>3.08</td>
</tr>
<tr>
<td>Lightning</td>
<td>1.34</td>
</tr>
<tr>
<td>Diablo Wind*</td>
<td>2.5</td>
</tr>
<tr>
<td>Santa Ana Wind</td>
<td>32</td>
</tr>
<tr>
<td>Sundowner Wind*</td>
<td>2 to 3</td>
</tr>
</tbody>
</table>

* Note: The Diablo and Sundowner wind hazards are not present in Fresno County. They are included here for information purposes only.

Potential Impacts of the Hazard

The significance (or priority) of a hazard’s potential impacts is based primarily on the frequency and resulting damage caused by the hazard, including deaths/injuries and property, crop, and economic damage. All assets and people within CSU Fresno campus areas are at risk from the effects of severe weather hazards.

**Wind Hazards (Including Tornadoes)**

Wind hazard events have the potential to impact people, property, and operations on campuses across the CSU system. People caught in the open during an extreme wind event are exposed to high winds and debris, and could be injured or killed.

The habitability of buildings can be compromised (by damaging roofs, windows, or other weak points in the building envelope), leading to long-term operational issues for the campus. As with most university campuses, space is always at a premium at the CSU Fresno campus, and the loss of any currently utilized space due to building or structural damage would likely disrupt operations and the University’s mission.
Extreme wind events can result in power failure, which would impact the operation of the campus. Fallen tree limbs and other potential transportation hazards may also cause disruption to the surrounding community and limit ingress/egress to the campus.

According to the 2018 Fresno County Multi-Jurisdictional Hazard Mitigation Plan (MJHMP), wind hazards (excluding tornadoes) are considered to be of medium significance, and therefore to have a moderate impact on the County and (by extension) the CSU Fresno campus.  

Tornadoes are considered to be of low significance, and therefore to have a minimal impact on the County and (by extension) the CSU Fresno campus.

**Hail**

Hail typically impacts property by damaging structures, cars, and utilities as it falls. Dents in cars, broken glass, and holes in roofs are common impacts of hail. Injuries to people from hail are less common, though they can happen, as hail is a hard object falling in an unpredictable manner at a fairly high rate of speed.

According to the 2018 Fresno County Multi-Jurisdictional Hazard Mitigation Plan (MJHMP), hail hazards are considered to be of low significance, and therefore to have a minimal impact on the County and (by extension) the CSU Fresno campus.

**Lightning**

Lightning strikes the United States about 20-25 million times a year. Although most lightning occurs in the summer months, people can be struck at any time of year. Since 1990, lightning has killed an average of 39 people each year in the United States, and hundreds more have been injured. Property losses due to lightning have been very costly across the U.S. For example, from 2005 through 2020, U.S. homeowner’s insurance claim payouts for lightning losses totaled approximately $15,334,600,000, or $958,412,500 worth of payouts per year. (Commercial claim payouts for lightning losses for the U.S. were not available.)

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According to the 2018 Fresno County Multi-Jurisdictional Hazard Mitigation Plan (MJHMP), lightning hazards are considered to be of low significance, and therefore to have a minimal impact on the County and (by extension) the CSU Fresno campus.\textsuperscript{189}

**Probability of Future Occurrence of the Hazard**

Areas throughout California, including all California State University (CSU) campuses, experience severe weather events every year, and future occurrences of such events are projected to increase in both their frequency and intensity. The 2018 Fresno County Multi-Jurisdictional Hazard Mitigation Plan (MJHMP) states that there is a near 100\% chance that some of the severe weather hazards profiled above for Fresno County (i.e., hail and lightning) will occur in the next year, a 10-100\% chance that wind hazards will occur in the next year, and a 1-10\% chance that a tornado will occur in the next year.\textsuperscript{190} Also, according to the NCEI Storm Events Database, some of these same severe weather hazards have occurred in Fresno County at least once per year. Furthermore, while the severe weather hazard is a non-spatial hazard that affects all areas of the CSU Fresno campus equally, the smallest geographic unit of measurement for almost all official severe weather event data is at the county level. Because the severe weather data used in this assessment do not exist at the campus level, it is assumed that the severe weather probabilities for the CSU Fresno campus reflect those of the surrounding community and County identified in the Table below.

Based on the data available from both the 2018 Fresno County Multi-Jurisdictional Hazard Mitigation Plan (MJHMP) and the NCEI Storm Events Database, the severe weather hazard is expected to occur on (or otherwise impact) the CSU Fresno campus at least once on an annual basis. Therefore, the probability of future occurrence of the severe weather hazard for CSU Fresno is **HIGHLY LIKELY**. See Table below for probabilities of future occurrence for component severe weather hazards for Fresno County and the CSU Fresno campus.


**Table 9-31: Severe Weather Hazard Probabilities of Future Occurrence for Fresno County and CSU Fresno**

<table>
<thead>
<tr>
<th>Severe Weather Hazard Category</th>
<th>Average Number of Hazard Events Per Year</th>
<th>Probability of Future Occurrence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wind (Includes High, Strong and Thunderstorm Winds ONLY)</td>
<td>13.54</td>
<td>Highly Likely</td>
</tr>
<tr>
<td>Tornado</td>
<td>0.67</td>
<td>Likely</td>
</tr>
<tr>
<td>Hail</td>
<td>3.08</td>
<td>Highly Likely</td>
</tr>
<tr>
<td>Lightning</td>
<td>1.34</td>
<td>Highly Likely</td>
</tr>
<tr>
<td>Diablo Wind**</td>
<td>2.5</td>
<td>Not Rated</td>
</tr>
<tr>
<td>Santa Ana Wind</td>
<td>32</td>
<td>Highly Likely</td>
</tr>
<tr>
<td>Sundowner Wind**</td>
<td>2 to 3</td>
<td>Not Rated</td>
</tr>
<tr>
<td>Severe Weather Hazard</td>
<td></td>
<td>Highly Likely</td>
</tr>
</tbody>
</table>

**Note:** The Diablo and Sundowner wind hazards are not present in Fresno County, and therefore are not rated for probability of future occurrence. They are included here for information purposes only.

**Vulnerability to the Hazard**

People, structures, and assets on the CSU Fresno campus are all vulnerable to the impacts associated with severe weather. Infrastructure can be damaged or destroyed by hail, wind, tornadoes, thunderstorms, and lightning, which can result in service interruptions and outages. Structures can be damaged or destroyed by hail, wind, tornadoes, thunderstorms, and lightning. People can be injured or killed by lightning, flying debris, hail, or extreme wind events. The CSU Fresno campus also has vehicles, as well as off-campus conference and recreational facilities, that are all vulnerable to a severe weather event.

**Estimate of Potential Losses**

Severe weather is a non-spatial hazard that affects the entire CSU Fresno campus. Each of the hazards associated with severe weather can result in losses throughout the planning area.

All structures within the CSU Fresno campus are at risk from severe weather. There are approximately 116 buildings on the main campus that could be damaged by wind, hail,
and/or lightning. If even a fraction of these assets were to be damaged, the resulting estimated losses would still be in the millions of dollars. The total replacement costs due to severe weather hazard are $395,965,157 for 107 buildings, and unknown for nine (9) buildings. An analysis of projected dollar losses to campus buildings from severe weather as a percentage of building replacement costs is also not currently available, though CSU leadership may pursue such data in the future.

The population at the CSU Fresno campus varies throughout the day. As of Fall, 2019, CSU Fresno had 24,139 students and 2,534 faculty and staff; all are at risk from severe weather events, with 26,673 being directly vulnerable in this scenario.¹⁹¹

Vulnerability Assessment Conclusions

Severe weather presents a variety of hazards to the CSU Fresno campus. People, assets, infrastructure, and vehicles can all be damaged by this hazard, and losses can quickly begin to rise. In the aggregate, severe weather is a frequently occurring hazard (mostly in the form of wind hazard events) that presents a variety of risks to CSU Fresno.

It is evident that the CSU Fresno campus has vulnerabilities to and risks from severe weather hazard incidents, and that pre-event planning, communication, and mitigation efforts should be implemented. Public education and outreach regarding areas of shelter that could be used by campus populations during severe weather events is considered by campus leadership to be one viable mitigation option. The campus planning committee will continue to look for feasible and cost-effective options for the mitigation of severe weather risks going forward.

Identified Data Limitations

Numerous federal agencies maintain a variety of records regarding losses associated with hazards. Unfortunately, no single source is considered to offer a definitive accounting of all losses. The Federal Emergency Management Agency (FEMA) maintains records on federal expenditures associated with declared major disasters. The US Army Corps of Engineers (USACE) and the Natural Resources Conservation Service (NRCS) collect data on losses during the course of some of their ongoing projects and studies. Additionally, the National Oceanic and Atmospheric Administration’s (NOAA) National Centers for Environmental Information (NCEI) collects and maintains data about natural hazards in summary format, as well as occurrences, dates, injuries, deaths, and estimated costs for individual storm events. Many of these databases and other data collection services, including the NCEI, have inherent data limitations when searching for information at a scale as small as a single campus.

The best available data and records have been used throughout this section. Where no data or records exist or could be located, that deficiency is noted.

¹⁹¹ Retrieved on 07.19.2021 from https://www2.calstate.edu/csusystem/about-the-csu/facts-about-the-csu/enrollment/Pages/default.aspx
9.4 Social Resilience Assessment

Overview

While every person is vulnerable to risk, individuals from diverse populations such as those with access and functional needs are disproportionately more vulnerable and may be at a higher risk to harm in a disaster event. In addition to physical vulnerabilities, the intersectionality between physical hazard risks and population social vulnerabilities must be considered to holistically address overall campus risk.

As inclusivity is a high priority for CSU, addressing campus risk and resilience must be done through the lens of inclusion and equity. Addressing social vulnerability is an increasingly critical requirement of state and national doctrines and described in Section 4.4 of the HVRA Base Plan. Every individual of the campus’s richly diverse population group needs to have the capacity, skills, and knowledge in order to understand, access, and participate in risk reduction and disaster response in ways that are meaningful to their own unique situation. In a campus community, having strong social support networks and active involvement in community disaster responses may negatively or positively impact these opportunities and reduce the resilience-building process. This section offers a glimpse into the CSU Fresno campus’s unique social construct, population demographics, strengths and concerns and presents a high-level assessment of the resilience, coping capacities and potential social vulnerabilities of students, staff and faculty. The research variables that were asked are often considered sensitive subjects, and few are traditionally included in emergency management/hazard mitigation planning.

This social resilience assessment of college campuses is the first of its kind in the nation. The research methodology unfolded as the interviews with campuses progressed. The assessment data presented are not definitive or authoritative. The answers, analysis, and suggested trends are strictly indicators for potential social risk. They do not represent an accurate data capture as limitations on the data gathering process influenced an ability to provide accuracy. This assessment provides indications of increased risk, not accuracy of response or a true reflection of the situation of the campus. The information presented is to be considered in the context of the more detailed system-wide CSU social vulnerability assessment that is included in the baseline HVRA.

Campus-Identified Populations of Concern

During the campus interview, the following responses were provided when asked, “In considering the diverse population group(s) amongst student body, faculty and staff, which are of the most concern in your emergency management planning?”
Table 9-32: High level summary of campus populations of concern

<table>
<thead>
<tr>
<th>Question</th>
<th>Campus Response</th>
</tr>
</thead>
</table>
| Which population groups amongst the student body, faculty, and staff, are of the most concern for physical and social vulnerabilities in emergency management planning? | • Commuter students and employees  
• First generation students  
• Populations without reliable transportation or technology |
| Which population groups are most difficult to reach in an event?         | N/A                                                                             |
| Which population groups have little/limited support networks if impacted by an event? | N/A                                                                             |

Resilience Variables Related to Campus Emergency Management

The interviewees were asked to reflect on a set of 12 variables for the campus populations of student, faculty and staff: homelessness (housing insecurity), food security, health and wellness, disability/access and functional needs (AFN), racial equity, digital equity, communications, international students, immigrants/immigration status issues (undocumented, DACA, etc.), LGBTQI (Lesbian Gay Bisexual Transgender Questioning (or queer) Intersex), and transportation dependency. They were also offered an opportunity to add any other factor they wanted to include. The following two questions were asked:

- Is this factor a particular issue of concern for emergency management on your campus? Responses were summarized as Very High, High, Medium, Low
- Is this factor reflected in the emergency plans and processes for your campus? Responses were summarized as Yes, No, In Progress, NA

In order to provide a high-level qualitative response for the answers, the approach of averaging response was taken. If conflicting answers were expressed by the interviewees,
the answer (code) was averaged out. A detailed explanation of the response averaging approach is included in the base HVRA.

Table 9-33: campus-specific emergency management issues of concern and inclusion in emergency management plans and processes.

<table>
<thead>
<tr>
<th>Issue of Concern</th>
<th>Plans &amp; Processes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Homelessness (Housing Insecurity)</td>
<td>Low</td>
</tr>
<tr>
<td>Food Security</td>
<td>Low</td>
</tr>
<tr>
<td>Health &amp; Wellness</td>
<td>Very High</td>
</tr>
<tr>
<td>AFN</td>
<td>Medium</td>
</tr>
<tr>
<td>Digital Equity</td>
<td>Low</td>
</tr>
<tr>
<td>Comms.</td>
<td>Low</td>
</tr>
<tr>
<td>International Students</td>
<td>Low</td>
</tr>
<tr>
<td>Immigrants / Immigration Status</td>
<td>Low</td>
</tr>
<tr>
<td>LGBTQI</td>
<td>Low</td>
</tr>
</tbody>
</table>

Qualitative Narrative: Campus Overview of Potential Resilience Vulnerabilities

The following are interview notes of interest:

- Fresno is a Commuter campus with many coming 50 miles one way.
- Major of students are first generation college students and may not have support if significantly impacted so there is a lot of vulnerability; not a lot of resources in transportation, technology, that supports their focus on school.
- Mental health concerns and with a huge increase during COVID.
- Twitter platform-driven campus
- Great dept called the Cross Cultural and Gender Center with programs and resources for LGBTQI students with quite a few panels and discussions for resources.

Campus High Hazards and Potentially Vulnerable Populations

This section provides a brief introduction to the link between socially vulnerable populations and a particular hazard type. While extensive research has been conducted
on the impacts of hazards, not all linkages have been documented or published, and
detail for finding them are beyond the scope of this assessment. It’s important to note,
the intersectional nature of what makes an individual’s personal experience and resilience
to an event is played out by unique factors for that individual or population. The nuanced
social vulnerabilities often come from the social and physical environment in which a
person is embedded.

In order to aid in further assessing campus resilience, below is a general description of
the known impacts. From some hazards, the descriptions are robust, while others are
only brief introductions.

Table 9-34: CSU Fresno *Highly Likely and Likely* Hazards

<table>
<thead>
<tr>
<th>Hazard</th>
<th>Future Occurrence Probability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Communicable Disease</td>
<td>Highly Likely</td>
</tr>
<tr>
<td>Drought</td>
<td>Highly Likely</td>
</tr>
<tr>
<td>Earthquake</td>
<td>Possible</td>
</tr>
<tr>
<td>Erosion</td>
<td>Highly Likely</td>
</tr>
<tr>
<td>Extreme Temperature</td>
<td>Likely (Heat); Possible (Cold)</td>
</tr>
<tr>
<td>Flood</td>
<td>Possible</td>
</tr>
<tr>
<td>Hazardous Materials</td>
<td>Possible</td>
</tr>
<tr>
<td>Power Outage</td>
<td>Likely</td>
</tr>
<tr>
<td>Wildfire</td>
<td>Unlikely (Fire; Possible (Smoke)</td>
</tr>
</tbody>
</table>
**Drought**

The 2012-2016 drought had severe effects on two vulnerable sectors of our population: those in low-income brackets, and those, especially Native Americans, who rely on subsistence fishing for their livelihoods.\(^{192}\) Water bills increased throughout the state. Due to rising water prices, for the working poor, many have paid four to five percent of their income for water. Since many CSU students are commuters, and many living with families, future drought impacts may potentially affect a percentage of non-resident students. NASA’s modeling shows that future droughts are likely to last longer and be more intense, even leading to “megadroughts” in the western states.\(^{193}\) Fresh water supplies are predicted to be full of extremes, with both droughts and extreme precipitation events being more severe. The interrelationship between drought and other hazard conditions may lead to a set of secondary impacts. Drought conditions lead to water quality issues due to loss of drinking water, increased fire danger that leads to drought-induced fires and elevated AQI levels, as well as extreme heat or prolonged heat events.

**Earthquake**

Impacts on populations from earthquakes are complex, with long-term implications on social stability for all populations. In addition to the physical impact exposure during a no-notice earthquake event and the social and logistical challenges of a recovering community, an earthquake can have lasting impacts long afterwards due to post traumatic stress disorder (PTSD).

Socioeconomic vulnerabilities of populations at risk were analyzed in the hypothetical yet scientifically realistic earthquake sequence that is being used to better understand hazards for the San Francisco Bay region during and after a magnitude-7 earthquake (mainshock) on the Hayward Fault and its aftershocks. In this study, the at-risk populations located in areas of concentrated damage are anticipated to experience longer recovery trajectories, increased long term housing displacement, and transportation impacts due to dependencies on transit dependencies. When neighborhood schools close, families with school age children may move to other areas to keep their children in schools. Persons with access and functions needs are likely to be more dependent on access to functioning medical, social and personal health care services that would be overwhelmed by the event and therefore increasing their vulnerabilities. For the homeless populations, the loss of social community services and damages to shelters could add to protracted relocations. For the young and mobile populations who rent, the major disruption to housing, jobs and transit will also drive relocation. Widespread


housing damage and preexisting housing market constraints will make it “extremely challenging” for the socially and economically vulnerable populations to find alternative housing near their home communities. Those who utilize interim and irregular housing for months and years after a disaster are more vulnerable to physical, social, and mental disorders, including suicide, substance abuse, and physical and verbal abuse. Aftershocks and post disaster conditions delay population return and increase outmigration.\textsuperscript{194}

\textbf{Erosion}

Risk from erosion relates to earthen and infrastructural losses. The degree of vulnerability to these events and their impacts depends on human behavior and the traditional social factors such as situational awareness, prior knowledge of hazards, social capital and decision-making capabilities, as well as increased vulnerability due to social factors, such as racial and economic disparities.

\textbf{Extreme Temps}

People susceptible to respiratory ailments (asthma, lower and upper respiratory disease) disproportionately suffer from the effects of fire, smoke, air pollutions, allergens, heat and PSPS. Those with limited income or without resources are affected disproportionately due to the inability to provide safe shelter, air conditioning, cooling, air purification, medical care, and quality foods, and are also least able to obtain information related to climate risks and adaptation strategies.

\textbf{Cold}

Research shows that excess morbidity and mortality occurs during cold weather periods. We critically reviewed evidence relating temperature variability, health outcomes, and adaptation strategies to cold weather. Health outcomes included cardiovascular-, respiratory-, cerebrovascular-, and all-cause morbidity and mortality. Individual and contextual risk factors were assessed to highlight associations between individual- and neighborhood-level characteristics that contribute to a person’s vulnerability to variability in cold weather events.

Skin exposure to cold weather may render one susceptible to adverse health outcomes.\textsuperscript{195} Respiratory tract infections are more likely to occur during periods of low temperatures and low humidity. Socioeconomic indicators related to morbidity and mortality do not appear to strongly contribute to a person’s susceptibility to cold weather.


\textsuperscript{195} Pozos RS, Danzl D. Human physiological responses to cold stress and hypothermia. \textit{Medical aspects of harsh environments}. 2001;1:351–82
However, the role of socioeconomic status is not clear as some evidence implies that income disparities and fuel poverty contribute to cold-related mortality.  

The greatest danger from extreme cold is to people, as prolonged exposure can cause frostbite or hypothermia, and can become life threatening. When someone is suffering from hypothermia, body temperatures can become so low that they affect the brain, making it difficult for the victim to think clearly or move well. In the case of frostbite, the frozen tissue becomes numb and the victim may be unaware that anything is wrong until someone else notices. This makes hazards from extreme cold particularly dangerous, as people may not understand what is happening to them or what to do about it.

The primary hazards from extreme cold are frostbite and hypothermia. Frostbite is caused by freezing of the skin and underly tissue. It causes a loss of feeling and color in the affected areas of the body, and most often affects the nose, chin, fingers, or toes. It can be permanently damaging if not treated promptly and can lead to infection, nerve damage, or amputation in severe cases. The risk of frostbite is increased in people with preexisting conditions, the elderly, people with reduced blood circulation, and people who are not dressed warmly enough for the conditions.

Hypothermia occurs when the body loses heat faster than it can produce heat, causing a dangerously low body temperature. A normal body temperature is around 98.6°F. Hypothermia occurs when your body temperature falls below 95°F. As this happens, the heart and other essential organs cannot work properly. If hypothermia is not treated, it can lead to heart failure, respiratory failure, and eventually to death.

Heat

Heatstroke, cardiovascular disease, respiratory disease and cerebrovascular disease are related to extreme heat events. Increased number of heat waves creates heat-related physical stress on populations and is exacerbated in the metropolitan areas where greater amounts of heat-absorbing surfaces (e.g., asphalt and concrete) trap heat and emit higher temperatures throughout the night.

The heat also extends the geographic range and the distribution of disease-carrying insects and pests. Health professionals are concerned that California’s warming climate will allow species to acclimate. Such vectors include such pests as ticks that carry Lyme disease, and mosquitos that transmit Zika, dengue fever, West Nile, plague and tularemia. Some others, such as chikungunya, Chagas disease, and Rift Valley fever virus, are threats as well.

196 Excess winter mortality in Europe: a cross country analysis identifying key risk factors.

Some communities of color and some low-income, homeless, and immigrant populations are more exposed to heat waves, as these groups often reside in urban areas affected by heat island effects. In addition, these populations are likely to have limited adaptive capacity due to a lack of adequately insulated housing, inability to afford or to use air conditioning, inadequate access to public shelters such as cooling centers, and inadequate access to both routine and emergency health care. These social, economic, and health risk factors give rise to the observed increase in deaths and disease from extreme heat in some immigrant and impoverished communities.

Heat stroke, the most serious heat-related illness, occurs when the body is unable to control its temperature. Body temperature rises rapidly, the sweating mechanism fails, and the body cannot cool down. In extreme causes, heat stroke can cause confusion and unconsciousness, so the victim is unable to seek treatment without assistance.

There are several groups of people who are uniquely vulnerable to the effects of extreme heat, such as infants and children, older adults aged 65 and up, athletes and outdoor workers, low-income households, and individuals with certain chronic medical conditions.

When dealing with an extreme heat event, the most common impacts are those generally felt by the people living in the targeted area. For people in particular, heat can kill when the body is pushed beyond its limits. Most heat disorders occur because the victim has been overexposed to heat. As discussed, the major human risks associated with extreme heat include dehydration, sunburn, fatigue, heat exhaustion, heat stroke, and in severe cases, death.

Some portions of the population are more at risk to the effects of extreme heat. The very young, the elderly, and certain groups with chronic medical conditions (such as asthma or other pulmonary illnesses, heart disease, poor blood circulation, neurological illnesses, and obesity) are generally more vulnerable to the effects of extreme heat, and are more likely to suffer illness or death as a result.

This is especially true if exposure is extended for a period of time and preventative measures are not taken immediately. Distributional implications of impacts, and even less on distributional implications of adaptation actions.  

**Flood**

Risk from floods relates to community risk, exposure and infrastructural losses. The degree of vulnerability to these events and their impacts depends on human behavior and the traditional social factors such as situational awareness, prior knowledge of hazards, social capital and decision-making capabilities. The exposure of humans to floods continues to increase, driven by changes in hydrology and land use. The adverse

impacts on socially vulnerable populations are amplified because a disproportionately high number live in flood-prone areas. Research has shown that places of social vulnerabilities are places characterized by housing and racial disparities, such as mobile home parks, structural fragility and poverty, and higher percentages of populations such as Black and Native Americans, and others with shared histories of discrimination, marginalization and exclusion. 198

Health impacts from flooding are well recognized due to the extensive history of flooding in California and around the nation. The impacts range from waterborne illnesses from contaminated waters, respiratory illnesses that impact the lungs, throat, and airways from airborne particles, mold on flooded buildings that can trigger asthma, allergies and other illnesses—all which are particularly impactful to older, younger and individuals with pre-existing health condition. Foodborne illnesses can increase if there are issues with power outages or sewer overflows. Individuals with increased mental health concerns can be impacted by the stress or anxiety from the impacts of the flood. Poor quality housing can increase vulnerability to many flood risks, including flood inundation, power outages, mold growth, rodent vectors, and serious health impacts. For those with limited finances, flood inundation and impacts to infrastructure or farmlands may lead to extensive income losses.

The poorest residents suffer disproportionately to flood situations, especially those who have been less able to fund homeowner’s insurance to protect against flood losses. Loss of life is not unusual in flooding situations, as is loss of property, livestock, pets, workplaces, and tourist industries. There is a strong interrelationship between water events and other hazards. Flooding, storms and water quality are related to each other. Drought conditions can exacerbate floods as the surface soils are hardened and not as ready to allow surface water absorption. Extreme heat events can cause snowmelt, inundating waterways and causing flood and water quality issues. Flooding and storm events can have impacts on public health, environmental health, agricultural heath and economic system health. Mental health issues are reported for all people who have experience flood losses, including anxiety, fear, anger, anger, sadness and grief. 199 Additionally, waterborne disease outbreaks are reported weeks after the flood events. Mold contamination leads to indoor air issues. Damp indoor environments lead to increased prevalence of asthma, and also upper and lower respiratory symptoms.

These issues may influence the diverse CSU populations, both on and off campus, in a number of ways long after a flood event, or the related hazards impacts, has concluded.


**Hazardous Materials**

The severity of a hazardous materials release depends upon the type of material released, the amount of the release, and the proximity to populations or environmentally sensitive areas such as wetlands or waterways. The release of materials can lead to injuries or evacuation of nearby residents. Wind direction at the time of the release can also have a bearing on the severity (as well as the location and extent) of a hazardous materials release.

The primary threat from the hazardous materials incident hazard is to the structures located along transmission lines and transportation routes or near facilities that use or store hazardous materials. Minor incidents would likely cause no damage and little disruption, assuming they could be contained quickly. Major incidents could have fatal and disastrous consequences. The severity of a hazardous material release relates primarily to its impact on human safety and welfare and on the threat to the environment. Threats to human safety and welfare include:

- Poisoning of water or food sources and/or supply
- Presence of toxic fumes or explosive conditions
- Damage to personal property
- Need for the evacuation of people
- Interference with public or commercial transportation

Environmental risks are not uniformly distributed across groups of people. Age, poverty, and minority status place some groups at a disproportionately high risk for environmental disease.\(^{200}\) Poor access to health information and health care means less health promotion, less risk avoidance, a less healthy diet, and more adverse conditions that increase susceptibility to exposure. Delayed recognition of exposure, diagnosis, and treatment allows effects to accumulate.\(^{201}\)

**Power Outage/Public Safety Power Shutdowns (PSPS)**

Loss of power creates economic hardship to a region experiencing regular PSPS events, such as those experienced throughout the state over the recent years. Many businesses close, including gas stations, grocery stores, and local retail establishments. These impacts may deeply impact students dependent on support jobs, as well impacting family members of campus staff and faculty. PSPS increases risks to the public due to inability to use medical devices, spoilage of food and medicines, and disruption to infrastructure, such as supply of clean water and electricity used to run home medical equipment, such as lift chairs and ventilators.

\(^{200}\) [https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3222496/](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3222496/)

**Wildfire**

Increased wildfire threat occurs especially in the end of fall, when conditions are driest, but before the winter rains have come; an east-to-west wind gusts exacerbate fire risk. Wildfire threats have the concomitant threat of Public Safety Power Shutoffs (PSPS). And, in the case of an actual wildfire, danger exists both from fire and from the smoke. Recent wildfires have demonstrated that some demographics are disproportionately affected. Native Americans are six times more likely to be affected than white people. Blacks and Hispanic people are 50 percent more vulnerable. These values take into account the likelihood of a community being affected and the greater difficulty of that community to recover. These statistics reflect the lack of access to resources to pay for insurance, to rebuild and recover, to implement fire safety measures, and to access other resources. Price gouging after a fire (such as documented in Sonoma County after the 2017 Tubbs Fire) further exacerbates the disparity. Furthermore, the disabled and the elderly are at particular risk from extreme wildfire conditions, as they are often not as able to effectively evacuate. Of the 85 people who died in the Camp Fire in Butte in 2018, 62 of them were at least 65 years old.

Smoke from wildfires creates a significant public health threat. Especially vulnerable are individuals who have heart or lung issues, such heart disease, lung disease or asthma. Those most vulnerable include the medically fragile, elderly and children. Air Quality Indexes track the level of the following: particulate matter, surface levels of ozone, carbon monoxide, sulfur dioxide, and nitrogen dioxide. All of these can cause respiratory distress and harm lungs.

The California Department of Public Health reports the increased public health risks, and risk indicators that include: heat-related ED visits, populations living in wildfire areas, adults with multiple chronic conditions, populations living in poverty, race/ethnicity, outdoor workers, public transit access, air conditioner ownership and tree canopy.

**Hazard Mitigation and Emergency Management Planning**

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The goal of this high-level assessment is to provide a starting point to encourage further exploring campus social risks and vulnerabilities, as well as to inform and to enhance holistic emergency management and hazard mitigation decision making, planning processes and future adaptive risk management strategies. By including the social resilience factors, mitigation investments may move beyond standardized planning and regulations, structure and infrastructure projects, and natural systems protections to embrace a more expanded, customized emergency operations plan and an education and outreach program unique to the campus.

A more robust social resilience inquiry is strongly encouraged to develop an accurate picture, based on methodical and scientific research-based data. Such an effort would be envisioned through both nuanced discussions with a variety of campus stakeholders and the invitation of nontraditional stakeholders to join in a collaborative resilience partnership. Such a forward-leaning effort would be directly in keeping with CSU’s commitment to inclusion and equity in risk reduction.
### Section 10

California State University, Fullerton

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10.1 University Profile

University History

California State University, Fullerton (CSU Fullerton) was founded in 1959 as the Orange County State College. Following name changes in 1962 and 1964, the school made its final name change to California State University, Fullerton in 1972. It has the largest student body and graduate student body of the California State University system. Today, the school includes eight colleges and is classed as a Doctoral/Research College by the Carnegie Institute. It is a federally recognized Hispanic-Serving Institution and has been selected by the Carnegie Foundation for Distinctive Community Engagement. CSU Fullerton is designated as both a Hispanic-Serving Institution (HSI) and an Asian American and Native American Pacific Islander-Serving Institution (AANAPISI).

University Governance

The campus president is the chief executive officer who oversees the administration of the entire university. The president manages campus operations and fundraising, sets campus priorities, and oversees the hiring and support of staff and faculty. The president also maintains a close working relationship with the CSU’s systemwide office, reporting to the chancellor and participating in the systemwide Executive Council.

The provost is the chief academic officer of the university, overseeing all academic affairs and programs of the university. The provost reports directly to the president.

The Academic Senate develops policy on academic curriculum, standards, and criteria for faculty performance and other matters. If a policy created by the Academic Senate is approved by the president, it becomes university policy.

University Mission

“Learning is preeminent at California State University, Fullerton. We aspire to combine the best qualities of teaching and research universities where actively engaged students, faculty and staff work in close collaboration to expand knowledge.

We are a comprehensive, regional university with a global outlook, located in Orange County, a technologically rich and culturally vibrant area of metropolitan Los Angeles. Our expertise and diversity serve as a distinctive resource and catalyst for partnership with public and private organizations. We strive to be a center of activity essential to the intellectual, cultural and economic development of our region.”

CSU Fullerton outlines several goals in support of their mission. These priorities center on the preeminence of and quality of learning, enhancing collaborative approaches, creating an environment supportive of all students, and expanding community connections.
University Location

The 241-acre CSU Fullerton campus is located on the site of former citrus groves in the northeast section of Fullerton, CA. Fullerton, a city of approximately 140,000, is located approximately 25 miles southeast of downtown Los Angeles and 11 miles northeast of the Pacific Ocean. The surrounding area is characterized by an expanding housing development, rapidly diminishing supplies of undeveloped land, and demographic changes. CSU, Fullerton is the top employer in the city, while Orange County is home to many technology and financial services companies.

University Population

CSU Fullerton typically enrolls over 30,000 students per semester. In fall 2020, the 41,408-student population, with an average age of 23, was overwhelmingly made up of undergraduate degree seekers. Hispanic/Latinx students made up 46.2% of all students, with Asian students making up the second most populous group at 20.7%. Almost a third of all students are first-generation.

In addition to the student population, the University is home to approximately 4,000 employees.

10.2 Interim Final Rule for Hazard Vulnerability and Risk Assessment

**Requirement §201.6(c)(2):** The plan shall include a risk assessment that provides the factual basis for activities proposed in the strategy to reduce losses from identified hazards. Local risk assessments must provide sufficient information to enable the jurisdiction to identify and prioritize appropriate mitigation actions to reduce losses from identified hazards.

**Requirement §201.6(c)(2)(i):** [The risk assessment shall include a] description of the type...location and extent of all natural hazards that can affect the jurisdiction. The plan shall include information on previous occurrences of hazard events and on the probability of future hazard events.

**Requirement §201.6(c)(2)(ii):** [The risk assessment shall include a] description of the jurisdiction’s vulnerability to the hazards described in paragraph (c)(2)(i) of this section. This description shall include an overall summary of each hazard and its impact on the community.

**Requirement §201.6(c)(2)(ii)(A):** [The risk assessment] must also address National Flood Insurance Program (NFIP) insured structures that have been repetitively damaged floods.

**Requirement §201.6(c)(2)(ii)(A):** The plan should describe vulnerability in terms of the types and numbers of existing and future buildings, infrastructure, and critical facilities located in the identified hazard area.
Requirement §201.6(c)(2)(ii)(B): [The plan should describe vulnerability in terms of an] estimate of the potential dollar losses to vulnerable structures identified in paragraph (c)(2)(ii)(A) of this section and a description of the methodology used to prepare the estimate ..

Requirement §201.6(c)(2)(ii)(C): [The plan should describe vulnerability in terms of] providing a general description of land uses and development trends within the community so that mitigation options can be considered in future land use decisions.

Requirement §201.6(c)(2)(iii): For multi-jurisdictional plans, the risk assessment must assess each jurisdiction’s risks where they vary from the risks facing the entire planning area.

10.3 Hazard Identification and Risk Assessment

Overview of California State University, Fullerton History of Hazards

Numerous federal agencies maintain a variety of records regarding losses associated with hazards. Unfortunately, no single source is considered to offer a definitive accounting of all losses. The Federal Emergency Management Agency (FEMA) maintains records on federal expenditures associated with declared major disasters. The US Army Corps of Engineers (USACE) and the Natural Resources Conservation Service (NRCS) collect data on losses during the course of some of their ongoing projects and studies. Additionally, the National Oceanic and Atmospheric Administration’s (NOAA) National Centers for Environmental Information (NCEI) database collects and maintains data about natural hazards in summary format. The data includes occurrences, dates, injuries, deaths, and estimated costs. Many of these databases and other data collection services, including the NCEI, have inherent data limitations when searching for information at a university scale.

The best available data and records were used throughout this assessment.

Hazard Identification

As part of the initial hazard identification process, the Campus Assessment Team considered potential hazards with the most chance to significantly affect the planning area. The hazards include those that have occurred in the past and may occur in the future. A variety of sources were used to develop the list of hazards considered including national, regional, and local sources such as emergency operations plans, FEMA’s How-To Series, websites, published documents, databases, and maps, as well as discussion among the Campus Assessment Team members.

In the initial phase of the planning process, the Campus Assessment Team considered 14 hazards and the risks they create for the University and its material assets, population, and operations. The hazards initially considered, and the determinations as to the treatment of those hazards, are shown in Table 10-1 (following).
### Table 10-1: Hazard Identification Determinations

<table>
<thead>
<tr>
<th>Hazard</th>
<th>Determination (Yes/No)</th>
<th>Reason for Determination</th>
<th>Future Occurrence Probability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Communicable Disease</td>
<td>Yes</td>
<td>Hazard of concern for campus</td>
<td>Highly Likely</td>
</tr>
<tr>
<td>Dam and Levee Failure</td>
<td>Yes</td>
<td>Hazard of concern for campus</td>
<td>Unlikely</td>
</tr>
<tr>
<td>Drought</td>
<td>Yes</td>
<td>Hazard of concern for campus</td>
<td>Highly Likely</td>
</tr>
<tr>
<td>Earthquake</td>
<td>Yes</td>
<td>Hazard of concern for campus</td>
<td>Possible</td>
</tr>
<tr>
<td>Erosion</td>
<td>Yes</td>
<td>Hazard of concern for campus</td>
<td>Highly Likely</td>
</tr>
<tr>
<td>Extreme Temperature</td>
<td>Yes - Heat; No - Cold</td>
<td>Hazard of concern for campus</td>
<td>Highly Likely (Heat Only)</td>
</tr>
<tr>
<td>Flood</td>
<td>Yes</td>
<td>Hazard of concern for campus</td>
<td>Unlikely</td>
</tr>
<tr>
<td>Hazardous Materials</td>
<td>Yes</td>
<td>Hazard of concern for campus</td>
<td>Possible</td>
</tr>
<tr>
<td>Landslide</td>
<td>Yes</td>
<td>Hazard of concern for campus</td>
<td>Unlikely</td>
</tr>
<tr>
<td>Power Outage</td>
<td>Yes</td>
<td>Hazard of concern for campus</td>
<td>Likely</td>
</tr>
<tr>
<td>Sea Level Rise</td>
<td>No</td>
<td>Not a hazard of concern for campus</td>
<td>N/A</td>
</tr>
<tr>
<td>Tsunami</td>
<td>No</td>
<td>Not a hazard of concern for campus</td>
<td>N/A</td>
</tr>
<tr>
<td>Volcano</td>
<td>Yes</td>
<td>Hazard of concern for campus</td>
<td>Unlikely</td>
</tr>
<tr>
<td>Wildfire</td>
<td>Yes</td>
<td>Hazard of concern for campus</td>
<td>Unlikely (Fire); Possible (Smoke)</td>
</tr>
</tbody>
</table>

**Future Occurrence Probability**

In order to determine the probability of future occurrences of each hazard profiled, the following scale was developed:

- Highly Likely- 76%-100% that the hazard would occur annually.
- Likely- 50%-75% that the hazard would occur annually.
- Possible- 11%-49% that the hazard would occur each annually.
- Unlikely- 0%-10% that the hazard would occur each annually.
**Communicable Disease**

**Description of the Hazard**

Communicable diseases are illnesses that occur due to infectious agents or their toxic products, and are infectious due to their potential of transmission from one person or species to another by a replicating agent. They may be transmitted from a reservoir to a susceptible host either directly as from an infected person or animal or indirectly through the agency of an intermediate plant or animal host, vector, or the inanimate environment. Communicable diseases are clinically evident illness resulting from the presence of pathogenic microbial agents, including pathogenic viruses, pathogenic bacteria, fungi, protozoa, multi-cellular parasites, and aberrant proteins known as prions. The degree of spread of a communicable disease depends on both the ability of an organism to enter, survive and multiply in the host and the comparative ease with which the disease is transmitted to other hosts.

Some ways in which communicable diseases spread are by:

- Travel through the air, such as tuberculosis, measles, or COVID-19;
- Physical contact with an infected person, such as through touch (staphylococcus), sexual intercourse (gonorrhea, HIV), fecal/oral transmission (hepatitis A), or droplets (influenza, TB, COVID-19);
- Contact with a contaminated surface or object (Norwalk virus), food (salmonella, E. coli), blood (HIV, hepatitis B), or water (cholera); and
- Bites from insects or animals capable of transmitting the disease (mosquito: malaria and yellow fever; flea: plague)

Collectively, the twenty-three (23) campuses and Chancellor’s Office of the California State University (CSU) system have identified nine (9) communicable disease hazards that that have had significant impacts on their respective student, faculty, and staff populations. Of these communicable diseases, COVID-19 is considered to be the most prominent and widespread agent across all CSU campuses. (See Table 10-2 below.)

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1 California Legislative Information. *Health and Safety Code – HSC*. Print. Retrieved 03.22.2021 from: [https://leginfo.legislature.ca.gov/faces/codes_displaySection.xhtml?lawCode=HSC&sectionNum=120290.&text=(2)%20%E2%80%9CInfectious%20or%20communicable%20diseases%20has%20significant%20public%20health%20implications](https://leginfo.legislature.ca.gov/faces/codes_displaySection.xhtml?lawCode=HSC&sectionNum=120290.&text=(2)%20%E2%80%9CInfectious%20or%20communicable%20diseases%20has%20significant%20public%20health%20implications)


Table 10-2: Communicable Diseases Identified CSU Campuses

<table>
<thead>
<tr>
<th>Collective List of Communicable Diseases Identified by All CSU Campuses</th>
<th>Number of CSU Campuses (Including Chancellor’s Office) Identifying Communicable Disease Having Significant Impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>COVID-19 (SARS-CoV-2)</td>
<td>24</td>
</tr>
<tr>
<td>Meningitis</td>
<td>7</td>
</tr>
<tr>
<td>Measles</td>
<td>6</td>
</tr>
<tr>
<td>Influenza (Including H1N1/ Swine Flu)</td>
<td>6</td>
</tr>
<tr>
<td>Tuberculosis</td>
<td>5</td>
</tr>
<tr>
<td>Norovirus</td>
<td>4</td>
</tr>
<tr>
<td>Mumps</td>
<td>2</td>
</tr>
<tr>
<td>E. Coli</td>
<td>2</td>
</tr>
<tr>
<td>Sexually Transmitted Diseases (STDs)</td>
<td>2</td>
</tr>
</tbody>
</table>

(Source: Interviews with CSU campus staff at CSU campuses and at CSU Chancellor’s Office.)

With the exception of COVID-19, there is variability among CSU campuses regarding which communicable diseases have had the greatest impact on individual campus communities. Table 10-3 shows the communicable disease hazards that have had the greatest impact on each CSU campus.

Table 10-3: Communicable Disease Hazards at CSU Campuses with Greatest Impact

<table>
<thead>
<tr>
<th>CSU Campus</th>
<th>Identified Communicable Disease Hazards with the Greatest Impact on CSU Campus</th>
</tr>
</thead>
<tbody>
<tr>
<td>CSU Bakersfield</td>
<td>COVID-19, Meningitis</td>
</tr>
<tr>
<td>CSU Channel Islands</td>
<td>COVID-19, Measles</td>
</tr>
<tr>
<td>Chico State</td>
<td>COVID-19, Tuberculosis</td>
</tr>
<tr>
<td>CSU Dominguez Hills</td>
<td>COVID-19</td>
</tr>
<tr>
<td>Cal State East Bay</td>
<td>COVID-19, Meningitis</td>
</tr>
<tr>
<td>Fresno State</td>
<td>COVID-19, Meningitis, Tuberculosis</td>
</tr>
<tr>
<td>Cal State Fullerton</td>
<td>COVID-19, Influenza</td>
</tr>
<tr>
<td>Humboldt State</td>
<td>COVID-19, Measles, Norovirus, Influenza, STDs</td>
</tr>
<tr>
<td>Cal State Long Beach</td>
<td>COVID-19</td>
</tr>
</tbody>
</table>
Cal State LA: COVID-19, E. coli, Measles
Cal Maritime: COVID-19
CSU Monterey Bay: COVID-19
CSUN (Northridge): COVID-19, Measles
Cal Poly Pomona: COVID-19, Influenza (Swine Flu - H1N1)
Sacramento State: COVID-19
Cal State San Bernardino: COVID-19, Tuberculosis
San Diego State: COVID-19, Meningitis, Mumps
San Francisco State: COVID-19
San José State: COVID-19, H1N1
Cal Poly San Luis Obispo: COVID-19, Meningitis, Norovirus
CSU San Marcos: COVID-19
Sonoma State: COVID-19, H1N1, Norovirus
Stanislaus State: COVID-19, Tuberculosis
Office of the Chancellor: COVID-19

CSU System-Wide: COVID-19, Meningitis, Measles, Tuberculosis, Influenza-Swine Flu-H1N1, Mumps, Norovirus, E. coli, STDs

(Source: Interviews with CSU campus staff at CSU campuses and at CSU Chancellor’s Office.)

Descriptions of Identified Communicable Disease Hazards at CSU Fullerton

CSU Fullerton has identified two (2) communicable disease hazards that have had the greatest impact on campus – COVID-19 and Influenza. The following are brief descriptions of the communicable disease hazards at CSU Fullerton.

COVID-19 (SARS-CoV-2)

Coronaviruses are a family of viruses that can cause illnesses such as the common cold, severe acute respiratory syndrome (SARS) and Middle East respiratory syndrome (MERS). In 2019, a new coronavirus was identified as the cause of a disease outbreak that originated in China. This virus is now known as the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2). The disease it causes is called Coronavirus Disease 2019 (COVID-19). In March 2020, the World Health Organization (WHO) declared the COVID-19 outbreak a pandemic.
Signs and symptoms of coronavirus disease 2019 (i.e., COVID-19) may appear two to 14 days after exposure. Common signs and symptoms can include fever, cough, and tiredness. Early symptoms of COVID-19 may also include a loss of taste or smell.

The virus that causes COVID-19 spreads easily among people, and more continues to be discovered over time about how it spreads. Data has shown that the COVID-19 virus spreads mainly from person to person among those in close contact (within about 6 feet, or 2 meters). The virus is transmitted by respiratory droplets being released when someone with the virus coughs, sneezes, breathes, sings or talks. These droplets can be inhaled or land in the mouth, nose or eyes of a person nearby. In some situations, the COVID-19 virus can spread by a person being exposed to small droplets or aerosols that stay in the air for several minutes or hours (i.e., airborne transmission). It's not yet known how common it is for the virus to spread this way. The COVID-19 virus can also spread if a person touches a surface or object with the virus on it and then touches his or her mouth, nose or eyes; however, this is not considered to be a main way it spreads.

The severity of COVID-19 symptoms can range from very mild to severe. Some people may have only a few symptoms, and some people may have no symptoms at all. However, some people may experience worsened symptoms, such as worsened shortness of breath and pneumonia. People who are older have a higher risk of serious illness from COVID-19, and the risk increases with age. People who have existing medical conditions also may have a higher risk of serious illness from COVID-19. In some cases, the disease can cause severe medical complications and may even lead to death.5

Influenza (Including sub-type H1N1/Swine Flu)

Influenza is a viral infection that attacks the respiratory system (i.e., nose, throat, and lungs). Influenza viruses travel through the air in droplets when someone with the infection coughs, sneezes or talks. Influenza is transmitted either by inhaling virus-laden droplets directly, or by coming into physical contact with an object (e.g., telephone or computer keyboard) and then transferring the virus to the eyes, nose or mouth. People with the virus are likely contagious from about a day before symptoms appear until about five days after symptoms begin.

Common signs and symptoms of the flu include: fever, aching muscles, hills and sweats, headache, dry and persistent cough, shortness of breath, tiredness and weakness, runny or stuffy nose, sore throat, and eye pain. (Vomiting and diarrhea are also influenza signs and symptoms, but these are more common in children than in adults.)

Influenza viruses are constantly changing, with new strains appearing regularly. As a result, antibodies against influenza viruses that have been encountered in the past

may not offer protection from new influenza strains, as the new strains can be very different viruses from previous strains.\(^6\)

**H1N1 Flu (Swine Flu)**

The H1N1 flu, commonly known as swine flu, is a type of influenza A virus and is one of several flu viruses strains that can cause the seasonal flu. It is primarily caused by the H1N1 strain of the flu (influenza) virus. Symptoms of the H1N1 flu are the same as those of the seasonal flu.

The H1N1 virus is a combination of viruses from pigs, birds and humans that causes disease in humans. The virus enters your body when you inhale contaminated droplets or transfer live virus from a contaminated surface to your eyes, nose or mouth. It then infects the cells that line your nose, throat and lungs.\(^7\)

**Location of the Hazard**

Communicable diseases have the potential to affect the entire CSU Fullerton planning area equally. As a result, the communicable disease hazard can be found at the CSU Fullerton campus located in Fullerton, CA (Orange County). Because of the ubiquitous nature of many communicable diseases, students, faculty, staff at (and visitors to) CSU-Fullerton are at risk of exposure to the communicable disease hazard.

**CSU Student Housing Locations and Populations**

Although CSU-campus-owned student housing opportunities have been severely limited due to the COVID-19 pandemic, this situation is temporary. Eventually, students will be allowed back on campus at full capacity, and many of these students will be living in campus-owned housing. When this occurs, over 53,000 students (i.e., just over 11% of the CSU total enrollment) will be at increased risk of exposure to communicable disease hazards, owing to the “close-quarters” living arrangements in student housing. For CSU – Fullerton, 6% of the campus’ 39,868 students (2,392 students) lived in campus housing.

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Extent of the Hazard

Various communicable diseases are categorized by the Center for Disease Control and Prevention (CDC) by levels of containment called Biosafety Levels (or BSLs). The higher the BSL, the greater the level of containment and level of effort necessary to prevent transmission of the disease, and therefore the greater the hazard.

Biosafety Levels prescribe procedures and levels of containment for a particular microorganism or material (including research involving recombinant or synthetic nucleic acid molecules) and procedures associated with that containment. BSLs also consider primary barriers (e.g., biosafety cabinets), secondary barriers, facility design, air handling, laboratory security, etc. BSLs are graded from 1 to 4; as the BSL increases so does the relative risk of the agent/procedures as well the stringency of procedures and facility design.

Figure 10-1 describes the different BSLs, and provides examples of communicable diseases that would typically fall in to these classifications, as well as the typical protections that would be necessary to prevent transmission of each of the diseases.
The Extent of CSU Fullerton Communicable Disease Hazards Except COVID-19:

Before the COVID-19 pandemic, there were cases of Influenza at CSU Fullerton. Influenza would be classified at either the BSL-2 or BSL-3 containment level, depending on the strain.9

The Extent of CSU Fullerton COVID-19 Communicable Disease Hazard:

As a microorganism, the SARS-CoV-2 (COVID-19) virus requires a high level of containment. It is therefore classified at BSL-3.10

History of the Hazard

Over an approximately one-year period, from mid-March, 2020 to March 23, 2021, there were a reported 413 cases of COVID-19 at CSU Fullerton. CSU-campus-specific COVID-19 case data for CSU Fullerton can be found in the “History of the Hazard” section below.

Each CSU campus is an integral part of the surrounding community. Any event that occurs on a CSU campus has an effect on both the adjacent areas of campus and on the community-at-large – and vice-versa. Communicable disease hazard events are no exception. Most communicable disease data are maintained by at the state and at the

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county levels, and are not generally available at the municipal or campus levels, unless (a) the CSU campus falls under the jurisdiction of a city-level health department, or (b) a geographically specific outbreak occurs on campus or in the local community. The exception to this is the current COVID-19 pandemic, where both campus and County-level case data have been collected. As a result, it is important to provide COVID-19 case statistics for both CSU campuses and the counties where CSU campus assets are located.

Tables 10-5, 10-6, and 10-7 show campus- level and county-level COVID-19 case data for CSU Fullerton. These case data are updated on at least a weekly basis. (Please note that the COVID-19 case numbers here may not reflect the most recent updates.)

Since the beginning of the fall 2020 semester, the University has received the following number of reports of positive COVID-19 cases among students, employees and/or vendors/contractors who were on campus:

Table 10-4: COVID-19 Case Count Reported on Campus – CSU Fullerton (as of 03/15/2021)\(^1\)

<table>
<thead>
<tr>
<th>Population</th>
<th>Confirmed Cases</th>
</tr>
</thead>
<tbody>
<tr>
<td>Students</td>
<td>23</td>
</tr>
<tr>
<td>Employees</td>
<td>39</td>
</tr>
<tr>
<td>Vendor/Contractor</td>
<td>6</td>
</tr>
<tr>
<td><strong>Total Cases</strong></td>
<td><strong>68</strong></td>
</tr>
</tbody>
</table>

Table 10-5: Case Count Reported off Campus – CSU Fullerton (as of 03/15/2021)\(^2\)

<table>
<thead>
<tr>
<th>Population</th>
<th>Confirmed Cases</th>
</tr>
</thead>
<tbody>
<tr>
<td>Students</td>
<td>241</td>
</tr>
<tr>
<td>Employees</td>
<td>98</td>
</tr>
<tr>
<td>Vendor/Contractor</td>
<td>6</td>
</tr>
<tr>
<td><strong>Total Cases</strong></td>
<td><strong>345</strong></td>
</tr>
</tbody>
</table>


Table 10-6: Orange County COVID-19 Statistics (as of 03/21/2021)

<table>
<thead>
<tr>
<th>Total Confirmed County Cases</th>
<th>Total Deaths</th>
</tr>
</thead>
<tbody>
<tr>
<td>249,539</td>
<td>4,607</td>
</tr>
</tbody>
</table>

Potential Impacts of the Hazard

Communicable disease outbreaks and pandemics potentially have (and will continue to have) direct impact on life, health, and safety across the CSU system, including CSU - Fullerton. The extent of this impact is contingent on the type of infection or contagion, the severity of the outbreak, and the speed at which it is transmitted. Property and infrastructure integrity may be affected if large portions of CSU campus populations contract communicable diseases at the same time and are therefore unable to perform maintenance, operations, and educational tasks. This would be particularly disruptive if those impacted are first responders or other essential personnel. Long-term outbreaks affecting large numbers of CSU - Fullerton students could result in cancelled classes, delayed matriculation, or other disruptions to the CSU System's mission. This has already occurred with the current COVID-19 pandemic to some degree on the campus and could occur again with more virulent strains of communicable diseases, including COVID-19.

Communicable disease hazards found across the CSU system (including the Fullerton campus) vary both by level of containment (BSL) (described previously) and by level of individual/public health risk, or Risk Group (RG) level. While BSLs describe the procedures and required levels of containment in a laboratory setting, Risk Groups (RGs) reflect the potential effects of disease exposure on humans or animals. Like BSLs, RGs range from Level 1 (RG1) to Level 4 (RG4), with Level 1 (RG1) posing minimal risk to healthy individuals and public health and Level 4 (RG4) posing a very serious or extreme risks to individuals and public. BSLs generally correlate with Risk Group (RG) Levels (e.g., a RG2 agent is worked with at BSL-2), but there are exceptions (e.g., production volumes, high-risk procedures, etc.).

The World Health Organization’s (WHO) Laboratory Biosafety Manual, 3rd ed., NIH Guidelines, categorizes Risk Groups (RGs) in the following way:

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Table 10-7: WHO Risk Group Categorization

<table>
<thead>
<tr>
<th>Risk Group (RG)</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>RG1</td>
<td>Rarely associated with disease in healthy adult humans or animals and pose no-to-little public health risk (e.g., Saccharomyces cerevisiae, E. coli K-12 strain derivatives often used for recombinant/molecular biology, many environmental organisms)</td>
</tr>
<tr>
<td>RG2</td>
<td>Associated with mild to moderate disease for which preventative measures or post exposure treatments are often available; public health impact is limited (e.g., Streptococcus pyogenes, Salmonella, hepatitis B virus)</td>
</tr>
<tr>
<td>RG3</td>
<td>Associated with serious to lethal human disease for which preventative vaccines or post-exposure therapies may be scarce. Public health impact is limited-to-moderate (e.g., Mycobacterium tuberculosis, hantaviruses, West Nile virus, SARS)</td>
</tr>
<tr>
<td>RG4</td>
<td>Associated with serious to lethal human disease for which preventative vaccines or post exposure therapies are not usually available. Public health impact is high (e.g., Ebola virus, Marburg virus, smallpox virus, etc.)</td>
</tr>
</tbody>
</table>

Table 10-9 describes the four (4) Risk Group Levels (RGs), and provides examples of communicable diseases that would typically fall in to these classifications, and the typical protections that would be necessary to prevent transmission of the disease. It is important to note that all but two (2) communicable disease hazards identified by CSU campuses fall under either the lower-risk RG1 or RG2 categories. COVID-19 and tuberculosis are the two (2) communicable diseases fall under the higher-risk RG3 category. However, with the advent of the recently-developed COVID-19 vaccine, and with the expectation of an increasingly robust vaccine supply, it is possible that the RG level for COVID-19 could be lowered in the future, thereby reducing both the extent and the potential impact of COVID-19.

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Table 10-8: Risk Group Levels (RGs) with Example Diseases and Recommended Precautions

<table>
<thead>
<tr>
<th>Level</th>
<th>Examples</th>
<th>Typical Protection to Prevent Transmission</th>
</tr>
</thead>
<tbody>
<tr>
<td>RG I</td>
<td>E. Coli</td>
<td>Precautions are minimal, most likely involving gloves and some sort of facial protection. Usually, contaminated materials are left in open (but separately indicated) waste receptacles. Decontamination procedures for this level are similar in most respects to modern precautions against everyday viruses (i.e.: washing one's hands with anti-bacterial soap, washing all exposed surfaces of the lab with disinfectants, etc.).</td>
</tr>
<tr>
<td>RG 2</td>
<td>Chicken Pox, Hepatitis A, B, C, Lyme disease, Salmonella, Mumps, Measles, Malaria, Scrapie, Dengue Fever, HIV</td>
<td>These bacteria and viruses cause mild disease in humans or are difficult to contract via aerosol. Routine diagnostic work with clinical specimens can be done safely at BSL-2, using BSL-2 practices and procedures.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>RG 3</th>
<th>Anthrax</th>
<th>These bacteria and viruses cause severe to fatal disease in human, but vaccines or other treatments do exist to combat them. Laboratory personnel have specific training in handling pathogenic and potentially lethal agents and are supervised by competent scientists who are experienced in working with these agents. This is considered a neutral or warm zone.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>West Nile Virus</td>
<td></td>
</tr>
<tr>
<td></td>
<td>SARS Virus (Including COVID-19)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Tuberculosis</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Typhus</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Yellow Fever</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Hantaviruses</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Avian Flu</td>
<td></td>
</tr>
<tr>
<td>RG 4</td>
<td>H5N1 (Bird Flu)</td>
<td>These viruses and bacteria cause severe to fatal disease in humans, for which vaccines or other treatments are <em>not</em> available. When dealing with biological hazards at this level the use of a Hazmat suit and a self-contained oxygen supply is mandatory. The entrance and exit of a BSL-4 lab will contain multiple showers, a vacuum room, an ultraviolet light room, autonomous detection system, and other safety precautions designed to destroy all traces of the biohazard. Multiple airlocks are employed and are electronically secured to prevent both doors opening at the same time. All air and water service going to and coming from a BSL-4 lab will undergo similar decontamination procedures to eliminate the possibility of an accidental release.</td>
</tr>
<tr>
<td></td>
<td>Dengue Hemorrhagic Fever</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Marburg Virus</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Ebola Virus</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Smallpox</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Lassa Fever</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Crimean-Congo Hemorrhagic Fever</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Other Hemorrhagic Diseases</td>
<td></td>
</tr>
</tbody>
</table>

**Probability of Future Occurrence of the Hazard**

There have been cases of a variety of communicable disease throughout the CSU system, including COVID-19 (SARS-CoV-2), Meningitis, Measles, Influenza (Including H1N1/Swine Flu), Tuberculosis, Norovirus, Mumps, E. Coli, and Sexually Transmitted Diseases (STDs). However, there are significant data limitations regarding non-COVID-19 communicable disease cases, as the information thereof is outdated, anecdotal, and/or inadequate. As a result, it is not feasible to provide quantitative probabilities of future occurrence for non-COVID-19 communicable disease hazards. However, based
on the limited data, it is feasible to present qualitative probabilities of future occurrence based on ranges of communicable disease frequency.

Table 10-10 shows a probability scale of future occurrence for the nine (9) communicable disease hazards profiled in this assessment. This scale is divided into four (4) levels of probability:

Table 10-9: Likelihood of Future Hazard Occurrence

<table>
<thead>
<tr>
<th>Likelihood</th>
<th>Parameters for Determining Likelihood</th>
</tr>
</thead>
<tbody>
<tr>
<td>Highly Likely</td>
<td>76 – 100% probability that hazard will occur annually (high to very high frequency)</td>
</tr>
<tr>
<td>Likely</td>
<td>50 – 75% probability that hazard will occur annually (moderate to high frequency)</td>
</tr>
<tr>
<td>Possible</td>
<td>11 – 49% probability that hazard will occur annually (low to moderate frequency)</td>
</tr>
<tr>
<td>Unlikely</td>
<td>0 – 10% probability that hazard will occur annually (very low to low frequency)</td>
</tr>
</tbody>
</table>

Due to significant data limitations surrounding non-COVID communicable diseases, the probability of future occurrence of CSU-system-wide communicable disease is measured by the proportion of campuses that have identified a particular communicable disease as having an impact on the campus community. In this measure, the more frequent a communicable disease is seen as impactful CSU-wide, the greater the probability of future occurrence. It is important to note here that a communicable disease can be rated as having a probability of future occurrence CSU-system-wide that is different from that at the individual CSU campus level.

Table 10-10: Probability of Future Occurrence of Communicable Disease Hazard for CSU System

<table>
<thead>
<tr>
<th>Collective List of Communicable Diseases Identified by All CSU Campuses</th>
<th>Number of CSU Campuses (Including Chancellor’s Office) Identifying Communicable Disease Having Significant Impact</th>
<th>Proportion of CSU Campuses Identifying Communicable Disease as Having Significant Impact System-Wide</th>
<th>CSU System-Wide Probability Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>COVID-19 (SARS-CoV-2)</td>
<td>24</td>
<td>1.00</td>
<td>Highly Likely</td>
</tr>
<tr>
<td>Meningitis</td>
<td>7</td>
<td>0.29</td>
<td>Possible</td>
</tr>
<tr>
<td>Measles</td>
<td>6</td>
<td>0.25</td>
<td>Possible</td>
</tr>
<tr>
<td>Disease</td>
<td>Risk</td>
<td>Probability</td>
<td>Likelihood</td>
</tr>
<tr>
<td>----------------------------------------------</td>
<td>------</td>
<td>-------------</td>
<td>------------</td>
</tr>
<tr>
<td>Influenza (Including H1N1/Swine Flu)</td>
<td>6</td>
<td>0.25</td>
<td>Possible</td>
</tr>
<tr>
<td>Tuberculosis</td>
<td>5</td>
<td>0.21</td>
<td>Possible</td>
</tr>
<tr>
<td>Norovirus</td>
<td>4</td>
<td>0.17</td>
<td>Possible</td>
</tr>
<tr>
<td>Mumps</td>
<td>2</td>
<td>0.08</td>
<td>Unlikely</td>
</tr>
<tr>
<td>E. Coli</td>
<td>2</td>
<td>0.08</td>
<td>Unlikely</td>
</tr>
<tr>
<td>Sexually Transmitted Diseases (STDs)</td>
<td>2</td>
<td>0.08</td>
<td>Unlikely</td>
</tr>
</tbody>
</table>

(Source: Interviews with staff at CSU campuses and at the CSU Chancellor’s Office.)

Vulnerability to the Hazard

Vulnerability to a communicable diseases hazard resides in the population of a given area – both human and animal – not in the infrastructure or physical assets. While CSU assets and infrastructure could be impacted indirectly by the communicable disease hazard, these impacts would be secondary to the impact that the communicable disease hazard would have on students, faculty, staff, and visitors at CSU campuses.

CSU campus settings are geographically diverse, with locations ranging from small towns to medium-sized cities to densely populated urban areas. Hundreds of thousands of people work, study, and/or pass through CSU campuses on any given day. (As of Fall 2019, the CSU – Fullerton campus had 39,868 students and additional faculty and staff.)

Each of these persons is vulnerable to communicable disease, particularly if it is a pathogen that individual has not been immunized against, or for which no immunization exists. Prolonged outbreaks could result in a loss of services, failure of infrastructure (from lack of operators or maintenance), and closure of facilities. This exact scenario has played out in the current COVID-19 pandemic.

Estimate of Potential Losses

COVID-19 Pandemic Health Impact on CSU Campuses and Surrounding Communities

The nationwide campus-related COVID-19 death rate of 0.02% remains well below the average COVID-19 death rate in the U.S. However, due to data limitations, there is no information on CSU-campus-specific deaths by COVID-19 or by any other

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17 The California State University. Enrollment. Retrieved 05.03.2021 from: https://www2.calstate.edu/csu-system/about-the-csu/facts-about-the-csu/enrollment/Pages/default.aspx
18 The California State University. Employee Head Count by Campus. Retrieved 05.03.2021 from: https://www2.calstate.edu/csu-system/faculty-staff/employee-profile/csu-workforce/Pages/employee-headcount-by-campus.aspx
communicable diseases. In fact, COVID-19 is the only communicable disease for which case reports have been readily available for CSU campuses.

At some point in the future, CSU campuses will return to full capacity. Without adequate surveillance regarding campus access and student and employee interaction, CSU campuses are at risk of developing an extreme incidence of COVID-19 and may become “super-spreaders” for adjacent communities. The emergence of more virulent COVID-19 variants would only add to the potential for high negative impacts on life safety, operations, and service delivery across the CSU system. (Other communicable diseases would also re-emerge, but with low to moderate negative impacts on life safety, operations, and service delivery.)

**Economic Impact of COVID-19 Pandemic on CSU Financial Health**

During the first few months of the COVID-19 pandemic in 2020, the CSU system suffered tremendous negative fiscal impacts. From March through July of 2020 alone, over $146 million worth of revenue losses were sustained across the CSU system due to refunds to students for parking, housing and dining service fees during Spring Semester, 2020. Several CSU campuses saw refund losses surpass $10 million. (See Figure below.)

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Mitigative Relief from Federal Assistance

The $1.5 billion in total federal assistance sent to the CSU system will help relieve the losses of revenues from services like dorms, parking and dining services during a year of mainly empty campuses. (See Table below) However, because of staggering COVID-related revenue losses, the CSU system is planning for three (3) years of fiscal duress.

---

Table 10-11: Total Federal Assistance to CSU for COVID-19 Related Losses, 2020 – 2021\textsuperscript{21,22,23}

<table>
<thead>
<tr>
<th>Institution</th>
<th>December 2020 Stimulus</th>
<th>CARES Act</th>
<th>APLU Projection of HEERF Total ARP Act Funding Allocation</th>
<th>Total Estimated Federal COVID Relief Funding</th>
</tr>
</thead>
<tbody>
<tr>
<td>California Polytechnic State University</td>
<td>$20,752,799</td>
<td>$14,725,000</td>
<td>$37,000,928</td>
<td>$72,478,727</td>
</tr>
<tr>
<td>California State Polytechnic University, Pomona</td>
<td>$48,614,353</td>
<td>$31,102,000</td>
<td>$86,044,649</td>
<td>$165,761,002</td>
</tr>
<tr>
<td>California State University Channel Islands</td>
<td>$14,288,099</td>
<td>$8,512,000</td>
<td>$24,915,170</td>
<td>$47,715,269</td>
</tr>
<tr>
<td>California State University Maritime Academy</td>
<td>$1,381,700</td>
<td>$1,204,000</td>
<td>$2,472,622</td>
<td>$5,058,322</td>
</tr>
<tr>
<td>California State University - Sacramento</td>
<td>$59,891,260</td>
<td>$35,643,000</td>
<td>$104,900,13</td>
<td>$200,434,393</td>
</tr>
<tr>
<td>California State University, Bakersfield</td>
<td>$22,855,632</td>
<td>$12,483,000</td>
<td>$40,285,565</td>
<td>$75,624,197</td>
</tr>
<tr>
<td>California State University, Chico</td>
<td>$31,603,856</td>
<td>$20,019,000</td>
<td>$55,754,538</td>
<td>$107,377,394</td>
</tr>
<tr>
<td>California State University,</td>
<td>$31,843,563</td>
<td>$18,312,000</td>
<td>$55,915,410</td>
<td>$106,070,973</td>
</tr>
</tbody>
</table>


<table>
<thead>
<tr>
<th>Institution</th>
<th>Total Revenue</th>
<th>Total Operating Revenues</th>
<th>Total Financial Aid</th>
<th>Total Enrollment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dominguez Hills</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>California State University, East Bay</td>
<td>$24,243,652</td>
<td>$14,394,000</td>
<td>$42,929,208</td>
<td>$81,566,860</td>
</tr>
<tr>
<td>California State University, Fresno</td>
<td>$52,725,317</td>
<td>$32,557,000</td>
<td>$92,926,594</td>
<td>$178,208,911</td>
</tr>
<tr>
<td><strong>California State University, Fullerton</strong></td>
<td><strong>$67,736,949</strong></td>
<td><strong>$41,088,000</strong></td>
<td><strong>$120,859,884</strong></td>
<td><strong>$229,684,833</strong></td>
</tr>
<tr>
<td>California State University, Long Beach</td>
<td>$67,421,424</td>
<td>$41,202,000</td>
<td>$119,508,329</td>
<td>$228,131,753</td>
</tr>
<tr>
<td>California State University, Los Angeles</td>
<td>$61,905,561</td>
<td>$40,067,000</td>
<td>$108,543,672</td>
<td>$210,516,233</td>
</tr>
<tr>
<td>California State University, Monterey Bay</td>
<td>$13,455,716</td>
<td>$8,705,000</td>
<td>$23,922,768</td>
<td>$46,083,484</td>
</tr>
<tr>
<td>California State University, Northridge</td>
<td>$74,004,088</td>
<td>$47,458,000</td>
<td>$131,021,450</td>
<td>$252,483,538</td>
</tr>
<tr>
<td>California State University, San Bernardino</td>
<td>$42,438,131</td>
<td>$27,924,000</td>
<td>$74,982,459</td>
<td>$145,344,590</td>
</tr>
<tr>
<td>California State University, San Marcos</td>
<td>$26,602,684</td>
<td>$15,542,000</td>
<td>$46,496,808</td>
<td>$88,641,492</td>
</tr>
<tr>
<td>California State University, Stanislaus</td>
<td>$22,007,207</td>
<td>$12,928,000</td>
<td>$38,636,391</td>
<td>$73,571,598</td>
</tr>
<tr>
<td>Humboldt State University</td>
<td>$16,130,016</td>
<td>$11,146,000</td>
<td>$28,831,619</td>
<td>$56,107,635</td>
</tr>
<tr>
<td>San Diego State University</td>
<td>$45,914,127</td>
<td>$30,394,000</td>
<td>$80,592,385</td>
<td>$156,900,512</td>
</tr>
<tr>
<td>San Francisco State University</td>
<td>$47,404,409</td>
<td>$30,000,000</td>
<td>$83,075,470</td>
<td>$160,479,879</td>
</tr>
<tr>
<td>San Jose State University</td>
<td>$46,631,939</td>
<td>$30,977,000</td>
<td>$82,976,130</td>
<td>$160,585,069</td>
</tr>
</tbody>
</table>
Vulnerability Assessment Conclusions

Before the COVID-19 pandemic, populations at all CSU campuses and CSU-affiliated facilities were substantial. Collectively, as of Fall 2019, CSU campuses had 480,541 students and 53,763 faculty and staff. All were at risk from the communicable disease events, with 534,304 people being directly vulnerable. The COVID-19 pandemic has caused campus population numbers to plummet to a small fraction of full capacity.

At some point in the future, campus population numbers will return to their pre-pandemic levels, and students, faculty, and staff will again be vulnerable to the communicable disease hazard. If just 10% of the total CSU population were to become ill with a highly infective communicable disease like influenza or another strain of SARS, this would mean that approximately 53,430 people would be sick at the same time. This scenario would likely overwhelm available on-campus medical services could even overwhelm portions of the larger community’s medical resources—especially if there were large numbers of infected people with immune system compromises or other underlying health problems. Table 10-13 shows the “10% outbreak scenario” projections both for each CSU campus and for the entire CSU system.
Table 10-12: Scenario of Communicable Disease Hazard Affecting 10% of the CSU Population

<table>
<thead>
<tr>
<th>CSU Campus</th>
<th>Approximate Enrollment Population (Fall 2019)</th>
<th>Approximate Total FT/PT Faculty/Staff Population (Fall 2019)</th>
<th>Total Combined Approximate Student and Faculty/Staff Population</th>
<th>10% Outbreak Scenario (Students and Faculty/Staff Combined)</th>
</tr>
</thead>
<tbody>
<tr>
<td>CSU Bakersfield</td>
<td>11,199</td>
<td>1,277</td>
<td>12,476</td>
<td>1,248</td>
</tr>
<tr>
<td>CSU Channel Islands</td>
<td>7,093</td>
<td>994</td>
<td>8,087</td>
<td>809</td>
</tr>
<tr>
<td>Chico State</td>
<td>17,019</td>
<td>1,969</td>
<td>18,988</td>
<td>1,899</td>
</tr>
<tr>
<td>CSU Dominguez Hills</td>
<td>17,027</td>
<td>1,761</td>
<td>18,788</td>
<td>1,879</td>
</tr>
<tr>
<td>Cal State East Bay</td>
<td>14,705</td>
<td>1,764</td>
<td>16,469</td>
<td>1,647</td>
</tr>
<tr>
<td>Fresno State</td>
<td>24,139</td>
<td>2,534</td>
<td>26,673</td>
<td>2,667</td>
</tr>
<tr>
<td>Cal State Fullerton</td>
<td>39,868</td>
<td>3,736</td>
<td>43,604</td>
<td>4,360</td>
</tr>
<tr>
<td>Humboldt State</td>
<td>6,983</td>
<td>1,171</td>
<td>8,154</td>
<td>815</td>
</tr>
<tr>
<td>Cal State Long Beach</td>
<td>38,074</td>
<td>4,004</td>
<td>42,078</td>
<td>4,208</td>
</tr>
<tr>
<td>Cal State LA</td>
<td>26,361</td>
<td>2,821</td>
<td>29,182</td>
<td>2,918</td>
</tr>
<tr>
<td>Cal Maritime</td>
<td>911</td>
<td>329</td>
<td>1,240</td>
<td>124</td>
</tr>
<tr>
<td>CSU Monterey Bay</td>
<td>7,123</td>
<td>1,059</td>
<td>8,182</td>
<td>818</td>
</tr>
<tr>
<td>CSUN (Northridge)</td>
<td>38,391</td>
<td>3,832</td>
<td>42,223</td>
<td>4,222</td>
</tr>
<tr>
<td>Cal Poly Pomona</td>
<td>27,914</td>
<td>2,650</td>
<td>30,564</td>
<td>3,056</td>
</tr>
<tr>
<td>Sacramento State</td>
<td>31,156</td>
<td>3,228</td>
<td>34,384</td>
<td>3,438</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Campus</th>
<th>Enrollment</th>
<th>Students</th>
<th>Population</th>
<th>Cases</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cal State San Bernardino</td>
<td>20,311</td>
<td>2,118</td>
<td>22,429</td>
<td>2,243</td>
</tr>
<tr>
<td>San Diego State</td>
<td>35,081</td>
<td>3,702</td>
<td>38,783</td>
<td>3,878</td>
</tr>
<tr>
<td>San Francisco State</td>
<td>28,880</td>
<td>3,401</td>
<td>32,281</td>
<td>3,228</td>
</tr>
<tr>
<td>San José State</td>
<td>33,282</td>
<td>3,568</td>
<td>36,850</td>
<td>3,685</td>
</tr>
<tr>
<td>Cal Poly San Luis Obispo</td>
<td>21,242</td>
<td>2,871</td>
<td>24,113</td>
<td>2,411</td>
</tr>
<tr>
<td>CSU San Marcos</td>
<td>14,519</td>
<td>1,687</td>
<td>16,206</td>
<td>1,621</td>
</tr>
<tr>
<td>Sonoma State</td>
<td>8,649</td>
<td>1,338</td>
<td>9,987</td>
<td>999</td>
</tr>
<tr>
<td>Stanislaus State</td>
<td>10,614</td>
<td>1,276</td>
<td>11,890</td>
<td>1,189</td>
</tr>
<tr>
<td>Office of the Chancellor</td>
<td>0</td>
<td>673</td>
<td>673</td>
<td>67</td>
</tr>
<tr>
<td><strong>CSU System-Wide</strong></td>
<td><strong>480,541</strong></td>
<td><strong>53,763</strong></td>
<td><strong>534,304</strong></td>
<td><strong>53,430</strong></td>
</tr>
</tbody>
</table>

*Note: Enrollment figures do not include non-specific CSU campus International Programs (455 students) or CALStateTEACH Program (933 students).*

While the case numbers of COVID-19 have been significantly lower (about 1% of the total CSU population) than those in the 10% scenario, the degree of virulence and resultant morbidity and mortality caused by COVID-19 have led to widespread campus shutdowns, educational disruption, and economic harm to the CSU system. In short, the real-time COVID-19 communicable disease outbreak scenario has proven far more devastating than the 10% simulated scenario.

**Identified Data Limitations**

There is a wealth of technical information available for communicable disease. However, there is also limited non-COVID-19 communicable disease data available regarding risk or vulnerability of specific populations throughout the CSU. Much of the data that does exist is protected by privacy policies, and therefore cannot be obtained for more specific populations. As a result, performing a detailed quantitative assessment for this hazard is difficult.

Data that could be collected prior to the next update in order to improve this methodology includes:

- Data regarding infection rates at the campus level and for specific populations;
- Data regarding communicable disease case numbers and outcomes, by CSU campus;
- Data regarding projected population changes;
- Data regarding absenteeism; and
Data regarding increased operating costs as a result of absenteeism (i.e., temporary shifting of duties resulting in business interruption).

**Dam and Levee Failure**

Description of the Hazard

A dam failure represents the structural collapse of a dam that stores water in a reservoir behind the dam. These failures are typically the result of structural age, damage to the structure caused by earthquake or flooding, inadequate discharge or spillway capacity, inadequate maintenance, improper construction materials, or extreme inflow of water into the reservoir. Prolonged precipitation may result in overtopping of the dam resulting in structural compromise. The tremendous energy generated by a sudden breach of the dam will have significant downstream effects. Flood damage resulting from dam failures potentially will result in economic losses, environmental damage, destruction of agriculture, and human casualties. This type of incident is extremely dangerous as it can occur rapidly, with no warning resulting in an inability to effectively evacuate threatened communities.

A levee failure is similar to dam failures as the result will be a breach causing flooding on the dry side of the levee. Levees are embankments whose primary purpose is to furnish flood protection from seasonal high water or divert the flow of water. Most levees in California are intended to withstand peak water levels generated by heavy precipitation or rapid snowmelt in a watershed. Other levees are designed to withstand fluctuating water levels on a continuous basis such as those in the California Delta exposed to tidal influences. Levees routinely extend for lengthy distances immediately protecting communities. Levees can be found throughout the state but are most prominent in the Sacramento and San Joaquin Valleys.

Levee failures can vary from overtopping to small uncontrolled discharge to catastrophic failure. Areas downstream of the failure will be subject to inundation dependent on the volume of water released. These levee failures are also typically the result of structural age, damage to the structure caused by earthquake or flooding, slumping, seepage underneath the levee, high velocity flows eroding the levee, inadequate capacity, inadequate maintenance, improper construction materials, or extreme inflow of water into the system. Flood damage resulting from levee failures potentially will result in economic losses, environmental damage, destruction of agriculture, and human casualties.

A Dam or levee failure flooding will vary depending on a number of factors including the extent of the collapse or breach, the volume of water behind the structure, and the

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nature of the exposed downstream features. This unpredictable flooding presents a threat to life and property in addition to critical infrastructure. Lifelines and supply routes will likely be damaged or made impassible by flood erosion or standing water. Water quality and health concerns would likely be cascading effects of dam or levee failures.

Location of the Hazard

Orange County is home to a variety of flood control facilities and levee systems mostly along the base of the various mountains and hills throughout the county. Levees have been constructed along flood control channels providing community protection, primarily the Santa Ana River. The CSU Fullerton campus is in proximity to two relatively small dams upstream along the Fullerton Creek. The campus is not in proximity to rivers or flood control channels lined with levees.
There are a number of dam facilities along the base of the Santa Ana Mountains, Chino Hills, and the San Joaquin Hills. The larger facilities include the Prado Dam located in Riverside County on the Santa Ana River. This is a large reservoir with the potential holding capacity of 295,581-acre feet of water when full, however this lake is not a storage facility that routinely holds water instead used for flood control when needed. The CSU Fullerton campus lies outside of dam inundation zones for this facility but major transportation routes south of the campus are included.
Figure 10-4: Fullerton Inundation Map

27 California Department of Water Resources, Dam Breach Inundation Map Publisher, https://fmds.water.ca.gov/webgis/?appid=dam_prototype_v2
The Santa Ana drains the San Bernardino Mountains and parts of the San Gabriel and Santa Ana Mountains. A number of flood control systems feed into the Santa Ana River throughout the Inland Empire and northern Orange County. The length of the Santa Ana River from Prado Dam to the outlet into the ocean is a levee lined channel. The channel is located almost 3 miles southeast of the CSU Fullerton campus, is separated from the campus by additional flood control channels, and is lower in elevation than the campus. The campus is located within a levee protected zone for the Santa Ana River.

The Fullerton Creek is a drainage channel that runs alongside the northwest corner of the campus that drains a portion of the Puente Hills, Chino Hills, the Humble Reservoir, and Fullerton Reservoir. The channel feeds into the Coyote Creek Channel in La Palma. The Fullerton Creek is a rock lined flood control channel fed by additional channels near the campus. The creek is regulated by the Fullerton Dam ½ north of the campus. The campus lies within the flood inundation zone for the Fullerton Dam.

Extent of the Hazard

Dams are classified according to the hazard that they pose to life and property in the event of failure, rather than the likelihood of that failure.

- **High hazard potential dams** may result in loss of human life, and will likely result in economic, environmental, or lifeline losses.
- **Significant hazard potential dams** are not expected to result in loss of life, but are expected to cause economic, environmental, and lifeline losses.
- **Low hazard potential dams** are not expected to result in loss of life, and there is a low expectation of economic, environmental, or lifeline losses. What losses do occur are generally limited to the dam owner.

Dams classified as high hazard are required to have Emergency Action Plans (EAP). EAPS are formal documents that identify potential emergency conditions at the dam and specify preplanned actions to be followed in case of failure. An EAP is required for all high hazard dams and is recommended for all significant hazard dams.

Table 10-13: Orange County Dams in Proximity to CSU Fullerton

<table>
<thead>
<tr>
<th>River</th>
<th>Dam</th>
<th>Storage</th>
<th>Hazard Severity</th>
</tr>
</thead>
<tbody>
<tr>
<td>East Fullerton</td>
<td>Fullerton</td>
<td>1,342af</td>
<td>High Hazard</td>
</tr>
</tbody>
</table>

The CSU Fullerton campus lies within the inundation zone of the dams listed above. In the event of a catastrophic failure of the identified dams, the CSU Fullerton campus is expected to be in the inundation area covering the campus with the exception of the southeast corner of the campus. The City of Fullerton Local Hazard Mitigation Plan provides that the inundation area is expected to spread water in areas on the campus and to the west of the campus. Additionally, there are multiple transportation corridors, utilities, and other critical infrastructure that lie within the dam inundation zones that could compromise transportation routes, service options, and areas the campus community reside or work. Based on the above factors, the planning committee ranks the extent of the hazard as **Moderate**.

**Extent - Levee Failure**

Levees are used along numerous flood control channels and other waterways including the Santa Ana River. The CSU Fullerton campus lies outside of any levee flood protected area. In the event any of these channels were flowing at elevated levels and a failure of a levee were to occur, the community surrounding the campus would likely experience flood related damages. This specific hazard could alter the ability of the campus to maintain operations but the campus is not at risk of direct impacts. Based on the above factors, the planning committee ranks the extent of the hazard as **Low**.

**History of the Hazard**

There are no records of dam or levee failures in areas that present a threat to the CSU Fullerton campus. Orange County has experienced the following dam incidents:
Table 10-14: Orange County Dam Failures

<table>
<thead>
<tr>
<th>Date</th>
<th>Dam</th>
<th>Release</th>
<th>Damage</th>
</tr>
</thead>
<tbody>
<tr>
<td>2005</td>
<td>Brea</td>
<td>Unknown</td>
<td>Golf course; Road damage</td>
</tr>
</tbody>
</table>

Potential Impacts of the Hazard

**Dam Failure Impacts** - Water that is released due to a dam that has failed generates tremendous energy and force causing a flood that will be catastrophic to life and property. Water levels from the failed dam could be significantly higher than those experienced in worst case scenario flood events. Areas closer to the failed dam will be more likely to experience complete devastation while other areas within the inundation zone will see varying levels of flood waters. The extent of the impacts of a failed dam would vary based on a number of factors such as the volume of water released, the base flow of the river, the time of the failure, the amount of warning provided, and the distance from the dam. Impacts resulting from a dam failure include:

- Loss of life
- Property destruction or damage
- Loss of property contents
- Infrastructure damage
- Flooded or destroyed lifelines/supply routes
- Damaged or destroyed utilities
- Loss of community economic base
- Employment losses
- Agricultural (crops and livestock) damages or destruction
- Environmental damage
- Floods generating threats to public health
- Flood generated debris
- Damage or destruction of academic materials, fine arts, and research
- Damage or destruction of university computer systems and networks
- Damaged university infrastructure
- Reduced or eliminated student engagement with academic programs
- Reductions in campus revenues

The area downstream from the Humble Reservoir and Fullerton Reservoir includes the populated areas of Brea and northern Fullerton. These areas separate the campus and the dams in addition to border the CSU Fullerton campus. Members of the campus community who reside or are employed in these areas would be most impacted. The campus may experience the same effects from a dam inundation event that would be experienced by the broader region. This would primarily be in the form of transportation routes and other community critical infrastructure being impacted by

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29 City of Fullerton Local Hazard Mitigation Plan, May 21, 2020
the inundation. This specific hazard would substantially alter the ability of the campus to maintain operations as damages would be extensive, the campus community in these areas would be heavily affected with the loss of life and homes, and student financial capacity to support ongoing education being diminished.

**Levee Failure Impacts** – A levee failure may result in substantial amounts of water to enter into developed areas protected by the levee. The force and volume of water that is generated by a levee failure may cause extensive structural damage in close proximity to the breach and effects of flooding spreading well beyond the point of the failure. The extent of the impacts would vary based on a number of factors such as the volume of water released, the time of the failure, the amount of warning provided, the location of the breach, elevation, and distance from the breach. Potential impacts resulting from a levee failure include:

- Loss of life
- Property destruction or damage
- Loss of property contents
- Infrastructure damage
- Public health hazards resulting from mold, mildew, and disease due to flood water
- Flooded or destroyed lifelines/supply routes
- Damaged or destroyed utilities
- Loss of community economic base
- Employment losses
- Agricultural (crops and livestock) damages or destruction
- Environmental damage
- Prolonged periods of necessary dewatering
- Disruptions to education delivery to community
- Damage or destruction of academic materials, fine arts, and research
- Damage or destruction of university computer systems and networks
- Damaged university infrastructure
- Reduced or eliminated student engagement with academic programs
- Reductions in campus revenues

**Probability of Future Occurrence of the Hazard**

Orange County is determined to be at risk from dam and levee failure in many parts of the county. The location of the CSU Fullerton campus downstream from the Orange County / Humble Reservoir Dam demonstrates that the potential exists for future dam or levee related issues. The dam inundation zone for the Humble reservoir is stopped at the dam located in Craig Regional Park just north of the campus. There are no identified levees in proximity to the campus and thus the campus is outside of any levee protected zone. There are no official recurrence intervals that have been calculated for dam or levee failures.
The probability of future occurrence for both dam and levee failures is **Unlikely**.

**Vulnerability to the Hazard**

Given High Priority dam monitoring and maintenance practices in place, a catastrophic dam or levee failure is highly unlikely. In addition, the campus does not lie within an inundation zone. However, in the unlikely event of a catastrophic failure, the effects of flooding from compromised dams and levees on campus would most likely be limited to indirect or secondary effects in terms of disruption to regional transportation networks and services, and the amount of time to respond to the needs of the campus community prior to inundation will be limited.

Any breach along a levee is impossible to predict where a failure may occur. It is likely that response action will not be fully implemented until the incident situational intelligence provides adequate information as to compromised locations. These variables place all those working and living within the dam inundation and flood protection zones in vulnerable locations.

The distributed placement of levees, most near development may expose significant vulnerabilities to other areas of the region even if the campus is unaffected. There is potential the campus community will be affected as a breach may cause flooding and damages to the homes of students, faculty, and staff or to access/supply routes, utilities, or other critical services. The potential for flood damaged structures being left uninhabitable including campus residence halls will result in the vulnerability of numerous displaced individuals and households. The lack of flood insurance will cause extreme financial burdens on those affected.

Vulnerability to a dam or levee failure on the CSU Fullerton campus will vary depending on the degree of breach or structural failure and when the failure were to occur. The risk to the campus population will be lessened during periods when classes are not in session or during periods of breaks. Conversely, during the days and hours that classes are in session and staff are at their workplaces, the human vulnerability increases. However, in region-wide events this vulnerability may be shared with the homes and workplaces of members of the campus community and their families.

Certain campus populations will experience greater challenges to a post-flood / failure environment. Vulnerable populations will likely need to navigate through flood generated debris, face extreme health safety issues from flood waters, experience extreme stresses of a disaster, an inability to communicate to or gain access to support networks, and find difficulty in accessing equipment or supplies to aid in a specific need.

**Estimate of Potential Losses**

Estimates of potential losses will be influenced by a variety of factors. The volume and force of the water will determine the scale of damages affecting campus infrastructure, equipment, and other impacted features. The proximity to the failure and elevation above flood waters will affect the level of damage and individuals
exposed. The time of the academic year, the day of week, and hour in which the failure was to occur will influence the number of people on campus and potential casualties. Losses will be generated by the physical damages, the loss of revenue, loss of academic research, loss of building contents, and community wide economic reductions.

Based on estimate replacement costs of facilities and structures on campus, the total replacement costs due to earthquake are $453,119,067. However, it is unlikely for a dam or levee failure event to cause catastrophic destruction at CSU Fullerton.

**Vulnerability Assessment Conclusions**

While the occurrence of dam and levee failures have not been historically relevant near the CSU Fullerton campus, the potential for hazards related to the region’s levees and dams still exist. However, the presence of earthquake faults in proximity to the existing dam and levee structures presents a valid danger to downstream locations in the event of an earthquake. In the unlikely event of a high priority dam’s total failure, the consequences would be catastrophic to downstream communities. The potential for dam or levee failure further generates the added potential for a number of cascading effects such as disruptions to the local economy, utility failures, disruptions to providing for the needs of the community, and development of public health hazards. These effects would be exacerbated by effects of seasonal flooding, ongoing heavy precipitation, or excessive run-off from the watershed contributing to the river system. The potential for widespread flooding and damage of structures due to the force of water has exponentially powerful impacts on particular populations among the campus community including those with access or functional needs, international students, the homeless, and students residing in the residence halls.

**Identified Data Limitations**

Missing campus structural replacement costs and complete inventory of building construction features or mitigation efforts to lessen the impact due to flood inundation.

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**Drought**

**Description of the Hazard**

Drought is defined as a condition where moisture levels fall significantly below normal for an extended period of time over a large area that adversely affects plants, animal life, and humans. Drought is a gradual phenomenon. Although droughts are sometimes characterized as emergencies, they differ from typical emergency events. Most natural disasters, such as floods or forest fires, occur relatively rapidly and afford little time for preparing for disaster response. Droughts occur slowly, over a multi-year period, and it is often not obvious or easy to quantify when a drought begins and ends.
Throughout California, one dry year does not normally constitute a drought. California’s extensive system of water supply infrastructure (reservoirs, groundwater basins, and conveyance assets) mitigates the effect of short-term dry periods for most water users. Defining when a drought begins is a function of drought impacts to water users. Drought in one location may not constitute a drought for all water users, as some users in relative proximity may have a different water supply. For example, individual water suppliers may use a combination of sources such as rainfall/runoff, water in storage, or expected supply from a water wholesaler to define their water supply conditions.

Drought can be characterized as one or more of the four following types:

- **Meteorological drought** is defined on the degree of dryness (in comparison to some “normal” or average amount) and the duration of the dry period. A meteorological drought must be considered as region-specific since the atmospheric conditions that result in deficiencies of precipitation are highly variable from region to region.

- **Hydrological drought** is associated with the effects of periods of precipitation (including snowfall) shortfalls on surface or subsurface water supply (e.g., streamflow, reservoir and lake levels, ground water). The frequency and severity of hydrological drought is often defined on a watershed or river basin scale. Although all droughts originate with a deficiency of precipitation, hydrologists are more concerned with how this deficiency plays out through the hydrologic system. Hydrological droughts are usually out of phase with or lag the occurrence of meteorological and agricultural droughts. It takes longer for precipitation deficiencies to show up in components of the hydrological system such as soil moisture, streamflow, and ground water and reservoir levels. As a result, these impacts are out of phase with impacts in other economic sectors.

- **Agricultural drought** focus is on soil moisture deficiencies, differences between actual and potential evaporation, reduced ground water or reservoir levels, and so forth. Plant water demand depends on prevailing weather conditions, biological characteristics of the specific plant, its stage of growth, and the physical and biological properties of the soil.

- **Socioeconomic drought** refers to when physical water shortage begins to affect health, well-being, and quality of life of people, or when the drought starts to affect the supply and demand of an economic product that relies on water.

The drought issue in California is further compounded by water rights. The central challenge is how to prioritize water usage among a broad variety of contexts. It is for this reason that water is a commodity possessed and utilized under a variety of legal doctrines. As such, many competing sets of interests create a dynamic prioritization process between, for example, farming and federally protected fish habitats and water
supply for municipal/public use (including usage for CSU – Fullerton versus water usage for wildfire abatement or natural resource protection.

Location of the Hazard

Drought conditions have been identified in the City of Fullerton and Orange County where CSU - Fullerton is located. Drought is not a location-specific hazard and affects the entire planning area equally. Drought location is not isolated to each campus footprint but occurs as a geographic sub-set of drought conditions occurring at larger scales. From 2000 – 2020, drought conditions have existed continuously somewhere in the state, with 80-100% of the state impacted for 12 of the last 20 years.30

Extent of the Hazard

Given the historical occurrence of severe drought impacts throughout the planning area and across the state and the potential future impact exacerbated by climate change, the CSU Planning Committee recognizes that drought will continue to pose a high degree of risk, potentially impacting crops, livestock, water resources, the natural environment at large, buildings and infrastructure (from land subsidence), and local economies. In addition, although drought affects the entire planning equally, the potential impacts may be variable and specific to each campus/jurisdiction, depending on contextual factors such as the degree of assets and activities, historically impacted by drought within each jurisdiction. In addition, land subsidence has occurred and will continue in areas where the groundwater basin has been subject to overdraft and long-term recharge is inadequate to maintain the water table elevation, leaving underground voids. Subsidence levels have been measured up to 30-feet with subsidence bowls covering hundreds of square miles. As such, drought-related subsidence may result in serious structural damage to buildings, roads, irrigation ditches, underground utilities, and pipelines. These effects, though not reported on the campus, remain applicable concerns for the campus over the long term.

The U.S. Drought Monitor developed tables of impacts reported during past droughts in California in order to depict the extent of drought risk for each level of drought on the U.S. These possible extent conditions for California complement the general impacts column of the U.S. Drought Monitor Classification Scheme.

Table 10-15: Impacts of Drought Levels as Determined by US Drought Monitor31

<table>
<thead>
<tr>
<th>Category</th>
<th>Impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>D0</td>
<td>Soil is dry; irrigation delivery begins early</td>
</tr>
<tr>
<td></td>
<td>Dryland crop germination is stunted</td>
</tr>
</tbody>
</table>

31 United States Drought Monitor. *Drought Classification*. Retrieved 05.04.2021 from: [https://droughtmonitor.unl.edu/About/AbouttheData/DroughtClassification.aspx](https://droughtmonitor.unl.edu/About/AbouttheData/DroughtClassification.aspx)
<table>
<thead>
<tr>
<th>D1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Active fire season begins</td>
</tr>
<tr>
<td>Winter resort visitation is low; snowpack is minimal</td>
</tr>
<tr>
<td>Dryland pasture growth is stunted; producers give supplemental feed to cattle</td>
</tr>
<tr>
<td>Landscaping and gardens need irrigation earlier; wildlife patterns begin to change</td>
</tr>
<tr>
<td>Stock ponds and creeks are lower than usual</td>
</tr>
<tr>
<td>D2</td>
</tr>
<tr>
<td>Grazing land is inadequate</td>
</tr>
<tr>
<td>Producers increase water efficiency methods and drought-resistant crops</td>
</tr>
<tr>
<td>Fire season is longer, with high burn intensity, dry fuels, and large fire spatial extent; more fire crews are on staff</td>
</tr>
<tr>
<td>Wine country tourism increases; lake- and river-based tourism declines; boat ramps close</td>
</tr>
<tr>
<td>Trees are stressed; plants increase reproductive mechanisms; wildlife diseases increase</td>
</tr>
<tr>
<td>Water temperature increases; programs to divert water to protect fish begin</td>
</tr>
<tr>
<td>River flows decrease; reservoir levels are low and banks are exposed</td>
</tr>
<tr>
<td>D3</td>
</tr>
<tr>
<td>Livestock need expensive supplemental feed, cattle and horses are sold; little pasture remains, producers find it difficult to maintain organic meat requirements</td>
</tr>
<tr>
<td>Fruit trees bud early; producers begin irrigating in the winter</td>
</tr>
<tr>
<td>Federal water is not adequate to meet irrigation contracts; extracting supplemental groundwater is expensive</td>
</tr>
<tr>
<td>Dairy operations close</td>
</tr>
<tr>
<td>Marijuana growers illegally tap water out of rivers</td>
</tr>
<tr>
<td>Fire season lasts year-round; fires occur in typically wet parts of state; burn bans are implemented</td>
</tr>
<tr>
<td>Ski and rafting business is low, mountain communities suffer</td>
</tr>
<tr>
<td>Orchard removal and well drilling company business increase; panning for gold increases</td>
</tr>
<tr>
<td>Low river levels impede fish migration and cause lower survival rates</td>
</tr>
<tr>
<td>Wildlife encroach on developed areas; little native food and water is available for bears, which hibernate less</td>
</tr>
</tbody>
</table>
Water sanitation is a concern, reservoir levels drop significantly, surface water is nearly dry, flows are very low; water theft occurs

Wells and aquifer levels decrease; homeowners drill new wells

Water conservation rebate programs increase; water use restrictions are implemented; water transfers increase

Water is inadequate for agriculture, wildlife, and urban needs; reservoirs are extremely low; hydropower is restricted

| Fields are left fallow; orchards are removed; vegetable yields are low; honey harvest is small |
| Fire season is very costly; number of fires and area burned are extensive |
| Many recreational activities are affected |
| Fish rescue and relocation begins; pine beetle infestation occurs; forest mortality is high; wetlands dry up; survival of native plants and animals is low; fewer wildflowers bloom; wildlife death is widespread; algae blooms appear |
| Policy change; agriculture unemployment is high, food aid is needed |
| Poor air quality affects health; greenhouse gas emissions increase as hydropower production decreases; West Nile Virus outbreaks rise |
| Water shortages are widespread; surface water is depleted; federal irrigation water deliveries are extremely low; junior water rights are curtailed; water prices are extremely high; wells are dry, more and deeper wells are drilled; water quality is poor; |

**History of the Hazard**

Although campus level drought data is not available, historically, drought has been so prevalent in California that its presence is almost continuous, including Orange County which surrounds the CSU - Fullerton footprint. According to the US Drought Monitor, Time Series data, Orange County experienced numerous periods of drought between 2000-2021, including an extended period from 2012-2019.
According to the National Drought Mitigation Center, over 3,500 reports and publications covering 370 drought-related events took place across the state (many of which were statewide events) between 2000-2020. In addition, the National Center for Environmental Information (NCEI) reports more than 500 events statewide during this same time period. These events produced a comprehensive range of impacts to water supply, regulations and allocations to businesses and municipalities, budgets and resources for firefighting, water law and policy, and physical impacts to built and natural environments. As such, data records of previous occurrences can be viewed as separate time and event demarcations for a hazard almost continuously in effect across the state with cascading impact potential.\textsuperscript{33} 34

According to the Department of Water Resources, droughts exceeding three years are relatively common in Southern California, but relatively rare in Northern California - the region is the geographic source of much of the state’s developed water supply. The 1929-34 drought established the criteria commonly used in designing storage capacity and yield of large Northern California reservoirs.\textsuperscript{35}

According to the US Drought Monitor’s time series data, from 2000-2021 (with the exception of a 2–3-month period in 2000 and 2011), some degree of drought conditions have been continuously in effect somewhere in California. In fact, 80% -
100% of the state has been subjected to drought conditions for 12 of the last 20 years, with the most severe drought being the 100% state-wide event from 2012-2017.

Figure 10-6: Periods of Drought in State of California, 2001 – 2021

![Graph showing periods of drought in California from 2001 to 2021]

Given the extent of the drought risk in California, the following drought event was selected as an exemplar due to its broad and significant impacts on the state, on Orange County, which surrounds the CSU - Fullerton campus planning area:

**2012 – 2017** – Drought produced severe impacts to water wells throughout the state of California, with a high number of wells running dry. Land subsidence due to increased groundwater pumping also occurred in numerous areas of the state such as the San Joaquin and Central Valleys. Crop damage was widespread as well. Water allotments were drastically reduced in many towns and water agencies, with extremely high costs for procuring water. In addition, job loss occurred with many families requiring food supply assistance, and water supply assistance provided to home-owners with dry wells. According to a report released by UC Davis Center for Watershed Sciences, the 2014-2017 period of the California drought cost the state’s agriculture industry about $1 billion in lost revenue, with a total statewide economic cost of the drought calculated to be $2.2 billion. The report says, “it is responsible for the greatest water loss ever seen in California agriculture - about one third less than normal”. The report calls the groundwater situation in California "a slow-moving train wreck." Spring snowpack at Donner Summit reached record low levels in 2014, exceeded in 2015 by a remarkable April 1 snow-water-equivalent value of only 5% of average. Decreased precipitation since contributed to near-record low levels in the Shasta Reservoir. The ongoing drought has contributed to declines in crop values across the state. For example, crops including cotton, corn silage and barley (the field crop category) fell by 42 percent.

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Potential Impacts of the Hazard

Drought impacts are wide-reaching and may be economic, environmental, and/or societal. This assessment of its impact recognizes that historic occurrences of drought throughout the planning area are a sub-set of larger and inter-connected local and regional droughts, and that the (related) historic impacts provide a sound basis for understanding potential (future) impacts.

The most significant potential impact associated with drought across the CSU - Fullerton campus planning area is the potential reduction in water availability for the municipal area tied to the campus. Other impacts include crop loss and damage to trees and other natural resources (See Tree Mortality below). The footprint of CSU - Fullerton to some extent includes these vulnerable resources based on the campus landscape (trees) and the presence (and footprint size) of agricultural research crops and field stations.

As a secondary impact of drought, wildfire is directly attributable to dry atmospheric conditions. Wildfires almost always coincide with drought in California, though not limited to such. However, the wildfire hazard is analyzed separately in this plan.

In reviewing the occurrences of drought for the state and Orange County, the US Drought Monitor and the National Drought Mitigation Center report that tens of millions of trees died during the (2014-2017) state-wide drought disaster. Though data sources do not provide data for tree mortality specific to CSU - Fullerton, the broad geographic extent of the impact makes it likely that tree mortality occurred to some degree on the campus. Due to the lasting and ongoing effects of drought on the landscape, trees will continue to be impacted within the municipalities, counties and regions wherein lies the CSU campus system as long as drought conditions continue to occur in the future.

Given the absence of data, in order for the CSU Committee to assess the impact of tree mortality, it is useful to view it as a risk sub-set to the probability, location, extent, severity and duration of the drought hazard within each campus-located municipality, county and region. Regarding potential impacts, standing dead trees could fall, posing a risk to people, buildings, power lines, roads and other infrastructure. In addition, drought-impacted trees become susceptible to diseases and insect infestations (bark beetle) further adding to the risk of tree mortality and related potential impacts. No data is currently available for tree mortality on campus, however, the CSU Planning Team will pursue data on this issue in the future.

As a potential tertiary impact, prolonged and repeated drought conditions over time can produce land subsidence and the risk of damage to building foundations and infrastructure on campus resulting from ground instability and collapse. Land subsidence is defined as the vertical sinking of the land over manmade or natural

underground voids. Subsidence is often the direct result of groundwater over-extraction in response to drought conditions, as well as oil and gas extraction. Weight can accelerate the process of subsidence resulting from surface development and infrastructure such as roads and buildings, vibrations from construction blasting and heavy truck or train traffic. For example, the State Water Project’s 444-mile-long California Aqueduct has required repairs such as the raising of canal linings, bridges, and water control structures on the Aqueduct – in the Central Valley a five-mile reach of the Eastside Bypass was impacted by subsidence, and the Department of Water Resources estimated that it may cost in the range of $250 million to acquire flowage easements and levee improvements to restore the design capacity of the subsided area.39

At present, drought related damage to campus buildings and infrastructure at CSU - Fullerton has not been reported, but the potential for such impacts is possible. With regard to overall potential impact, water supply/availability for CSU - Fullerton is ultimately tied to broader inter-dependent, and more intensive modes of water use at local and regional scales such as agriculture and ranching, wildfire protection, larger metropolitan/municipal usage, manufacturing and commerce, tourism, recreation, and wildlife preservation. During drought periods, the State of California’s regulated water allocations are modified and often reduced, which can result in reduced water availability for all usage contexts, including CSU - Fullerton. A reduction of electric power generation and water quality deterioration are also potential impact factors.

Table 10-16: Summary of Drought Impacts on Water Resources\(^{40}\)

<table>
<thead>
<tr>
<th>Resource</th>
<th>Type of Impact</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sea Level</td>
<td>Direct</td>
<td>Sea level is rising and will likely impact coastal areas</td>
</tr>
<tr>
<td>Soil Moisture</td>
<td>Direct</td>
<td>Prolonged dry seasons can lead to decreases in soil moisture; drier vegetation</td>
</tr>
<tr>
<td>Vegetation</td>
<td>Indirect</td>
<td>Longer and more intense fire season with increased extent of area burned</td>
</tr>
<tr>
<td>Stream Conditions</td>
<td>Direct</td>
<td>Increases in water temperature; potential effects on fish</td>
</tr>
<tr>
<td>Snowpack</td>
<td>Indirect</td>
<td>Increases in temperature will lead to decreases in snowpack</td>
</tr>
<tr>
<td>Runoff</td>
<td>Direct</td>
<td>Warmer temperatures are likely to lead to a shift in peak runoff from spring to winter and a likely decrease in summer base flow</td>
</tr>
<tr>
<td>Hydropower</td>
<td>Indirect</td>
<td>Decreased summer flows resulting from earlier snowmelt and a shift in peak runoff could affect hydropower generation during summer months</td>
</tr>
<tr>
<td>Precipitation</td>
<td>Direct</td>
<td>Warmer winter temperatures will result in a greater percentage of precipitation falling as rain rather than as snow</td>
</tr>
<tr>
<td>Groundwater</td>
<td>Indirect</td>
<td>Reduction in snowpack and extended periods of drought are likely to increase dependency on groundwater</td>
</tr>
</tbody>
</table>

**Probability of Future Occurrence of the Hazard**

**Highly Likely** — The US Drought Monitor’s time series data (2000-2020) indicates that some degree of drought has nearly a 100% probability of occurrence somewhere in the state in any given year. Given that CSU - Fullerton lies within a drought impacted region, it is prudent to extend this likelihood of occurrence to the planning area.

Vulnerability to the Hazard

In California, rising temperatures are projected to increase the average lowest elevation at which snow falls, reducing water storage in the snowpack, particularly at those lower mountain elevations which are now on the margins of reliable snowpack accumulation. Higher spring temperatures will also result in earlier melting of the snowpack. The shift in snow melt to earlier in the season is critical for California’s water supply because flood control rules require that water be allowed to flow downstream and that water cannot be stored in reservoirs for use in the dry season. As such, state-level drought risk factors that have led to drought’s state-wide severity and extent, and potential impacts also create drought vulnerabilities at the level of the CSU - Fullerton campus.

Moreover, climate change will likely adversely impact the vulnerability of watersheds and ecosystems in their ability to deliver important ecosystem services. These changes may limit the natural capacity of healthy forests to capture water and regulate stream flows. Sierra Nevada mountain winters and springs are warming, and on average, precipitation as snowfall relative to rain is decreasing. A warming climate with reduced snowpack will result in earlier snowmelt and will subsequently reduce downstream water availability during summer and early fall.

As such, the state and the CSU - Fullerton planning area stakeholders potentially have less capacity to address future drought risks due to projected temperature increases and shortages in water; ground-water withdrawals have been occurring at a deficit rate of 1 – 2-million-acre feet per year, where the impacts of drought include decreased availability of water for agriculture and environmental uses.41 In forested and other vegetated areas, prolonged drought decreases the moisture content of forest fuels and increases the risk of high severity wildfires.

It should be pointed out that California is the single most productive agricultural state and its agricultural industry relies heavily on reservoir water supplied by snowmelt and rainfall runoff. Yearly variations in snowpack depths have implications for water availability as snowmelt from the winter snowpack feeds a network of reservoirs. Spring snowpack at Donner Summit reached record low levels in 2014, exceeded in 2015 by a remarkable April 1 snow-water-equivalent value of only 5% of average. Decreased precipitation since 2011 has contributed to near-record low levels in the Shasta Reservoir.42

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Vulnerability of Populations

The historical and potential impacts of drought on California’s population include agricultural sector job loss, secondary economic losses to local businesses and public recreational resources, increased cost to local and state government for large-scale water acquisition and delivery, and water rationing and water wells running dry for individuals and families. As drought is often accompanied by prolonged periods of extreme heat, negative health impacts such as dehydration can also occur, where children and elderly are most susceptible. Air quality often declines in times of drought which can affect those with respiratory ailments. These same vulnerabilities apply to the students, faculty and staff of the CSU - Fullerton campus.

Property Vulnerability

The historical and potential impacts of drought on property include crop loss, injury and death of livestock and pets, and damage to infrastructure, homes and other buildings resulting from the secondary drought impact of land subsidence. The related drought impacts of tree mortality and land subsidence pose risks to vulnerable critical infrastructure and property. These same vulnerabilities apply to the properties of the CSU - Fullerton campus.

Natural Environment Vulnerability

Drought vulnerabilities in the natural environment are widespread throughout public and private lands within the state, including tree mortality, impacts to all flora and fauna, and destabilization (subsidence) of land along streams and rivers, and within watersheds.

The core issue shaping drought vulnerabilities throughout California is water supply and demand. Several factors play into the issue including groundwater basins, surface water run-off, public and agricultural demand, and surface water storage water sheds. A USGS led analysis was first conducted in 2010 through the Forest and Rangeland Assessment and ongoing through the USGS Forest and Rangeland Ecosystem Science Center to identify threats and assets where water supply would benefit from environmental management designed to protect or enhance water resources, the key effort which, in part, both defines and mitigates the severity of drought risk and vulnerabilities.

With regard to overall threat and asset findings shaping the potential severity of drought, the watersheds in the Sierra region contribute most greatly to the state’s water supply, but are under threat from climate change, wildfire and development. In addition, groundwater basins in the San Joaquin Valley and Sacramento Valley bioregions are an abundant resource that is heavily threatened by over pumping.

Critical Facilities Vulnerabilities
Drought vulnerabilities for CSU - Fullerton’s critical facilities include water shortfalls for facility operations and critical functions, and potential structural destabilization and damage resulting from land subsidence.

**Estimate of Potential Losses**

An estimate of potential losses from drought has not been calculated for the campus or the CSU system as a whole. However, drought-related losses to the City of Fullerton and the surrounding region such as crop loss and cost increases for water resources have re-occurred over time. Please consult city and county level government, and/or state agricultural agencies for data on the financial impacts from drought.

**Vulnerability Assessment Conclusions**

The CSU Planning Committee understands that the high degree of vulnerability posed by drought will be exacerbated by greater climate variation in the future and therefore greater variation and uncertainty regarding the availability of water supplies which are already under tremendous stress. In response to such vulnerability, state legislation passed in 2014 requires local governments to regulate pumping and recharge to better manage groundwater supplies, and groundwater-dependent regions are required to halt overdraft and bring basins into sustainable levels of pumping and recharge by the early 2040s. That said, the Committee will continue to work with local, regional and state partners and stakeholders to explore solutions for mitigating the drought hazard on its campuses by accessing the best available data and resources on climate change and its relationship to drought.

**Identified Data Limitations**

Data is limited concerning campus-related agricultural assets as well as data on campus tree mortality.
Earthquake

Description of the Hazard

An earthquake is a sudden motion or shaking caused by the release of pressure accumulated along the edge of tectonic plates covering the earth. These huge plates are constantly moving and move ever so slowly under, over, or by passing one another. This movement is gradual however the plates may lock together accumulating enormous amounts of energy. When this energy builds, stress develops, and the adjoining plates will eventually break free and result in ground shaking – an earthquake.

Large earthquakes may result in fissuring, ground settlement, and/or vertical or horizontal displacement. Earthquakes occur without warning and can result in extensive damages and human casualties. Damages associated to earthquake generated ground shaking is normally confined to a narrow area along fault trend from the earthquake epicenter. However, seismic waves may generate ground shaking resulting in damages in areas outside of the fault trend.

In addition to ground motion, there are several secondary hazards that can result from an earthquake including:

**Fault Rupture** – The rupture of faults is the differential movement of the two sides of the earth’s plates at the point of the fault. Horizontal or vertical displacement may be significant and occur over great distances. The movement and energy that occurs along a fault is released in waves resulting in ground shaking. The intensity of ground shaking varies based on the magnitude of the earthquake, the proximity to the earthquake epicenter, the composition of the ground sediment or rock the waves travel through, and the depth of the earthquake.

**Liquefaction** – In addition to the primary fault rupture that occurs right along a fault during an earthquake, the ground many miles away can also fail during intense shaking. As seismic waves travel through saturated granular soil; the soil begins to liquefy and act as a fluid. Soil strength and stability is lost causing the effects of ground shaking to intensify and for ground deformation to occur. These water saturated soils when shaken quickly lose the ability to support buildings, bridges, utilities, and other structures. Areas susceptible to liquefaction include places where sandy sediments have been deposited by rivers along their course or by wave action along beaches. The greater the magnitude of an earthquake and longer duration of strong ground shaking will result in an enhanced potential for liquefaction to occur. Settlement can cause damage when the amount settlement varies significantly across the length of a structure. Lateral spreading occurs when liquefaction occurs on gently sloping ground and the liquefied material at depth allows the area to slide, often toward a vertical discontinuity or “free face” such as a creek or stream channel. Liquefaction can occur in susceptible soils below bodies of water, and settlement and lateral spreading can damage structures built on or adjacent to these areas. Transportation bridges across water bodies, wharves, piers and other structures at
ports and harbors, and underwater utility lines can be severely damaged by this hidden hazard.

**Subsidence** - Changes in the local environment that cause subsidence or sinkholes are called triggering mechanisms. Water is the primary factor that affects the local environment and causes subsidence. Water level decline, changes in groundwater flow, increased loading, and deterioration (such as abandoned mines) are all triggering mechanisms. Water level decline may occur naturally, or it may be the result of human action. Factors that lead to water decline are pumping (from wells), localized drainage (for construction activities), dewatering, or drought. Changes in groundwater flow can result from an increase in the velocity of groundwater movement, and increase in the frequency of water table fluctuations, and changes in discharge (either increase or decrease). Increased loading can cause pressure in the soil, leading to the failure of underground cavities and space, such as caves. Vibrations from earthquakes, heavy machinery, and blasting may result in structural collapse, followed by surface resettlement.

**Location of the Hazard**

The State of California is particularly vulnerable to earthquake activity due to California’s location residing between two large tectonic plates. CSU Fullerton is located in northern Orange County. In general, fault systems surround and traverse through Los Angeles and Orange Counties including the area of CSU Fullerton. Throughout the basin the ground is saturated with sediment eroded from the mountains and foothills via multiple stream and river channels and resulting in liquefaction zones scattered across the region.

The Pacific Plate and the North American Plate come together at the San Andreas Fault 35-40 miles northeast of the CSU Fullerton campus. In addition to the San Andreas Fault, Orange County is home to or near additional fault systems with the potential to generate strong ground shaking. The Newport-Inglewood Fault traverses south to north paralleling the Orange County coastline extending within 15 miles southeast of the CSU Fullerton campus. The Puente Hills Fault extends from the southern base of the Puente Hills to downtown Los Angeles approximately 3 miles north of the campus. The 11-mile-long Yorba Linda Fault extends from central Fullerton to the northeast into the Chino Hills 1½ miles southeast of the CSU Fullerton campus. The Whittier-Elsinore Fault extends from the eastern base of the Santa Ana Mountains and western base of the Puente Hills 4 miles to the northeast of the campus. There are numerous additional faults in the area on all sides of the campus.
Figure 10-7: Faults near CSU-Fullerton

Portions of the CSU Fullerton campus reside on areas designated to be liquefaction zones. Campus facilities that are located within the liquefaction zone include the Fullerton Arboretum, Goodwin Field, Titan Stadium, and the Children’s Center. The liquefaction zone generally follows the path of the Fullerton Creek.
Extent of the Hazard

The extent or severity of earthquake damage is expressed in terms of magnitude and intensity. The amount of energy released during an earthquake is normally conveyed as a magnitude measured from a seismogram. Magnitude is expressed in numbers and decimals representing the physical size of the earthquake. The strength and effect of the shaking on the surface of the earth is classified as the intensity. Intensity is further defined from the effects the earthquake has on people, structures, and the natural environment. The intensity of an earthquake in terms of measuring magnitude and evaluating its effects is generally expressed using the Modified Mercalli (MM) Intensity Scale.

The Richter magnitude scale was developed in 1935 by Charles F. Richter of the California Institute of Technology as a mathematical device to compare the size of earthquakes. The Richter Scale is the best-known scale for measuring the magnitude of earthquakes. The magnitude value is proportional to the logarithm of the amplitude of the strongest wave during an earthquake. A recording of 7, for example, indicates a disturbance with ground motion 10 times as large as a recording of 6. The energy released by an earthquake increases by a factor of 31 for every unit increase in the Richter scale.

Table 10-17: Earthquake Intensity/Frequency Comparisons

<table>
<thead>
<tr>
<th>Magnitude</th>
<th>Mercalli Intensity</th>
<th>Potential Damage</th>
<th>Global Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 2.0</td>
<td>I</td>
<td>None</td>
<td>Continually</td>
</tr>
<tr>
<td>2.0 - 2.9</td>
<td>I to II</td>
<td></td>
<td>&gt; IM per year</td>
</tr>
<tr>
<td>3.0 - 3.9</td>
<td>II to IV</td>
<td></td>
<td>&gt; 100,000 per year</td>
</tr>
<tr>
<td>4.0 - 4.9</td>
<td>IV to VII</td>
<td>Light</td>
<td>10K to 15K per year</td>
</tr>
<tr>
<td>5.0 - 5.9</td>
<td>VI to VII</td>
<td>Moderate</td>
<td>1K to 1,500 per year</td>
</tr>
<tr>
<td>6.0 - 6.9</td>
<td>VII to X</td>
<td>Heavy</td>
<td>100 to 150 per year</td>
</tr>
<tr>
<td>7.0 - 7.9</td>
<td>VII &lt;</td>
<td></td>
<td>10 - 20 per year</td>
</tr>
<tr>
<td>8.0 - 8.9</td>
<td>VII &lt;</td>
<td>Very Heavy</td>
<td>1 per year</td>
</tr>
<tr>
<td>&gt; 9.0</td>
<td>VII &lt;</td>
<td></td>
<td>1 per 10-50 years</td>
</tr>
</tbody>
</table>

The Modified Mercalli Intensity Scale provides descriptive values of earthquake intensity that may provide greater meaning to the broader population as the description of intensity refers to the effects actually experienced. This scale uses an arbitrary ranking based on observed earthquake effects. The scale is composed of increasing levels of intensity ranging from shaking that is not recognizable to intense shaking resulting in catastrophic damages and casualties. The Modified Mercalli Intensity Scale is demonstrated below:
Table 10-18: Modified Mercalli Intensity Scale

<table>
<thead>
<tr>
<th>Intensity</th>
<th>Shaking</th>
<th>Description / Damage</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Not felt</td>
<td>Not felt except by a very few under especially favorable conditions.</td>
</tr>
<tr>
<td>II</td>
<td>Weak</td>
<td>Felt only by a few persons at rest, especially on upper floors of buildings.</td>
</tr>
<tr>
<td>III</td>
<td>Weak</td>
<td>Felt quite noticeably by persons indoors, especially on upper floors of buildings. Many people do not recognize it as an earthquake. Standing motor cars may rock slightly. Vibrations similar to the passing of a truck. Duration estimated.</td>
</tr>
<tr>
<td>IV</td>
<td>Light</td>
<td>Felt indoors by many, outdoors by few during the day. At night, some awakened. Dishes, windows, doors disturbed; walls make cracking sound. Sensation like heavy truck striking building. Standing motor cars rocked noticeably.</td>
</tr>
<tr>
<td>V</td>
<td>Moderate</td>
<td>Felt by nearly everyone; many awakened. Some dishes, windows broken. Unstable objects overturned. Pendulum clocks may stop.</td>
</tr>
<tr>
<td>VI</td>
<td>Strong</td>
<td>Felt by all, many frightened. Some heavy furniture moved; a few instances of fallen plaster. Damage slight.</td>
</tr>
<tr>
<td>VII</td>
<td>Very strong</td>
<td>Damage negligible in buildings of good design and construction; slight to moderate in well-built ordinary structures; considerable damage in poorly built or badly designed structures; some chimneys broken.</td>
</tr>
<tr>
<td>VIII</td>
<td>Severe</td>
<td>Damage slight in specially designed structures; considerable damage in ordinary substantial buildings with partial collapse. Damage great in poorly built structures. Fall of chimneys, factory stacks, columns,</td>
</tr>
</tbody>
</table>

---

<table>
<thead>
<tr>
<th>Magnitude</th>
<th>Intensity</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>IX</td>
<td>Violent</td>
<td>Damage considerable in specially designed structures; well-designed frame structures thrown out of plumb. Damage great in substantial buildings, with partial collapse. Buildings shifted off foundations.</td>
</tr>
<tr>
<td>X</td>
<td>Extreme</td>
<td>Some well-built wooden structures destroyed; most masonry and frame structures destroyed with foundations. Rails bent.</td>
</tr>
</tbody>
</table>

The graph below illustrates the increasing intensity of energy that is released and as the measured magnitude increases. While each whole number increases in magnitude represents a tenfold increase in the measured amplitude, it represents an increasing rate of 32 times more energy released in the same increase in magnitude. As the magnitude of an earthquake is measured higher, the intensity of the earthquake worsens progressively from one category to the next.
Portions of the CSU Fullerton campus reside on areas designated to be liquefaction zones. Campus facilities that are located within the liquefaction zone include the Fullerton Arboretum, Goodwin Field, Titan Stadium, and the Children’s Center. In addition, numerous fault systems surround and traverse the campus. Several severe and even catastrophic events have occurred in the region such as the Northridge event in 1994. Based on these factors, and the probability of future events (see below) the planning committee ranks the extent of the hazard for the campus as **Moderate to High**.

**History of the Hazard**

The State of California has a long history of chronic and destructive earthquakes throughout the state. On average, earthquakes strong enough to result in structural damages occur three to four times a year in California, while earthquakes Magnitude 6.0 to 6.9 occur once every two to three years. Orange County also has a long history of earthquake activity. The entire area of the Los Angeles Basin and Orange County is at risk to seismic activity and has a history of significant earthquakes resulting in damages.

---

<table>
<thead>
<tr>
<th>Date</th>
<th>Location</th>
<th>Magnitude</th>
<th>Damages</th>
</tr>
</thead>
<tbody>
<tr>
<td>12/8/1812</td>
<td>San Juan Capistrano</td>
<td>7.5</td>
<td>120 fatalities, $40 million</td>
</tr>
<tr>
<td>3/10/1933</td>
<td>Long Beach</td>
<td>6.4</td>
<td>120 fatalities, $40 million</td>
</tr>
<tr>
<td>2/9/1971</td>
<td>San Fernando</td>
<td>6.6</td>
<td>58-65 fatalities, $553 million</td>
</tr>
<tr>
<td>10/1/1987</td>
<td>Whittier</td>
<td>5.9</td>
<td>8 fatalities, $358 million</td>
</tr>
<tr>
<td>2/28/1990</td>
<td>Upland</td>
<td>5.7</td>
<td>30 injuries, $12.7 million</td>
</tr>
<tr>
<td>6/28/1991</td>
<td>Sierra Madre</td>
<td>5.6</td>
<td>1 fatality, $40 million</td>
</tr>
<tr>
<td>6/28/1992</td>
<td>Landers</td>
<td>7.3</td>
<td>3 fatalities, $92 million</td>
</tr>
<tr>
<td>1/17/1994</td>
<td>Northridge</td>
<td>6.7</td>
<td>57 fatalities, $40 billion</td>
</tr>
<tr>
<td>7/29/2008</td>
<td>Chino Hills</td>
<td>5.5</td>
<td>Minor</td>
</tr>
<tr>
<td>3/28/2014</td>
<td>La Habra</td>
<td>5.1</td>
<td>$10 million</td>
</tr>
</tbody>
</table>

The January 9, 1994 Northridge Earthquake became the costliest seismic event in California history. The earthquake caused extensive damage to structures, the transportation infrastructure, utility systems, water storage, communications, and critical facilities. This level of damage due to the fault that ruptured was directly underneath a densely populated urban area. The Northridge Earthquake was found to raise the nearby mountains by as much as 70 centimeters. The earthquake was provided a federal disaster declaration (DR-1008).

The October 1, 1987 Whittier Narrows Earthquake shook a large part of southern California. The earthquake caused $358 million in damages, especially in the Alhambra, Pasadena, and Whittier areas. The earthquake resulted in extensive infrastructure damages, multiple injuries, and 8 fatalities. The earthquake was provided a federal disaster declaration (DR-799).

The February 9, 1971 Magnitude 6.5 San Fernando Earthquake struck the San Fernando Valley in Los Angeles just after 6am. The intense shaking caused the collapse of freeway overpasses, hospitals, and other infrastructure. It damaged thousands of homes and businesses, a reservoir, and critical infrastructure. 65 people were killed and 2,000 more were injured. The shaking was felt for 300 miles including...
in Las Vegas, Nevada. The earthquake was provided a federal disaster declaration (DR-299).

The March 10, 1933 Long Beach Earthquake registered at a Magnitude 6.4 occurred along the Newport-Inglewood Fault. The earthquake resulted in over $50 million in damages, 500 injuries, and 120 fatalities. Unreinforced masonry structures were the source of most of the casualties. 70 schools were destroyed and 120 were damaged. This earthquake promoted statewide standards in building design and construction for schools and other structures to better withstand seismic events.

Potential Impacts of the Hazard

The shaking of the ground from earthquakes can result in building collapse, bridge failure, utility disruptions and other structural collapse. Large earthquakes can additionally cause natural gas lines to break resulting in structure fires. The proximity to the unstable soils to the east and west of the campus presents a potential for liquefaction creating greater ground instability during seismic events. The northern sections of the campus is located on a liquefaction zone A major earthquake in the Fullerton area would likely result in region-wide social disruptions in addition to structural damages. The region-wide structural damages may disrupt lifelines and supply chain routes limiting the campus from effective evacuation routes and receiving necessary supplies or equipment.

Most injuries resulting from earthquakes are from collapsing walls, flying glass, or other objects moved by ground shaking. The lack of warning allows individuals minimal time to react and find areas of safety. A moderate earthquake occurring near Fullerton could cause injuries or fatalities to members of the campus community or support networks the campus relies on. These earthquake effects might be aggravated by collateral incidents such as fire, flooding, hazardous material spills, dam/levee compromises, and other cascading events. A catastrophic earthquake near Fullerton could result in extensive casualties, expansive structural damages, panic, widespread utility outages, communication failures, and secondary emergencies such as fire. A catastrophic earthquake would certainly affect the broader Orange and Los Angeles Counties region limiting immediate assistance that the campus may normally expect.

Local impacts to CSU Fullerton campus caused by an earthquake could include:

- Damage and secondary fires to industrial buildings to the south of the campus
- Potential hazardous material releases on and off campus
- Infrastructure damage to freeway system
- Damages to railyard, rail lines, and rail cars 1 mile to south of campus
- Structural damage to bridges
- Damages to oil fields west of campus in East Coyote Hills
- Potential isolation of campus from community
• Potential isolation among on-campus residents
• Damages to homes and apartment complexes surrounding the campus and in broader community
• Structural damage to Fullerton and Humble Reservoirs
• Damage to flood control and drainage systems
• Structural damage to campus academic and support buildings
• Structural damages to parking structures
• Structural damage and reduction of capacity of trigeneration power plant
• Damages to emergency generator system
• Structural damage to residence halls resulting in displaced student populations
• Structural damage to nearby residences
• Community members arriving on campus for refuge from damaged homes
• Damaged university communications, computer systems, and networks
• Considerable stress and fear among community
• Closure or reduction of service to campus operations
• Reduction of campus revenue

Probability of Future Occurrence of the Hazard

The Working Group on California Earthquake Probabilities (WGCEP), a collaboration between the United States Geological Survey (USGS), the Southern California Earthquake Center (SCEC), and the California Geological Survey (CGS) develops Uniform California Earthquake Forecasts (UCERFs) using the best currently available science and technology. The UCERF version 3 provides a three-dimensional view of the likelihood a region in California will experience a Magnitude 6.7 or greater earthquake in the next 30 years. The likelihood for the Orange County fault systems surrounding Fullerton is included in the following table.

Table 10-20: Major Potentially Active Faults in Proximity to CSU Fullerton

<table>
<thead>
<tr>
<th>Fault Zone</th>
<th>Recurrence</th>
<th>Maximum Magnitude</th>
<th>UCERF3 Likelihood</th>
</tr>
</thead>
<tbody>
<tr>
<td>Compton</td>
<td>Historic: Unknown</td>
<td>6.5 to 7.1</td>
<td>1%</td>
</tr>
<tr>
<td>Newport-Inglewood</td>
<td>Historic: Unknown</td>
<td>6.0 to 7.4</td>
<td>1%</td>
</tr>
<tr>
<td>Palos Verdes</td>
<td>Historic: Unknown</td>
<td>6.0 to 7.0</td>
<td>3%</td>
</tr>
<tr>
<td>Puente Hills</td>
<td>Historic: Unknown</td>
<td>6.6</td>
<td>1%</td>
</tr>
</tbody>
</table>

47 City of Fullerton Local Hazard Mitigation Plan, May 21, 2020
<table>
<thead>
<tr>
<th>Fault System</th>
<th>Duration</th>
<th>Magnitude Range</th>
<th>Probability</th>
</tr>
</thead>
<tbody>
<tr>
<td>San Andreas</td>
<td>Varies: 100-300 years</td>
<td>6.8 to 8.0</td>
<td>18-20%</td>
</tr>
<tr>
<td>San Jacinto</td>
<td>Varies: 100-300 years</td>
<td>6.5 to 7.5</td>
<td>4-5%</td>
</tr>
<tr>
<td>San Joaquin Hills</td>
<td>Unknown</td>
<td>Unknown</td>
<td>1%</td>
</tr>
<tr>
<td>Santa Monica</td>
<td>Historic: Unknown</td>
<td>6.0 to 7.0</td>
<td>1%</td>
</tr>
<tr>
<td>Sierra Madre</td>
<td>Historic: 1,000-3,000 years</td>
<td>6.0 to 7.0</td>
<td>1-2%</td>
</tr>
<tr>
<td>Whittier/Elsinore</td>
<td>Historic: Unknown</td>
<td>6.0 to 7.2</td>
<td>1-3%</td>
</tr>
<tr>
<td>Yorba Linda</td>
<td>Historic: Unknown</td>
<td>6.0 to 7.2</td>
<td>1%</td>
</tr>
</tbody>
</table>

Based on the earthquake shaking potential in the Orange County region, the proximity to the above listed fault systems, the probability of seismic ground shaking generating damage is considered **Possible**.

**Vulnerability to the Hazard**

A considerable challenge regarding earthquakes is they generally occur without warning. The fault systems surrounding the region all cross major transportation routes potentially reducing the availability of access and the supply chain. The geographic location of Fullerton places the campus in a busy commercial and industrial areas that is heavily populated. Earthquake effects experienced in the neighboring local community will likely spill over onto the campus. Portions of the northern side of the campus are designated as liquefaction zones and may be impacted by the Fullerton and Humble Reservoirs if full.

The aftermath of a major earthquake will likely result in widespread search and rescue operations for trapped and injured individuals. The demand on emergency services will be great, potentially requiring the campus community to be prepared for these scenarios and initiate response actions as needed. There will be needs for emergency medical care, shelter, water, and food for individuals who have been displaced by the earthquake. In earthquakes causing significant damages, there may be a necessity to provide assistance with identification and support to local agencies in mass fatality management.

The known fault systems generating the threat to Fullerton generally surround the city and some cross into the city including near the CSU Fullerton campus. The proximity and potential for large earthquake development from these surrounding systems expose significant vulnerabilities. The potential for earthquake damaged structures being left uninhabitable including campus residence halls will result in numerous
displaced individuals and households. The lack of earthquake insurance will cause extreme financial burdens on those affected. Campus buildings and equipment would be vulnerable to damages from building, seismic shaking, secondary fires, and secondary building floods from broken pipes.

Elements of the vulnerability to a major earthquake on the CSU Fullerton campus will vary depending on when the earthquake were to strike. The risk to the campus population will be lessened during periods when classes are not in session or during periods of breaks. Conversely, during the days and hours that classes are in session and staff are at their workplaces, the human vulnerability increases. Generally, people are safer when at home in wood frame structures as earthquakes tend to generate less structural damage to wood construction than in commercial or industrial facilities. The greater number of people on campus at the time of an earthquake will result in more people being exposed to effects from damaged campus facilities or equipment and require greater evacuation assistance. However, in region-wide events this vulnerability may simply shift to the homes and workplaces of members of the campus community and their families.

The aftermath of a major earthquake will likely result in widespread search and rescue operations for trapped and injured individuals. The demand on emergency services will be great, potentially requiring the campus community to be prepared for these scenarios and initiate response actions as needed. There will be needs for emergency medical care, shelter, water, and food for individuals who have been displaced by the earthquake. In earthquakes causing significant damages, there may be a necessity to provide assistance with sheltering and care of those unable or unwilling to return to their homes. Damages to the homes of the members of the campus community may place greater demands on campus resources and capabilities in the short-term period following a seismic event.

There may be a need to evacuate members of the campus community from the campus and to other locations that are deemed to be safer locations. As the CSU Fullerton campus is downstream from dam facilities, the decision to evacuate will need to take into account whether flood control facilities are filled with water and the actual threat to the dam or levees.

Certain campus populations will experience greater challenges to a post-earthquake environment. Vulnerable populations will likely need to navigate through earthquake generated debris, extreme stresses of a disaster, an inability to communicate to or gain access to support networks, and find difficulty in accessing equipment or supplies to aid in a specific need.

**Estimate of Potential Losses**

Estimates of potential losses will be influenced by a variety of factors. The intensity of the earthquake will determine what scale of damages affecting campus infrastructure, equipment, and other impacted features. Losses will be generated by the physical
damages, the loss of revenue, loss of academic research, loss of building contents, and community wide economic reductions.

Based on estimate replacement costs of facilities and structures on campus, the maximum total replacement costs due to earthquake are $453,119,067.

Table 1021: HAZUS Peak Ground Acceleration Zone (PGA) Estimated Losses

<table>
<thead>
<tr>
<th>PGA Zone Designation</th>
<th>Intensity</th>
<th>No of Buildings</th>
<th>Maximum Replacement Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Extreme</td>
<td>X+</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Violent</td>
<td>IX</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Severe</td>
<td>VIII</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Very Strong</td>
<td>VII</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Strong</td>
<td>VI</td>
<td>38</td>
<td>$453,119,067</td>
</tr>
<tr>
<td>Moderate</td>
<td>V</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Light</td>
<td>IV</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Weak</td>
<td>II-III</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Not Felt</td>
<td>I</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>NA</td>
<td>NA</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>No Building Value Data Provided*</td>
<td>NA</td>
<td>11</td>
<td>Unknown</td>
</tr>
</tbody>
</table>

*Buildings with no value defined are also included in the respective Zones they are found in.

Vulnerability Assessment Conclusions

It is difficult to predict the severity of casualties, property, and cascading impacts generated by future seismic events affecting the greater Orange County region and the CSU Fullerton campus. Each of the earthquake generated effects will vary widely based on the intensity of the earthquake, location of the epicenter, proximity to people and development, time of day and year, the soil composition under the impacted structures, building construction, among others. In any case, the potential for a major earthquake exists affecting the campus and causing extensive challenges to the CSU Fullerton campus and community.

In the event that a major earthquake was to strike along the many fault systems surrounding Fullerton, the effects could be significant to the campus community and campus operations. The widespread impacts generated by a major earthquake would extend the effects of casualties, damages, and other impacts to the broader Orange County region creating large-scale regionwide needs for critical assistance and a heavy demand on limited emergency resources. The threat and impacts presented to the campus will be shared with the campus community from their homes and places
of work. The campus will likely be required to address critical needs independently during early phases of the disaster.

Vulnerabilities will be seen in the physical infrastructure on the campus and the human population of the campus community. Campus infrastructure is vulnerable to severe shaking particularly in areas where the ground is loose or susceptible to liquefaction. Specifically older buildings, masonry constructed buildings, and other structures susceptible to shaking related damage are the most vulnerable. Communication systems, computer networks, and other electronic systems may be vulnerable when overwhelmed by increased demand during emergencies or by shaking related damages. The people of the campus community are vulnerable to effects of intense shaking in the form of injuries from falling debris, exposure to secondary floods or fires, loss of employment, extreme disaster induced stress, and loss of access to critical services or social contacts.

The campus population is additionally vulnerable to the effects of major ground shaking that are far reaching. The psychological and social impacts a major earthquake will give rise to will potentially harm individuals and cause tremendous fear. The willingness to return indoors may be hampered especially as after-shocks continue. These effects are magnified for populations having specific vulnerabilities or access limitations. Populations having various limitations or specific needs may be vulnerable to reduced or eliminated access to essential services that have been rendered incapable to respond.

**Identified Data Limitations**

Missing campus structural replacement costs and an inventory of building construction types to include status of earthquake retrofitting. HAZUS generated analysis is focused on the broader community level versus finetuning the analysis to the micro-level for facilities such as a university campus.
Erosion

Description of the Hazard

The US Geological Survey (USGS) defines erosion as “the process whereby materials of the earth’s crust are loosened, dissolved, or worn away and simultaneously moved from one place to another.”49 Erosion may occur in areas of streams and rivers, along bluffs, around immovable objects (such as buildings or bridge abutments), or as a cascading result of other natural hazards, such as earthquakes or wildfires. When erosion occurs along bodies of water, the removal of material causes the shore to move further landward.

Forces such as sea level rise and changes in sediment supply impact erosion gradually and can be difficult to recognize. In contrast, the impacts of short-term events, such as storms and flooding, can be severe and are immediately recognizable. Along the Pacific coast, rain, wind, and waves can induce significant short-term erosion.

Location of the Hazard

Erosion is a severe hazard in coastal communities, where sea level rise and storms contribute to de-sedimentation and the retreat of coastal cliffs, bluffs, and beaches. While coastal erosion can happen in any storm, it is more likely during El Nino events, which occur every 5-7 years.

Other incidents of erosion, such as around building foundations, can occur in any locations with conducive soil structure and a source of movement, such as water or wind. An area’s potential for erosion is determined by several factors, including rainfall, topography, soil characteristics, and vegetative cover. For the purpose of this analysis, the risk is located consistently across those areas of the campus with erosion-prone characteristics. In the future, the campus leadership may fully investigate to what extent specific sites of erosion activity are observably in process, given that erosion has caused past damage on campus.

In agricultural areas, the erosion of soil degrades the quality of the soil, which can lead to reduced crop yields.50 At the Fullerton Arboretum Learning Farm, soil erosion can create significant concerns for agriculture and research. Eroded test plots can negatively impact experiments and tests, resulting in a loss of knowledge and data.

Extent of the Hazard

Erosion is occurring on the Pacific coastline west of CSU Fullerton. While there is no published scale of severity or extent for this geologic hazard on the CSU Fullerton campus, erosion is likely to occur if conditions are favorable. Given that such

conditions exist and have resulted in damages to campus infrastructure, the planning committee ranks the extent of the hazard as **Moderate**.

**History of the Hazard**

Erosion resulting from heavy rainstorms in 2017 has contributed to structural damage on campus. Heavy precipitation also poses a risk of erosion to outdoor landscapes.

**Potential Impacts of the Hazard**

Coastal erosion can result in severe impacts to infrastructure, including the undermining of foundations, exposure of underground infrastructure, and breaches of natural or constructed protections. The latter can expose communities to the destructive forces of floodwaters, surge, and debris impacts. On campus, areas of erosion can create pedestrian and transportation hazards, and structures may become unsafe if erosion is not controlled. Public health and safety, structures, and infrastructure can all be negatively impacted, damaged, or destroyed by the erosion hazard.

**Probability of Future Occurrence of the Hazard**

Erosion is an on-going and dynamic process that occurs regularly. As climate change raises sea levels and induces more frequent and intense weather events, coastal and other erosion may generally become more widespread or severe. As a result, and in consideration of the potential extent of erosion, the probability of future occurrence is high.

**Vulnerability to the Hazard**

Topography, soil structure, land use, and precipitation are all factors of erosion. CSU Fullerton infrastructure and buildings located on steep slopes, in areas with little vegetation, or in areas with conducive soil types are more vulnerable to erosion.

In the wider Los Angeles community, erosion vulnerabilities include agricultural sector job loss, degradation of riverine ecosystems and coastlines, and loss of water quality.

**Estimate of Potential Losses**

The historic and potential impacts of erosion on property statewide include reduced agricultural productivity, lower surface water quality, and damaged drainage networks.

Current modeling is not precise enough to allow for an assessment of potential losses to buildings and infrastructure on campus.

**Vulnerability Assessment Conclusions**

While the ability to predict future erosion on the CSU Fullerton campus is limited, the core issues shaping erosion vulnerability on campus are flora and landscaping. If left
unchecked, erosion can cause significant damage to campus infrastructure and the surrounding environment.

Identified Data Limitations

The complex interactions between soil erosion factors make predictive modeling, determination of hazard areas, and quantification of loss difficult. Localized data on this hazard is also limited, resulting in more generalized findings.

**Extreme Temperatures (Includes Extreme Cold and Extreme Heat)**

Description of the Hazard

What is considered an excessively hot temperature varies according to the normal climate for that region. However, when temperatures are extremely high, people are at higher risk for heat-related illnesses, such as dehydration, heat exhaustion, heat stroke, and in severe cases, death.51

Hazards from extreme heat are made worse when high temperatures are accompanied by high levels of humidity, which is defined as the amount of moisture in the air.52 As the temperature climbs, the air is able to hold more moisture. High humidity prevents the human body from cooling down naturally, which leads people to perceive that the temperatures “feels” hotter. The combination of temperature and humidity is known as the heat index.53

Heat stroke, the most serious heat-related illness, occurs when the body is unable to control its temperature. Body temperature rises rapidly, the sweating mechanism fails, and the body cannot cool down.54 In extreme causes, heat stroke can cause confusion and unconsciousness, so the victim is unable to seek treatment without assistance.

There are several groups of people who are uniquely vulnerable to the effects of extreme heat, such as infants and children, older adults aged 65 and up, athletes and outdoor workers, low-income households, and individuals with certain chronic medical conditions.55

Location of the Hazard

Extreme heat events are a non-spatial hazard and may occur at the Cal State Fullerton campus.

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53 Ibid.


Extent of the Hazard

Extreme heat has a wide range of extent and severity markers and characteristics. Monthly average maximum temperatures in June through October range approximately from the high 70s to high 80s in the City of Fullerton. According to data from the National Climatic Data Center (NCDC), the highest daily temperature recorded at the Fullerton Municipal Airport was 116°F on July 6, 2018. This was part of a large-scale heat event that affected much of the western United States. In California, combined conditions of heat and dryness fueled spreading wildfires, leading to deaths, evacuations, and power outages across large sections of the state. Given 9 extreme heat events since 2007, along with the history of event impacts, along with increased risk of wildfires, the planning committee ranks the extent of the hazard as Moderate.

The National Weather Service issues a Heat Advisory when the heat index value is expected to reach 100°F – 104°F within the next 12 to 24 hours. Excessive Heat Warnings are issued when there is an anticipated heat index of 105°F or greater that will last for two (2) or more hours. Excessive Heat Warnings are issued by the county when any location in the county is expected to reach that criteria. In anticipation of an Excessive Heat Warning, an Excessive Heat Watch may be issued 1 to 2 days in advance, when the Heat Warning criteria is 50 – 79% likely to occur.

Figure 10-12 (following) depicts the National Weather Service’s methodology for determining the heat index, using the % humidity and the actual temperature.

As the heat index rises, so does the potential danger to people and animals. Table 10-23 (following) shows the health hazards associated with extreme heat.

Table 10-22: Health Risks Associated with Heat Index

<table>
<thead>
<tr>
<th>Category</th>
<th>Heat Index</th>
<th>Health Hazards</th>
</tr>
</thead>
<tbody>
<tr>
<td>Extreme Danger</td>
<td>130° F or higher</td>
<td>Heat stroke / sunstroke is likely with continued exposure.</td>
</tr>
<tr>
<td>Danger</td>
<td>105° – 129° F</td>
<td>Sunstroke, heat cramps, and/or heat exhaustion is likely with prolonged exposure and/or physical activity.</td>
</tr>
<tr>
<td>Extreme Caution</td>
<td>90° – 104° F</td>
<td>Sunstroke, heat cramps, and/or heat exhaustion is possible with prolonged exposure and/or physical activity.</td>
</tr>
<tr>
<td>Caution</td>
<td>80° – 89° F</td>
<td>Fatigue is possible with prolonged exposure and/or physical activity.</td>
</tr>
</tbody>
</table>

History of the Hazard

Based on data gathered from the National Centers for Environmental Information (NCEI) Storm Events Database, there have been nine excessive heat events in Orange County since 2007. A few of these events have been grouped into two- or three-day heat waves.

**September 2, 2007:** A combination of high temperatures and high humidity produced an extreme heat event across most of Southern California. Heat index values during this heat wave ranged from 105° to 112° F. There were eight deaths attributable to this excessive heat event.

**September 1, 2017:** This heat event began in late August and extended into early September, affecting most of the western United States. Many metro areas broke daily, monthly, and even all-time heat records.

**October 23-25, 2017:** A second heat wave followed approximately two months later, primarily in Southern California. The City of Fullerton reached a temperature of 107° F.

**July 6, 2018:** As mentioned above, this heat event was part of a larger heat wave that affected much of California. As part of this heat event, more than 30,000 customers of the Los Angeles Department of Water and Power experienced power outages and Flex Alerts were issued by state authorities.

**September 13, 2019:** After high temperatures in both July and August, temperatures again climbed to 15 to 20 degrees above normal (or higher) in areas of Southern California.

**October 21-22, 2019:** This heat event, occurring much later than usual, also fueled heightened concerned about wildfires.

**Potential Impacts of the Hazard**

Cal State Fullerton may experience impacts from extreme heat due to cancelled classes or postponed outdoor events in order to protect students, faculty, and staff from the weather.

In addition to the threat extreme heat poses to humans, high temperatures also pose a threat to utility production, which in turn threaten facilities and operations that rely on utilities. As temperatures rise, more people stay indoors, increasing the demand for air conditioning, fans, and other electronics. This puts a strain on the electrical grid, which can cause temporary outages. These outages can impact operations throughout campus, resulting in interruptions and delays in service. Outages may also negatively impact research efforts on campus, as the inability to maintain a steady, constant temperature may impact research specimens and experimental results.

**Probability of Future Occurrence of the Hazard**

There have been multiple excessive heat events over the last decade that have impacted the City of Fullerton. Therefore, using the scale provided, it is highly likely that the hazard will occur annually.
Vulnerability to the Hazard

When dealing with an extreme heat event, the most common impacts are those generally felt by the people living in the targeted area. For people in particular, heat can kill when the body is pushed beyond its limits. Most heat disorders occur because the victim has been overexposed to heat. As discussed, the major human risks associated with extreme heat include dehydration, sunburn, fatigue, heat exhaustion, heat stroke, and in severe cases, death.

Some portions of the population are more at risk to the effects of extreme heat. The very young, the elderly, and certain groups with chronic medical conditions (such as asthma or other pulmonary illnesses, heart disease, poor blood circulation, neurological illnesses, and obesity) are generally more vulnerable to the effects of extreme heat, and are more likely to suffer illness or death as a result.58 This is especially true if exposure is extended for a period of time and preventative measures are not taken immediately.

Several cooling centers are open throughout Orange County during extremely hot days, however, the campus’s limited emergency notification and communication system may make it difficult for Cal State Fullerton to spread information about cooling centers to more vulnerable campus populations, such as students with access or functional needs and international students who may have a language barrier.

The risk of power shut-offs affecting air conditioning is not a concern for on-campus facilities because Cal State Fullerton has a system of solar panels and also has its own campus substation. The campus is able to generate approximately 13% of its energy from a clean, renewable energy source.59

Extreme heat is a hazard that the campus may experience with regularity, and there are a few improvements that could help Cal State Fullerton handle the risks and vulnerabilities.

Estimate of Potential Losses

Based on the previous historical occurrences, annualized losses are considered to be negligible. In an extreme heat event, loss of human life or health impacts are a greater concern than is property damage.

Vulnerability Assessment Conclusions

While the ability to predict future heat events at Call State Fullerton is limited, the effects of climate change may provide some information. According to the Environmental Protection Agency (EPA), Southern California has warmed about three

degrees on average over the last century, with less rainfall. This may lead to stronger and more frequent heat events, drought, and an increased risk of wildfires.⁶⁰

**Identified Data Limitations**

Numerous public and private actors conduct research, acquire data and disseminate meteorological information and forecasting to the general public, including the CSU university system. Currently, it is assumed that, apart from regular access to climate change models on changes to temperature extremes over time, the CSU community maintains sufficient access to the data needed to plan for, respond to, and mitigate the effects of extreme heat and cold.

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**Flood**

**Description of the Hazard**

The incredible geographic diversity in California presents tremendous challenges for flood planning and response. The state is home to extensive mountain ranges such as the Sierra Nevada, Cascades, Klamath, Coastal Ranges, and the Southern California Transverse Range all creating tremendous watersheds. Large river systems drain the mountains traveling through populated communities including the Sacramento and San Joaquin Rivers draining into the California Delta. The state has a complex system of reservoirs, dams, and levees providing water storage and flood protection. Finally, California’s 840-mile coastline exposes the coastal regions to tidal influences.

Floods are characterized by the rising and overflowing of excess water from a water source such as a stream, river, lake, canal, or coastal body onto an area of normally dry floodplain. A floodplain is a lowland area downstream and adjacent to water bodies that are subject to flood events. Flooding is a naturally occurring event that become hazardous when populations and property are affected.

Flooding can result from excessive precipitation from weather systems generating prolonged rainfall, excessive snowmelt from watersheds upstream from the floodplain, infrastructure failure, exceeding the capacity of dams or levees, tidal influences, or a combination from any of the previous factors.

Floods represent one of the costliest and most frequent natural disasters that influences human suffering and economic impact in the United States. Flooding will likely result in significant damage to structures, infrastructure, utilities, landscapes, and the environment. Erosion of stream banks, roadways, other feature may result

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from the movement of flood waters. The saturated ground resulting from standing flood waters may cause ground instability, collapse, erosion, or other damages. Further, floods will often generate substantial debris that will accumulate and be deposited throughout the flooded areas.

Floods can be either slow-rise or rapid onset floods. With slow rise floods, there is often warning preceding water rise by hours or days before dangerous conditions present themselves. Slow rise floods that are expected to enter into populated areas generally allow for some time to initiate evacuation and sand bagging efforts. Flooding that occurs rapidly conversely are water events that present with extremely limited warning times and a limited ability to take response actions until flooding has already begun to occur.

Flooding may take on different forms:

- **Flash Flooding** – Flash flooding is typically characterized by a rapid rise, short duration, and large volume of water in a localized area. Heavy rainfall in areas that have limited drainage capacities often contribute to flash flooding conditions. These flooding events frequently occur with limited notice requiring immediate evacuation or rapid response efforts such as sand bagging. Flash flooding may arrive with fast moving water creating added hazardous conditions.

- **Riverine Flooding** – Riverine flooding is usually caused by prolonged rainfall or rainfall combined with heavy snowmelt. When soils are already saturated, the ability for the ground to absorb water is minimized. In a riverine flood, the water way exceeds channel capacity and extends into areas outside of the channel, often in developed communities. In California, riverine flooding is most likely to occur from November through April. The duration of riverine floods may vary from a period of hours to weeks.

- **Localized Flooding** – Localized flooding is commonly the result of stormwater drainage systems being overwhelmed by unusually heavy rainfall. These flooding events frequently occur in areas that are urbanized or developed with greater amounts of impervious surfaces not allowing ground absorption. This generates added runoff into the drainage systems and onto roadways creating backups.

- **Infrastructure Failure** – Failures of dams or levees presents a serious flooding concern for areas downstream from the compromised structure. This situation may result in a catastrophic flood with limited warning time and widespread areas affected.

- **Coastal Flooding** – Coastal flooding can occur in multiple areas along the California coastline. Flooding may result from intense storms coming from the Pacific Ocean that generate elevated water levels or storm surge. The size, duration, winds generated, and intensity of the storm will influence the effect the waves will have on the shoreline. Periods of high tide can aggravate the conditions allowing greater wave impingement into coastal areas.
Atmospheric River

California, including the location of this campus, is subject to the effects of a phenomenon referred to as atmospheric rivers. These weather events consist of long, narrow regions in the atmosphere transporting tremendous amounts of water vapor from the tropics. These weather regions behave like rivers in the sky. They can carry heavy volumes of water vapor compared to the amount of water flow at the mouth of the Mississippi River. As these atmospheric rivers arrive into California they tend to generate significant rain and snow.

Atmospheric rivers can arrive in many different shapes and sizes. The larger events are able to generate extreme rainfall amounts resulting in flooding. They can stall over watersheds vulnerable to flooding, often saturated with heavy snow amounts. The atmospheric rivers known as a “Pineapple Express” coming from the tropics and arriving with warmer air may produce heavy rains that will melt ground snow adding to the water volume that will be added in the flood runoff.

These events can produce heavy amounts of precipitation creating extensive damages. However, these events may present as weaker systems that produce precipitation that is enough to be beneficial for the local water supply. At the higher elevations in the California mountains, these events have the potential to generate a tremendous snowpack providing a source of water during the dry summer months.
The science behind atmospheric rivers

An atmospheric river (AR) is a flowing column of condensed water vapor in the atmosphere responsible for producing significant levels of rain and snow, especially in the Western United States. When ARs move inland and sweep over the mountains, the water vapor rises and cools to create heavy precipitation. Though many ARs are weak systems that simply provide beneficial rain or snow, some of the larger, more powerful ARs can create extreme rainfall and floods capable of disrupting travel, inducing mudslides and causing catastrophic damage to life and property. Visit www.research.noaa.gov to learn more.

Location of the Hazard

Fullerton lies at the base of the Coyote Hills in Orange County. Along the northern edges of Orange County are low rising hills that are a part of the Transverse Ranges. These include the Puente and Chino Hills which provide a potential for developing water run-off during heavy precipitation events. There are a number of flood retention basins and flood control channels along the base of these hills to protect these Orange County communities including Fullerton. The area surrounding the campus is a developed suburban environment predominately consisting of residential and commercial land uses.

The CSU Fullerton campus is located 2-3 miles north of the Santa Ana River that flows through Anaheim. The Santa Ana River watershed receives the majority of its water from snowfall from the Santa Ana, San Bernardino, and San Gabriel Mountains. The Santa Ana River does not contribute to a direct flood hazard to the campus but may compromise access routes to the campus. The Fullerton Creek extends along the northwest corner of the campus. Fullerton Creek when filled with water drains from the Fullerton Reservoir and Humble Reservoir located ½ mile and 3 miles respectively to the north of the campus. The majority of the CSU Fullerton campus sits within a Special Flood Hazard Area (SFHA) Zone X: Area of Minimal Flood Risk designation on the Flood Insurance Rate Map. Extending down State College Blvd, portions of the Nutwood Parking Structure, parking lot C West, and parking lot A reside in a Zone X: 0.2% of Annual Chance of Flood Hazard.

Extent of the Hazard
The CSU Fullerton campus is located predominately in a designated Zone X: Area of Minimal Flood Risk. Portions of the western edges of the campus are located within a
Zone X: 0.2% Annual Chance Flood Hazard. The neighborhoods opposite of the State Route 57 Freeway are designated as Zone X: 0.2% Annual Chance Flood Hazard. Based on these factors along with no history of flooding on campus other than occasional small-scale ponding and isolated street flooding, the planning committee ranks the extent of the hazard on campus as **Low**.

In support of the NFIP, FEMA identifies those areas that are more vulnerable to flooding by producing Flood Hazard Boundary Maps (FHBM), Flood Insurance Rate Maps (FIRM), and Flood Boundary and Floodway Maps (FBFM). Several areas of flood hazards are commonly identified on these maps, including the 1% annual chance flood zone. Flood zones are further delineated by risk and are assigned a letter signifier. The flood zone designations are defined and described in the following table.

**Table 10-23: Flood Zone Designations and Descriptions**

<table>
<thead>
<tr>
<th>Zone Designation</th>
<th>Percent Annual Chance of Flood</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Zone V</td>
<td>1%</td>
<td>Areas along coasts subject to inundation by the 1% annual chance of flooding with additional hazards associated with storm-induced waves. Because hydraulic analyses have not been performed, no BFEs or flood depths are shown.</td>
</tr>
<tr>
<td>Zones VE and V1-30</td>
<td>1%</td>
<td>Areas along coasts subject to inundation by the 1% annual chance of flooding with additional hazards associated with storm-induced waves. BFEs derived from detailed hydraulic analyses are shown within these zones. (Zone VE is used on new and revised maps in place on Zones V1-30.)</td>
</tr>
<tr>
<td>Zone A</td>
<td>1%</td>
<td>Areas with a 1% annual chance of flooding and a 26% chance of flooding over the life of a 30-year mortgage. Because detailed analyses are not performed for such areas, no depths or base flood elevations are shown within these areas.</td>
</tr>
<tr>
<td>Zone</td>
<td>Percentage Chance of Flooding</td>
<td>Description</td>
</tr>
<tr>
<td>--------</td>
<td>------------------------------</td>
<td>-----------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Zone AE</td>
<td>1%</td>
<td>Areas with a 1% annual chance of flooding and a 2 6% chance of flooding over the life of a 30-year mortgage. In most instances, base flood elevations derived from detailed analyses are shown at selected intervals within these zones.</td>
</tr>
<tr>
<td>Zone AH</td>
<td>1%</td>
<td>Areas with a 1% annual chance of flooding where shallow flooding (usually areas of ponding) can occur with average depths between one and three feet.</td>
</tr>
<tr>
<td>Zone AO</td>
<td>1%</td>
<td>Areas with a 1% annual chance of flooding, where shallow flooding average depths are between one and three feet.</td>
</tr>
<tr>
<td>Zone X (shaded)</td>
<td>0.2%</td>
<td>Represents areas between the limits of the 1% annual chance flooding and 0.2% chance flooding.</td>
</tr>
<tr>
<td>Zone X (unshaded)</td>
<td>Undetermined</td>
<td>Areas outside of the 1% annual chance floodplain and 0.2% annual chance floodplain, areas of 1% annual chance sheet flow flooding where average depths are less than one (1) foot, areas of 1% annual chance stream flooding where the contributing drainage area is less than one (1) square mile, or areas protected from the 1% annual chance flood by levees. No Base Flood Elevation or depths are shown within this zone.</td>
</tr>
</tbody>
</table>

**History of the Hazard**

Flooding in Fullerton and the broader Orange and Los Angeles County regions have typically occurred during the winter months when Pacific storms are more common. The occurrences of significant flooding typically have been the result of successive intense storms with heavy precipitation. The region has experienced flood events that have caused tens of millions of dollars in damages and casualties. The following provides insight into information of past flooding events that are significant to the CSU Fullerton campus. No flood events have been reported specifically for the
campus, though heavy rainfall events will sometimes produce small-scale flooding and/or ponding.
Table 10-24: Historic Flooding Events in Orange County

<table>
<thead>
<tr>
<th>Date</th>
<th>Event</th>
<th>Declaration</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>March 1962</td>
<td>Flood</td>
<td>DR-122-CA</td>
<td>Countywide</td>
</tr>
<tr>
<td>October 1962</td>
<td>Flood</td>
<td>DR-138-CA</td>
<td>Countywide</td>
</tr>
<tr>
<td>February 1963</td>
<td>Flood; Heavy Rains</td>
<td>DR-145-CA</td>
<td>Countywide</td>
</tr>
<tr>
<td>February 1978</td>
<td>Flood; Winter Storms</td>
<td>DR-547-CA</td>
<td>Countywide</td>
</tr>
<tr>
<td>February 1980</td>
<td>Flood; Winter Storms</td>
<td>DR-615-CA</td>
<td>Countywide</td>
</tr>
<tr>
<td>December 1988</td>
<td>Winter Storms</td>
<td>DR-812-CA</td>
<td>Countywide</td>
</tr>
<tr>
<td>February 1992</td>
<td>Winter Storms</td>
<td>DR-935-CA</td>
<td>Countywide</td>
</tr>
<tr>
<td>January 1993</td>
<td>Winter Storms</td>
<td>DR-979-CA</td>
<td>Countywide</td>
</tr>
<tr>
<td>January 1995</td>
<td>Flash Flood; Heavy Rains</td>
<td>DR-1044-CA</td>
<td>Countywide</td>
</tr>
<tr>
<td>March 1995</td>
<td>Flash Flood; Heavy Rains</td>
<td>DR-1046-CA</td>
<td>Countywide</td>
</tr>
<tr>
<td>December 1996</td>
<td>Flood; Winter Storms</td>
<td>DR-1155-CA</td>
<td>Countywide</td>
</tr>
<tr>
<td>January 1997</td>
<td>Flood</td>
<td>DR-1155-CA</td>
<td>Countywide</td>
</tr>
<tr>
<td>February 1998</td>
<td>Flood; Winter Storms</td>
<td>DR-1203-CA</td>
<td>Countywide</td>
</tr>
<tr>
<td>January 2005</td>
<td>Flood; Winter Storms</td>
<td>DR-1577-CA</td>
<td>Countywide</td>
</tr>
<tr>
<td>February 2005</td>
<td>Flood; Debris Flows</td>
<td>DR-1585-CA</td>
<td>Countywide</td>
</tr>
<tr>
<td>January 2017</td>
<td>Flood; Winter Storms</td>
<td>DR-4305-CA</td>
<td>Countywide</td>
</tr>
</tbody>
</table>

62 City of Fullerton Local Hazard Mitigation Plan, May 21, 2020
Potential Impacts of the Hazard

A flood will potentially result in extensive amounts of water entering onto developed areas. The force and volume of water that is generated by a flood may cause extensive structural damage in areas subject to standing or moving water. The effects of flooding may spread over significant distances covering large areas of land. The extent of the impacts would vary based on a number of factors such as the volume of water flooding, the time of the flood event, the amount of warning provided, the location and extent of the flood boundary, facility elevation, and distance from the flood source. Potential impacts resulting from flooding include:

- Injuries or loss of life
- Property destruction or damage
- Loss of property contents
- Infrastructure damage including roadways, bridges, other transportation means
- Public health hazards resulting from mold, mildew, and disease due to flood water
- Flooded or destroyed lifelines/supply routes
- Damaged or destroyed utilities, including on campus power generation
- Loss of community economic base
- Employment losses
- Agricultural (crops and livestock) damages or destruction
- Environmental damage
- Prolonged periods of necessary dewatering
- Flooding erosion may alter natural drainage channels
- Threat, inundation, or damage to on campus childcare facilities and occupants
- Societal and community impacts
- Psychological impacts of impacted populations
- Disruptions to education delivery to community

Additionally, individuals who were unable to evacuate in time or refused to leave will likely need assistance or rescue from the flooded area. Remaining in or being trapped by flood waters places individuals in significant risk of injury or death. The impacts extend beyond the danger placed upon the affected individual and places greater resource demands on agencies and organizations making efforts to rescue trapped individuals.

Probability of Future Occurrence of the Hazard

Orange County is determined have considerable portions of the county to be at high risk from flooding. The repeated historic occurrences have shown that the region is subject to flooding in any given year. Floods can occur at any time but are most common in the Fullerton area with winter storms that are saturated with subtropical moisture. The area surrounding the CSU Fullerton campus does not generally promote conditions for flood waters to accumulate. The campus is designated as Zone
X (Area of Minimal Flood Hazard). However, bordering on both the east side and west side of the campus are areas designated as Zone X (0.2% of Annual Chance of Flood Hazard). There are specific buildings and areas of the campus that have a greater risk for isolated flooding. However, the area is subject to isolated urban or street flood events providing a demonstration of potential flood activity.

The probability of future occurrence for flooding is **Unlikely**.

**Vulnerability to the Hazard**

The CSU Fullerton campus is subject to the effects of limited and isolated flooding resulting primarily from localized flooding and ponding from excessive precipitation and isolated strong storms. There is a more remote potential for flooding and damage on campus and surrounding residential and commercial areas of Fresno due to overflow or damage to flood control systems such as the Fullerton Creek System. The flood control channels and drainage systems that surround the campus have limited storage or volume capacities. The campus and the campus community are vulnerable to the effects generated by flooding from these systems.

Vulnerability to flooding on the CSU Fullerton campus will vary depending on when the flood were to occur and on the location of any people or assets within any low lying areas. The risk to the campus population will be lessened during periods when classes are not in session or during periods of breaks. Conversely, during the days and hours that classes are in session and staff are at their workplaces, the human vulnerability increases. Members of the campus community may become trapped on campus depending on the level of flooding occurring on surface streets. However, in region-wide events this vulnerability may be extended to the homes and workplaces of members of the campus community and their families.

CSU Fullerton is in proximity to residential neighborhoods and commercial areas. When these areas are inundated with flood water, the potential for release of contaminants, hazardous materials, biological contaminants, and other chemicals presents possible exposures to individuals from the campus community. Any flood waters left standing in the area would pose a significant vulnerability to the campus community remaining on campus in potential health and safety effects.

Some campus buildings and infrastructure in low lying areas might be vulnerable to low probability, large-scale flooding if it reaches the university. Campus utilities, including the on-campus power plant, and communication capabilities could be impacted by flood waters rendering them disabled. A rare flood covering a large portion of the city might affect communication capabilities well beyond the boundaries of the campus. Remaining flood waters will leave behind molds and other health concerns in affected campus buildings and facilities likely requiring extensive restoration or demolishing. The residents of the on-campus residence halls in low lying areas may have transportation limitations requiring evacuation and alternative housing procedures to be implemented if populated. In such areas, flood waters may result in damage to campus equipment, communication systems, protected
documents, artwork, academic materials, computer systems, research, and other critical activities on lower levels of buildings.

Certain campus populations will experience greater challenges to a post-flood / failure environment. Vulnerable populations will likely need to navigate through flood generated debris, face extreme health safety issues from flood waters, experience extreme stresses of a disaster, an inability to communicate to or gain access to support networks, and find difficulty in accessing equipment or supplies to aid in a specific need. Students remaining on campus such as those residing in the residence halls would be particularly vulnerable especially those without access to adequate transportation.

**Estimate of Potential Losses**

Estimates of potential losses will be influenced by a variety of factors. The volume and force of the water will determine the scale of damages affecting campus infrastructure, equipment, and other impacted features. The location and elevation above flood waters will affect the level of damage and individuals exposed. The time of the academic year, the day of week, and hour in which the flooding was to occur will influence the number of people on campus and potential casualties. The severity of the storms producing precipitation, the speed of the storms moving across the area, the level of snowpack in the higher elevations, and amount of resulting snowmelt will produce varying effects on damages produced and costs incurred. Losses will be generated by the physical damages, the loss of revenue, loss of academic research, loss of building contents, and community wide economic reductions.

Based on estimate replacement costs of facilities and structures on campus, the maximum total replacement costs due to flood are $453,119,067. However, it is unlikely for flood to cause destructive losses to the entire campus.

**Table 10-25: Special Flood Hazard Area (SFHA) Estimated Losses**

<table>
<thead>
<tr>
<th>Zone Designation</th>
<th>No of Buildings</th>
<th>Maximum Replacement Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Zone V</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Zone VE &amp; V 1-30</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Zone A</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Zone AE</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Zone AH</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Zone AO</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Zone X .2%</td>
<td>1</td>
<td>$29,913,000</td>
</tr>
</tbody>
</table>
Vulnerability Assessment Conclusions

While the campus is located in an area of minimal flood potential (Zone X), the primary vulnerabilities to flood on campus are people and assets in low lying areas exposed to mostly localized flooding and ponding from overflow of campus creeks or low probability, large-scale storms that produce heavy amounts of precipitation directly over the campus and surrounding neighborhoods. The proximity to the Fullerton Creek and Santa Ana River further presents an additional flood risk factor to the campus.

Vulnerabilities to flood will be seen in the physical infrastructure on the campus and the human population of the campus community. Campus infrastructure is vulnerable to water inundation particularly in areas where large water sources are in proximity to the campus allowing greater volumes of water to arrive. Specifically low-lying buildings, temporary constructed buildings, and structures with generators, HVAC, critical control systems, or other key components at or below ground level are the most vulnerable. Communication systems, computer networks, and other electronic systems may be vulnerable when overwhelmed by increased demand during emergencies or by water inundation on electronic equipment. The people of the campus community are vulnerable to effects of flooding in the form of injuries from flood waters, exposure to secondary fires, loss of employment, introduction of disease, extreme disaster induced stress, and loss of access to critical services or social contacts.

The potential for flooding generates the potential for a number of cascading effects such as disruptions to the local economy, utility failures, disruptions to providing for the needs of the community, and development of public health hazards. These effects could be exacerbated by effects of seasonal flooding, ongoing heavy precipitation, or excessive run-off from the watershed contributing to the river system. The potential for rare, widespread flooding and damage of structures due to the force of water, while unlikely, has exponentially powerful impacts on particular populations among the campus community including those with access or functional needs, international students, the homeless, and students residing in the residence halls.
Identified Data Limitations

Lack of comprehensive historic flooding occurrences, missing campus structural replacement costs, and complete inventory of building construction features or mitigation efforts to lessen the impact due to flood inundation.

**Hazardous Materials**

Description of the Hazard

A hazardous material is defined in California’s State Hazardous Materials Incident Contingency Plan (1991) as “a substance or combination of substances which, because of quantity, concentration, physical, chemical, or infectious characteristics may: cause, or significantly contribute to an increase in deaths or serious illnesses; and/or pose a substantial present or potential hazard to humans or the environment.” Hazardous materials are one or more of the following: flammable, corrosive or an irritant, oxidizing, explosive, toxic (poisonous or infectious), thermally unstable or reactive, or radioactive. Hazardous materials are ubiquitous in modern society and may be found at all stages of production, consumption, and disposal.

Federal and state laws permit the intentional release of some hazardous materials into the environment such that the risk to human health and the environment is thought to be acceptable. However, sometimes releases are unintentional, resulting from leaks, accidents, or natural hazards. This section focuses on such accidental releases and fall into the following key categories:

**Fixed Hazardous Materials Incident**

A fixed hazardous materials incident is the accidental release of chemical substances or mixtures during production or handling at a fixed facility.

**Transportation Hazardous Materials Incident**

A transportation hazardous materials incident is the accidental release of chemical substances or mixtures during highway, waterway or air transport. Populations, built and natural environments are potentially impacted.

**Pipeline Incident**

A pipeline transportation incident occurs when a break in a pipeline creates the potential for an explosion or leak of a dangerous substance (oil, gas, etc.) possibly requiring evacuation. An underground pipeline incident can be caused by environmental disruption, accidental damage, or sabotage. Incidents can range from a small, slow leak to a large rupture where an explosion is possible. Inspection and maintenance of the pipeline system along with marked gas line locations and an early warning and response procedure can lessen the risk to those near the pipelines.

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Hazardous materials can also be classified according to worker safety and health.\(^6^4\) Information provided by California Division of Safety and Health includes guidelines related to:

- **Safety hazards** (fire and fire byproducts, electricity, flammable gases, unstable structures, demolition, sharp or flying objects, excavations)
- **Health hazards** (carbon monoxide ash, soot and dust; asbestos; hazardous liquids; other hazardous substances; heat illness)

**Natural-Technological Incidents (Natecs)**

During the past two decades, increasing attention has been given to hazardous materials releases resulting from *Natechs* or a natural disaster event that triggers a technological hazard event. As pointed out by Lindell and Perry (1996), Young, Balluz, and Malilay (2004), and Steinburg, Sengul, and Cruz (2008), natechs are of particular concern for the following reasons:

- They can produce a simultaneous effect on many industrial facilities\(^6^5\)
- Can overwhelm response capacity
- Containment systems may fail
- May produce cascading disasters\(^6^5\)
- Response may be hindered by a disaster’s impact on the physical environment

**Location of the Hazard**

Hazardous materials and infrastructure such as fuel tanks, rail lines, chemicals, hazardous waste sites and gas pipelines to varying degrees are located within the CSU system and/or within its surrounding communities. Please refer to Annex ? for the map identifying the types and locations of hazardous materials and infrastructure on or near the CSU – Fullerton campus. The planning committee indicates that chemicals are located in the science lab, but otherwise no known hazardous materials are present on campus. At larger scales (beyond the campus planning area) hazardous materials and infrastructure are located throughout the city of Fullerton and Orange County, and reflect different types, configurations and scales dispersed across these geographic areas.

**Extent of the Hazard**

There is no comprehensive statewide vulnerability assessment available at this time. As such, the true extent of the hazardous materials risk in California and its communities is not known, meaning no overarching conclusions have been reached


which have been able to integrate all qualitative and quantitative risk factors to produce a comprehensive measure of the extent of the hazard.

However, for the CSU – Fullerton planning committee, although no hazmat events have taken place on campus, and hazardous materials are limited to chemicals in the science building, gas pipelines and hazardous waste sites are located very close to the campus, as well as chemical facilities and a rail line located about 1.5 miles from the campus. Based on these factors along with the types and levels of hazardous materials in the larger community, it is prudent to rank the extent of the hazard for the CSU – Fullerton campus as Low to Moderate, and to consider worst case scenarios as the main driver of policy in order to fully mitigate all possible hazardous materials event outcomes.

For example, according to the 2018 CA State Hazard Mitigation Plan, 400 hazardous materials problems are tied to 32 past earthquakes, including over 150 problems from the Loma Prieta Earthquake alone. That said, the plan indicates that it is likely that many such hazardous materials releases have received little attention in the past because public authorities, the media, and the public have overlooked them in the rush to address and recover from immediate disaster threats, and that responsible parties may have an incentive to understate the extent of releases or not to report them at all.66

History of the Hazard

According to the CA Governor’s Office of Emergency Services’ Hazardous Materials Spill Report, the state experiences from 10 to 30 spill events daily. As of April 20th, 2021 already 2096 spill events had occurred. Such events have occurred in all the cities and/or counties where CSU campuses are located.67

According to the 2018 CA State Hazard Mitigation Plan, with regard to natural-technological hazard events (Natechs), 400 hazardous materials events are tied to 32 past earthquakes, including over 150 Natech events from the Loma Prieta Earthquake alone.

For more details on specific hazmat events, please refer to the local, county and/or multi-jurisdictional hazard mitigation plans where CSU campuses are located at: https://www.caloes.ca.gov/cal-oes-divisions/hazard-mitigation/hazard-mitigation-planning/local-hazard-mitigation-program

According to the campus planning committee, no hazmat events have taken place on the CSU – Fullerton campus.

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Potential Impact of the Hazard

A large hazardous materials release could affect an entire community or city under certain conditions related to direction of air flow (air-based chemical release) and population density or the contamination of a community’s main water supply. Either type of release could necessitate large scale evacuation. By contrast, in the rural unincorporated areas where population densities are low, even in the event of a large release, the number of homes that may need to be evacuated would be significantly lower than in an urban environment. The occurrence of a hazmat incident can also result in the shut-down of transportation corridors which can last for hours at a time while the impacted area is stabilized.

The release of some toxic gases may cause immediate death, disablement, or sickness if absorbed through the skin, injected, ingested, or inhaled. Contaminated water resources become unsafe and unusable, depending on the amount of contaminant. Some chemicals cause painful and damaging burns if they come in direct contact with skin. Prolonged and concentrated exposure to such chemicals can produce severe long-term impacts to respiratory, endocrine and nervous systems, heart and brain health.

The potential impacts of chemicals and toxic gases discussed here also apply to the students, staff and environment on the CSU – Fullerton campus.

With regard to the natural environment overall, contamination of air, ground, or water may result in harm to fish, wildlife, livestock, and crops. The release of hazardous materials into the environment may cause debilitation, disease, or birth defects over a long period of time. Loss of livestock and crops may lead to economic hardships within the community.

Recent California examples include the 2016 Aliso Canyon methane gas leak, which caused evacuation of nearby residents, many of whom experienced temporary health problems such as difficulty breathing and eye irritation; and the 2016 Fruitland metal recycle plant fire in Maywood, which released heavy metals such as lead, magnesium, copper, aluminum, antimony, calcium, iron, sulfur, tin, potassium, and zinc which pose severe risks to public health.\textsuperscript{68} Health effects from exposure to these metals included short-term symptoms such as irritation to the eyes, nose, throat, and lungs.\textsuperscript{69}

**Potential Impact of the Hazard (Natecs)**

Natural disasters, including earthquake, flood, and fire also pose risks to public health and the environment. For example, following the Northridge Earthquake, California State University (CSU) Northridge laboratories and chemical storage rooms


experienced multiple chemical spills. Such incidents, triggered by a natural disaster, pose a significant risk to students, faculty, staff, and first responders. At a minimum, all CSU campuses with a science lab (including CSU – Fullerton) is at risk of potential impact from a natural-technological (combined impact) event.

In a severe flood event, floodwaters are often contaminated with hazardous materials posing a threat to public and animal health, groundwater, and other parts of the environment. These hazardous materials may be released from damaged or flooded underground tank sites (e.g., gas stations or chemical storage facilities), propane tanks, manure or human waste handling facilities, fertilizer and pesticide storage, agricultural sites, and household hazardous waste.

In a fire event, (such as the October 2017 Northern California firestorms which destroyed approximately 6,000 residences) entire neighborhoods can be burned to the ground. Hazardous material release creates public health concerns which can delay the initial steps of fire recovery, including reopening burned areas to residents and initiating debris removal activities. The post-fire “toxic sweep” poses a risk of coming into contact with toxic substances due to the presence of synthetic and hazardous materials.70

Probability of Future Occurrence of the Hazard

The probability of occurrence for a hazmat event on the CSU – Fullerton campus can be viewed in two different ways: the history of occurrence serves as a sound predictor of future probability assuming current risk and vulnerability factors remain somewhat constant. For the purposes of the current estimate, no current data clearly indicates otherwise. As such, the probability of occurrence is Low to Moderate - the risk on campus is limited to chemicals in the science lab, and the campus has not experienced a hazmat event. However, nearby hazardous waste sites and gas pipelines increase vulnerability. That said, hazmat occurrences are largely based on human error, and any changes in risk and vulnerability factors such as a decreased vigilance in materials oversight and handling practices or changes in the amount of chemicals or exposure will likely increase the probability on campus.

Vulnerability to the Hazard

Hazardous materials pose a risk to the CSU – Fullerton campus. As identified by the campus planning committee and on the hazmat map, the following vulnerabilities are present on campus: chemicals are present in the science lab, and gas pipelines and hazardous waste sites are very close to the campus footprint. Gases and chemicals or hazardous waste, if spilled or released, could severely impact human health and campus operations.

Although it is quite difficult to produce a quantitative measure of vulnerability because (unlike natural hazards) the probability of occurrence is dependent on human error, which itself is variable based upon a fluctuating set of interrelated factors, some of which lack prediction or control, given the complexity of how all natural and built environments and hazmat risks factors interrelate at the local or campus level, it is prudent to assume for planning purposes that the campus’ vulnerability is a sub-set of the larger community’s vulnerability. As such, the CSU – Fullerton leadership maintains vigilance to mitigate the campus’ vulnerabilities identified above at a minimum.

Estimate of Potential Losses

As discussed previously, it is difficult if not impossible to produce an accurate quantitative measure of vulnerability because of the variable nature of a hazardous materials spill. For example, the release of a toxic airborne chemical in a populated area has severe impact potential, whereas the impact potential of a small chemical spill in a remote or rural area is most likely limited to remediation of soil. And, in both cases, the probability of occurrence is dependent on human error, which itself is variable based upon a fluctuating set of interrelated factors, some of which lack prediction or control. In all cases, different types and amounts of hazardous materials interact with fluctuating combinations of human error to produce different event outcomes with variable impact costs.

Vulnerability Assessment Conclusions

It is well understood that with regards to hazmat vulnerability, each campus and its surrounding community (including CSU – Fullerton) operates through a complex and dynamic interaction between industrial and commercial inputs and outputs and the natural and built environment. Such activity produces hazardous materials that move through the environment along both convergent and divergent routes and across all levels of land-use from site to campus to city and county and beyond. It is also clear from a review of the Orange County hazard mitigation plan and Cal OES’ records of hazardous material spills, that such events occur with great frequency and varying degrees of severity across jurisdictions statewide. As such, in assessing the vulnerability of the CSU – Fullerton campus, campus-level risks and vulnerabilities are not discreet or isolated but can become exacerbated or augmented through connections to broader community-level hazmat risks and vulnerabilities.

Finally, in order to draw conclusions on vulnerability, it should be noted that any identified vulnerabilities at the campus level and/or community level are circumscribed and potentially reduced by targeted policy and program interventions. Numerous policies and programs have been established in recent years in response to California’s widespread and complex and integrated hazardous materials risks - California established the Unified Program which consolidates and integrates the administrative requirements, permits, inspections, and enforcement activities of the following environmental and emergency response programs: the Aboveground...
Petroleum Storage Act (APSA) Program, Area Plans for Hazardous Materials Emergencies, the California Accidental Release Prevention (CalARP) Program, the Hazardous Materials Release Response Plans and Inventories (Business Plans), Hazardous Material Management Plan (HMMP) and Hazardous Material Inventory Statement (HMIS) requirements (California Fire Code), the Hazardous Waste Generator and Onsite Hazardous Waste Treatment (tiered permitting) Programs, and the Underground Storage Tank Program.

Identified Data Limitations

The CSU – Fullerton planning committee has provided information on campus-level hazmat materials and risks. Data limitations pertain to a comprehensive understanding of human activity and error related to materials control over the long term.

**Landslide**

Description of the Hazard

A landslide is a down-slope movement of soil, rock, or other debris, and can also be referred to as a mass movement or slope failure. These geological hazards can range in size from a few feet to over a mile in length and width and, when heavy and rapidly moving, can cause serious damage and loss of life.

Landslides are classified based on the type of material and type of movement involved. They can range from slow-moving earth flows to fast-moving debris flows, though many large slope failures involve more than one type of movement. The primary natural triggers of slope failures are water, seismic activity, and volcanic activity. Slope saturation by water can occur from intense rainfall, snowmelt, changes in ground-water levels, and surface-water level changes along coastlines. In winter months, El Nino storms or other high rainfall events may saturate soils and trigger slope failure.

**Deep-Seated Landslides**

Deep-seated landslides, ranging in depth from ten to several hundred feet, occur as a result of geologic and hydraulic changes, such as earthquakes or increased levels of groundwater. These landslides can move slowly or quickly and can cause extensive property damage, but rarely result in loss of life.

**Debris Flows Related to Shallow Landslides**

Shallow landslides may mobilize into rapidly moving debris flows and typically occur after sudden saturation of the ground. These types of debris flows are typically more dangerous because they move rapidly, causing both property damage and loss of life.

Debris flows may also occur as a result of post-fire conditions, where wildfires have left barren ground exposed to heavy rainfall. Intense rainfall, generally greater than .5 inch per hour, has the potential to trigger a post-fire debris flow.\textsuperscript{72} These landslides may impact lives and properties within the deposition zone and can result in downstream flooding. Post-fire debris flows often occur during the fall and winter following major summer fires.

**Location of the Hazard**

The susceptibility of an area to landslides depends on several variables, including magnitude of slope gradients, water content, ground cover, presence of erosion, and slope material and structure. However, landslides are most prevalent in terrain with weak material and steep slopes, and the highest risk is found in areas with high rainfall or high earthquake potential. Slope failures are also most likely to occur in areas where they have occurred in the past. In California, the most landslide-prone areas are found along the coast and in the northern Franciscan Formation.

General landslide vulnerability can be estimated from the distribution of weak rocks and steep slopes as seen in Figure 10-16. Based on the Figure below, the Fullerton campus is located somewhat adjacent to, but outside of landslide susceptibility zones.

Figure 10-13: Deep-Seated Landslide Susceptibility Surrounding CS-Fullerton

Extent of the Hazard

In Orange County, landslides are more likely to occur in the steep slopes outside of the metropolitan areas and along the coastline. The San Gabriel mountains, both steep and erosive, contain steeply walled canyons above areas with high population density. When heavy rain occurs, there is significant potential for floods and landslides throughout the County and indirect impacts may cover a larger geographic extent than that of direct impacts. Based on the campus’ location and only 1 historical occurrence of landslide in the City of Fullerton, the planning committee ranks the extent of the hazard on campus as **Low**.

History of the Hazard

NOAA recorded eight debris flow events in Orange County from 2003 to 2019. These occurred in the Santa Ana mountains south of Fullerton. FEMA has declared thirteen

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major disasters involving landslides, mudslides, mudflows, and debris flows since 1978. The only recorded landslide in the City of Fullerton was in January 2005 when a five-day rainstorm destabilized an embankment at the 2000 block of North Euclid Avenue and the 1800 block of Harbord Boulevard. There were no injuries, deaths, or significant property damage, but the roads were closed for several days. The campus has no record of landslide occurrence.

 Potential Impacts of the Hazard

CSU Fullerton may be impacted by the disruption of services as a result of landslides in the region. Landslides can result in physical damage to buildings and property and have the potential to significantly effect infrastructure. As a landslide moves, it distresses structural foundations by settlement, cracking, and tilting. Fast-moving flows can remove entire structures in one instance, while other types of flows can cause damage gradually.

Transportation and utility infrastructure are particularly vulnerable to landslides, since the failure of any component can disrupt service over a large area. The loss of power and communication and disruption of transportation can have cascading effects throughout an area, including impaired disposal of sewage, contamination of water supplies, and the release of flammable fuels. Transportation routes are also often expensive to clean up, and prolonged obstruction can disrupt the movement of people and goods for long periods of time.

 Probability of Future Occurrence of the Hazard

Slope failures are also often triggered by other natural hazards, so landslide frequency is often related to the frequency of these other hazards. As climate change impacts the frequency and intensity of triggers such as rain events, fires, and coastal erosion, landslides may generally occur more often. Historically, landslides have occurred occasionally around Fullerton and therefore are likely to occasionally occur in the future. Most of the city is on flat terrain, so the likelihood of a landslide in the city is low. The likelihood of occurrence on campus is ranked as Unlikely.

Vulnerability to the Hazard

Any population proximal to a landslide when it occurs is vulnerable to its impacts. There are three pump stations in Fullerton that are in potential earthquake-induced landslide areas, as shown in Figure 10-17. The vulnerability of the built environment to landslides depends on exposure and is more likely to incur damage as a result of proximity, rather than inferior structural design. The structures most vulnerable to landslides are buildings and utility/transportation lifelines, which can be impacted by either impact or ground deformation. Utilities and transportation infrastructure are particularly vulnerable, due to their geographic extent and susceptibility to physical

distress. The campus’ vulnerability is limited to the secondary effects of landslide to transportation routes.

Figure 10-14: Landslide Hazards

![Landslide Hazards Map]

**Estimate of Potential Losses**

There are no current models for estimating potential losses from a landslide directly impacting the campus.

Although the economic impact of landslide damage can exceed that of the direct repair costs, there are currently no applicable methods for estimating indirect costs related to CSU Fullerton.

**Vulnerability Assessment Conclusions**

Community exposure to landslides varies depending on their physical locations – whether in flat plains or on steep hillsides – and on their dependence on critical infrastructure located in landslide hazard zones.

Landslides could impact the campus in a variety of ways, primarily related to indirect impacts to transportation and utilities. Utility outages can impact health, particularly for vulnerable populations, and can cause interruptions in operations. Interruptions may impact student and employee’s ability to travel to campus and the delivery of classes and events.

**Identified Data Limitations**
The ability to predict future landslides at the CSU Fullerton campus is limited. However, the USGS estimates that climate change-induced shifts in weather will increase the frequency of post-wildfire landslides, which are expected to occur almost every year in California.\textsuperscript{13}

\textbf{Power Outage}

\textbf{Description of the Hazard}

CSU Fullerton is home to one of Southern California Edison’s registered commercial power plants in the city known as, CSUF Trigeneration. There are seven power substations: the Norweld, Gilbert, Sunnyhills, Basta, Fullerton, Paper, and Titans Substations. Although these are not all the resources for power for the City of Fullerton, they offer external connections to generate power with some redundancies against power outages, in the events that an individual power line is damaged. Damage to a substation may result in a much greater loss of energy.

Most aspects of modern life, and almost all aspects of suburban life, rely on the availability of reliable utilities, such as electricity, water, and natural gas. An Interruption in the supply or distribution of these commodities can leave highly populated areas, like Fullerton, with basic services, such as electricity or sanitation with an inability to manage. These interruptions can be cascading effects from other hazards, such as the result of major windstorm, or they can be caused by intentional disruption of transmission lines. Fullerton sits at the junction of State Route 57, 91 and Interstate 5, where the city is a major gateway from the Inland Empire to Orange County.

In the event of a power outage at CSU Fullerton, some possibilities from a power outage event can disrupt day-to-day operations of the campus, like in-person classes, potentially impede or limit digital, limit telephonic or radio communications, create traffic jams around the campus’s thoroughfares and boulevards surrounding the campus. Additionally, impacts can occur to the surrounding campus community by forcing temporary closures of local restaurants. Additionally, thousands of Fullerton State student residents in on-campus housing would also be affected by a power outage on campus and students residing in off campus housing close to the university.

Additionally, a severe outage to Orange County or the City of Fullerton would also directly affect the campus and the community creating social, economic, and potential health and safety impacts. To avoid an exacerbation of the hazards

An electric power disruptions and outages fall into two categories: intentional and unintentional.

The four types of \textbf{intentional} disruptions:

- Planned: Some disruptions are intentional and can be scheduled based maintenance or upgrading needs.
- Unscheduled: Some intentional disruptions must be done "on the spot" in response to an emergency.
- Demand-Side Management: Some customers (i.e., on the demand side) have entered into an agreement with their utility provider to curtail their demand for electricity during periods of peak system loads.
- Load Shedding: When the power system is under extreme stress due to heavy demand and/or failure of critical components, it is sometimes necessary to intentionally interrupt the service to selected customers to prevent the entire system from collapsing. These intentional interruptions result in rolling blackouts.

Unintentional or unplanned disruptions are outages that come with essentially no advance notice or warning. This type of disruption is the most problematic. The following are categories of unplanned disruptions:

- Accident by the utility, utility contractor, or others.
- Malfunction or equipment failure.
- Equipment overload (utility company or customer).
- Reduced capability (equipment that cannot operate within its design criteria).
- Tree contact other than from storms.
- Vandalism or intentional damage.
- Weather, including lightning, wind, earthquake, flood, and broken tree limbs taking down power lines.
- Wildfire that damages transmission lines.

Location of the Hazard

Although power outages can take place within a certain area, it has the potential to affect the entire planning area equally.

Extent of the Hazard

In order to anticipate outage conditions and reduce impacts, campus facility managers and others keep track of conditions and data provided by the media, municipal utilities, and the California Independent System Operator (CAISO), which is tasked with managing the power distribution grid that supplies most of California, except in areas served by municipal utilities. CAISO is thus the entity that coordinates statewide flow of electrical supply. CAISO uses a series of “stage alerts” to the media based on system conditions.

The alerts are as follows:

- Stage 1 - reserve margin falls below 7 percent.
- Stage 2 - reserve margin falls below 5 percent.
Stage 3 - reserve margin falls below 1.5 percent. Rotating blackouts become a possibility when Stage 3 is reached. Utility agencies aim to advise affected areas approximately 48 hours in advance of a potential PSPS event and will attempt notification again approximately 24 hours before power is shut off. Campus staff respond accordingly.

Given the prevalence of rolling blackouts and other power outages in California, the campus maintains safety precautions, situational awareness, access to emergency power generators and other protocols for managing campus power outages. Given that recorded outages have taken place on campus, the planning committee ranks the extent of the power outage hazard as Moderate.

History of the Hazard
CSU Fullerton did not report a history of power outages affecting the campus.
The City of Fullerton has experienced losses over time due to power losses as secondary events due to other events, like wildfires, thunderstorms, floods, etc. The following are events that experienced power outages as a cascading event.

- In February 1998, all of Southern California was impacted by heavy rains when 2 to 5 inches fell across the region. Many roads and bridges were washed away, or destroyed, and widespread power outages occurred.
- In October 1998, a thunderstorm sent destructive winds through Orange County. Trees everywhere were uprooted and blown onto vehicles and buildings. A power outage affected more than 18,000 utility customers across the communities of Los Alamitos, Rossmore, Cypress, Tustin, Santa Ana, and Garden Grove.

Potential Impacts of the Hazard
Instructors, campus residents, staff and administration rely on electricity for basic survival and operations. During a widespread power failure, it may take days to restore operations if a significant event occurs. Electrical power may be the only cooling source for many individuals around the campus and its community, and long-term outages can potentially put people’s health and life at risk. Disruptions in the supply of heating fuel may put people and property at risk during extremely cold weather if it relies on electric generation or heating mechanisms instead of gas. Additionally, many medical devices, communications devices, and security rely on power to maintain their functions.

Climate Change and Energy Shortage
Climate change is expected to bring more frequent and intense natural disasters. Over the years, what was once a disaster uncharacteristic to landscape is now occurring outside of historical areas. These changes have created a variability at a rate that
makes historical data a poor predictor of future climate. For example, the warmest years on record in California occurred in 2014, 2015, and 2016.

Changes in temperatures, precipitation patterns, extreme events, and sea-level rise have the potential to decrease the efficiency of thermal power plants and substations, decrease the capacity of transmission lines, render hydropower less reliable, spur an increase in electricity demand, and put energy infrastructure at risk of flooding.

With climate warming, higher costs from increased demand for cooling in the summer are expected to outweigh the decreases in heating costs in the cooler seasons. Hotter temperatures in California will mean more energy (typically measured in “cooling-degree days”) needed to cool homes and businesses both during heat waves and on a daily basis, during the daytime peak of the diurnal temperature cycle. During future heat waves, historically cooler coastal cities (e.g., San Francisco and Los Angeles) are projected to experience greater relative increases in temperature, such that areas that never before relied on air conditioning will experience new cooling demands.

Secondary impacts of energy shortages are most often felt by vulnerable populations. For example, those who rely on electric power for life-saving medical equipment, such as respirators, are extremely vulnerable to power outages. Also, during periods of extreme heat emergencies, the elderly and the very young are more vulnerable to the loss of cooling systems requiring power sources.

Probability of Future Occurrence of the Hazard

The probability of California experiencing a power outage can be difficult to quantify but is a hazard that occurs annually during the same seasonal periods of temperature variance throughout the calendar year. Fullerton and Los Angeles County experience such outages. As such, the probability ranking for the Fullerton area is Likely; although the campus has recorded fewer events than the surrounding area, it is prudent to assign this same ranking for the campus.

Climate models suggest summer global temperatures are likely to increase while changes between temperature extremes would be more pronounced. As such, it is expected that power outages will occur more frequently in the future.

Vulnerability to the Hazard

Based on the data available, and in consideration of the increasing effects of climate change, the probability future occurrences prompting intentional outages and creating unintentional power outages the hazard is high for the county in different areas but not specifically influencing the campus. Nonetheless, it would serve the campus to ensure to be able to mitigate and cope with an interruption to electrical power.

In an effort to maintain resilience on the CSU Fullerton campus, Upgraded electrical on campus. Mitigation efforts have been made through the acquisition and implementation of portable and fixed generators to supply power during power
outages. The campus has twenty-one fixed and portable generators throughout the campus and ready for deployment. These generators can be useful in the event that an evacuation must occur to ensure the safety of students, faculty, and staff. Additionally, the university has solar panels on campus that generates 15% of the electricity on campus. The solar panels add a reliable system of energy that will support the campus immediate needs until generators can be activated and engaged.

Estimate of Potential Losses

The data provided by CSU Fullerton does not report any value for potential losses due to power outage.

Vulnerability Assessment Conclusions

The vulnerability assessment concludes a power outage would impacts various ways, mainly due to other initial disaster events. Power outages can impact health, and certain populations may be more at risk. An unexpected power outage can create an interruption in operations on campus causing classes or event cancellation. During an expected power shutoff event, modifications may have to take place for the duration of the outage, like transitioning to a cyber or remote classroom environment, virtual conferences or postponement of classes or events. Additionally, staff may have to continue their everyday operations from a remote location like their own residences, alternative office space or a neighboring campus.

A loss of power outage can lead to potential hazards to students, faculty, and staff at CSU Fullerton. Elevators, entry ways, air filtration systems and lighting provide the campus community with the necessary functions to navigate through the campus with ease, maintain a safe campus environment and visibility during nighttime hours. The vulnerable population, like students with physical disabilities may be the most heavily affected by loss of power as they rely on elevators, entry ways with automatic doors and locks and lights may impede on a student with a disability’s ability to travel and utilize the campus and its structures safely.

The use of communication devices, billing, records, and electrical tools may also become unusable due to a loss of electricity. Many records and billing items may have to revert to “by-hand” procedures and paper copies may have to be kept continuing operations. Additionally, classrooms may not be usable if lighting equipment is not functioning impacting a semester or quarter’s progress for the academic year.

Identified Data Limitations

Data referencing the impacts of a power outage were not reported by the university.
Volcano (Associated Air Quality)

Description of the Hazard

The US Geological Service defines volcanoes as “openings or vents where lava, tephra (small rocks), and steam erupt on to the Earth’s surface. Through a series of cracks within and beneath the volcano, the vent connects to one or more linked storage areas of molten or partially molten rock (magma). This connection to fresh magma allows the volcano to erupt over and over again in the same location.”

A volcanic eruption occurs when magma, lighter than surrounding rock, is driven upwards by its buoyancy and by pressure from the dissolved gases contained within it. Gases are released from magma as it reaches the surface and pressure decreases. Magma can be erupted in several ways and violent eruptions typically cause tiny pieces of tephra (ash) to be carried away by the wind. This ash is hard, does not dissolve in water, is extremely abrasive and mildly corrosive, and conducts electricity when wet. The gases released in an eruption include carbon dioxide, sulfur dioxide, hydrogen sulfide, and hydrogen halides. Depending on their concentration, these are potentially hazardous to people, animals, agriculture, and property.

Location of the Hazard

There are eight volcanic areas located throughout California. Seven of these - Medicine Lake Volcano, Mount Shasta, Lassen Volcanic Center, Clear Lake Volcanic Field, Long Valley Volcanic Region, Coso Volcanic Field, and Salton Buttes – are considered active volcanoes. No portion of CSU Fullerton or Orange County is located within a volcano hazard zone.

Extent of the Hazard

Volcanic hazards are most severe within a few miles of the volcano vent and the severity generally decreases with distance. Ash impact zones can range from tens to hundreds of miles from the vent source. The US Geological Survey has estimated zones surrounding active volcanoes wherein 2 inches or more of ashfall following an eruption is possible. While CSU Fullerton does not fall within an estimated ashfall zone, lighter dustings of ash outside of those areas may directly or indirectly impact the campus. As such, the planning committee ranks the extent of the hazard for the campus as Low.
History of the Hazard

No historical eruption events in California have affected the campus. Over the last 1,000 years, there have been at least 12 eruptions in California.\textsuperscript{11} The most recent volcanic eruption in California occurred at Lassen Peak about 100 years ago, when a major explosion delivered windborne ash over 275 miles away.\textsuperscript{12}

Potential Impacts of the Hazard

The specific impacts vary widely and depend on which type of volcano erupts, the style of explosion, the volume of lava, the eruption duration, and the local water conditions. As CSU Fullerton is not proximal to an active volcano, only the potential impacts of ashfall and gases have been detailed. While both these hazards can be widespread, their most severe impacts are generally seen closer to the volcanic source.

Although ashfall is typically a nonlethal volcanic hazard, it is the most widespread and disruptive. Falling ash can damage crops, electronics, and machinery. It can also impact human health by irritating the respiratory tract, eyes, and skin. The particles may enter drinking water and structures and may cause structure failure if it is thick and heavy enough. Even a fine layer of ash can disrupt utilities. A portion of California’s major electric transmission lines, aerial telecommunication lifelines, transportation corridors, and water storage and conveyance lie within the state’s volcano hazard zones. Impacts to any of these can impact operations at CSU Fullerton.

The potential impacts of gases released during volcanic eruptions are as follows:

- Carbon dioxide typically becomes diluted very quickly and is not life threatening. However, it can become trapped in higher concentrations in low-lying areas and has the potential to be fatal.
- Sulfur dioxide can cause acid rain and air pollution downwind of a volcano.
- Hydrogen sulfide can cause irritation of the upper respiratory tract. At high concentrations it can cause unconsciousness and death.
- Hydrogen halides can coat ash particles and, once deposited, poison drinking water, agricultural crops, and grazing land.

Probability of Future Occurrence of the Hazard

The US Geological Survey, based on the record of volcanic activity in California, estimates that the probability of another small- to moderate-sized eruption in the next thirty years is about 16 percent. As such, the annual probability of future occurrence for the campus is ranked by the committee as Unlikely.

Vulnerability to the Hazard
Populations living near volcanoes are the most vulnerable to eruptions and lava flows. However, volcanic ash can travel and affect populations miles away. The location and thickness of ash in any given area is a function of the severity of the eruption and wind speed and direction. For CSU Fullerton, there is low vulnerability to the immediate impacts of volcanic eruptions due to the limited area affected and remote potential of an eruption. In the event of a widespread ashfall event, the elderly, infants, and populations with existing respiratory disease will be at higher risk.

**Estimate of Potential Losses**

Impacts to critical infrastructure, agriculture, and property from ashfall have the potential to cause widespread disruption, damage, and economic loss throughout the state. In the event of a widespread ashfall event, impacts will be immediate.

Current modeling is not precise enough to allow for an assessment of potential losses from ashfall to structures or infrastructure on or surrounding the campus.

**Vulnerability Assessment Conclusions**

CSU Fullerton is unlikely to experience the direct impacts of a volcanic event. While the campus may be indirectly impacted by ashfall elsewhere in the state, direct ashfall impacts are generally unlikely but possible in a widespread event. However, the likelihood of any volcanic eruption in the state impacting the campus is very low.

**Identified Data Limitations**

Not all active volcanoes in California have been zoned for hazards by the US Geological Survey. This, together with the infrequent occurrence of volcanic explosions and number of factors determining type and extent of impacts, make the quantification of potential loss difficult.

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**Wildfire**

**Description of the Hazard**

While wildfires are a natural part of California’s ecosystem, wildfires in California represent a hazard that presents one of the greatest probabilities of destruction along with a demonstrated history of catastrophic fire events in recent years. The destructive fire seasons of 2017 to 2020 illustrated the destructive forces fire presents to communities across the state. Wildfires may result in the structural loss, infrastructure loss, dangerous air quality, environmental damages, economic impacts, injuries, and loss of life. In many communities throughout California, wildfire presents greatest risk to human life and property.

Wildfires have been defined as any free burning vegetation fire that initiates from an unplanned ignition, whether natural or human caused demanding fire suppression
actions to contain.77 These fires are prone to become uncontrolled, spreading through vegetative fuels rapidly exposing people and structures to harm. Wildfires present a significant risk to communities across the state, as evidenced by increasing trends of structural losses from wildland fires. This risk is elevated in areas where development and community growth has intersected, also known as the wildland-urban interface (WUI). In the interface setting, development itself can provide additional fuel for large fires. Recent fires have also demonstrated the ability of fire to consume populated areas in extreme conditions.

California’s Mediterranean climate in combination with its geography and vast population create a combination of factors that promotes an optimal environment for large fire growth and consequences. As there is great diversity of geographic characteristics across the state, the risks and potential consequences of wildfire must be assessed locally. The physical location, weather patterns, local fuel types and volume, extent of the WUI, topography, and additional factors will factor differently from part of the state to another.

The behavior of wildfires in California is significantly influenced by three distinct geographic factors. These factors will help shape the size, direction of spread, rate of combustion, fire intensity, and ability to pre-heat fuels. The physical factors contributing to wildfire behavior include:

- **Topography** – The rate in which wildfires spread increases with greater slopes in topography. The greater the slope will result in more pre-heating of fuel above the advancing fire. The direction that a slope faces will also influence fire behavior as south facing slopes receive greater solar radiation and thus drier vegetation that is more susceptible to combustion. Ridgetops often denote the end of fire spread as fire has greater difficulty spreading downhill.

- **Weather** – Weather factors substantially in influencing the behavior of wildfires. Wind, temperature, humidity, lightning, and lack of precipitation all contribute to a fire’s ability or inability to spread and intensify. California routinely experiences conditions in which these factors are in alignment to contribute to extreme fire behavior during the summer and fall seasons. High winds, low humidity, and high temperatures provide an environment promoting extreme fire activity.

- **Fuels** – Certain types of vegetation are increasingly prone to igniting and promote more intense burning. Areas with greater “fuel loading” (amount of fuel present in terms of weight of fuel per unit of area) increases the amount of fuel to fuel a fire. Greater volumes of dead or dry vegetation compared to live plants is a critical factor. Vegetation during drought conditions will experience decrease in moisture content increasing the conditions for combustion. Fuels close proximity to one another allows for rapid spread through contact or radiant exposures.

77 State of California Hazard Mitigation Plan, September 2018
A risk assessment for wildfires should be implemented within a geospatial context focusing on the specific location features and incorporates the three components of the wildfire risk triangle – likelihood, intensity, and susceptibility.

Location of the Hazard

Substantial portions of the State of California are exceptionally vulnerable to wildfire activity or reside in a wildland-urban interface (WUI) area due to the vast open spaces, rangelands, forests and other lands with high susceptibility to fire occurring throughout the state. CSU Fullerton and the City of Fullerton are located in northern Orange County. This region is dominated by urban and suburban communities with limited direct exposures to wildland fire. CSU Fullerton has extensive residential neighborhoods to the north, south, and west of the campus. Large industrial land uses are located to the east of the campus and beyond the neighboring residential areas.

The CSU Fullerton campus is located in the eastern side of Fullerton bordering the City of Placentia. The campus is ½ mile from the eastern base of the Coyote Hills where there is a mix of residential neighborhoods and hillsides with moderate vegetative fuels. The campus is also 6-7 miles from the Puente and Chino Hills with extensive areas of fire hazard potential. The campus is not located next to areas with a fire hazard potential making direct impacts by fire on the campus unlikely.

However, the CSU Fullerton campus is surrounded by mountains and extensive areas of fire hazards further away. Surrounding the Los Angeles Basin and Orange County are large mountain ranges including the San Gabriel, San Bernardino, and Santa Ana Mountains. These mountain ranges host three national forests with extensive history of large fire development. The fires that burn in these areas have the potential to develop vast quantities of smoke that can fill the basin in the right wind conditions. The geography of the Los Angeles Basin and San Gabriel, San Bernardino, and Orange County valleys creates a topography that captures air pollutants including smoke within surrounding mountains and the development of inversion layers. The CSU Fullerton campus is located in a region in which wildfire smoke can saturate the air around the campus.
## Extent of the Hazard

The area immediately surrounding the CSU Fullerton campus is not in direct proximity to fire hazard zones designated as a High Fire Hazard Severity Zones. The campus does not have a history of wildfire activity occurring within proximity to the campus. However, the County is surrounded by areas that are considered to be of high fire threat and the Fullerton campus has experienced multiple days of poor air quality due to fires burning in the mountains. Based on the (above) factors, the planning committee ranks the extent of the hazard as **Moderate**.

The National Fire Danger Rating System (NFDRS) is the current system in use for rating and classifying the potential danger of fire. The NFDRS tracks the effects of previous weather events on both dead and live fuel loads and adjusts accordingly based on future or predicted weather conditions. These complex relationships and

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equations are computed, and the outputs are expressed in terms that users can quickly and easily understand. The current NFDRS is used by all federal and most state agencies to assess fire danger conditions.

The following table depicts the NFDRS, from the US Forest Service’s Wildland Fire Assessment System.

Table 10-26: National Fire Danger Rating System\(^\text{79}\)

<table>
<thead>
<tr>
<th>Rating</th>
<th>Basic Description</th>
<th>Detailed Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>CLASS 1: Low Danger (L)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>COLOR CODE: Green</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fires not easily started</td>
<td>Fuels do not ignite readily from small firebrands. Fires in open or cured grassland may burn freely a few hours after rain, but wood fires spread slowly by creeping or smoldering and burn in irregular fingers. There is little danger of spotting.</td>
<td></td>
</tr>
<tr>
<td>CLASS 2: Moderate Danger (M)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>COLOR CODE: Blue</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fires start easily and spread at a moderate rate</td>
<td>Fires can start from most accidental causes. Fires in open cured grassland will burn briskly and spread rapidly on windy days. Woods fires spread slowly to moderately fast. The average fire is of moderate intensity, although heavy concentrations of fuel – especially draped fuel -- may burn hot. Short-distance spotting may occur but is not persistent. Fires are not likely to become serious and control is relatively easy.</td>
<td></td>
</tr>
<tr>
<td>CLASS 3: High Danger (H)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>COLOR CODE: Yellow</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fires start easily and spread at a rapid rate</td>
<td>All fine dead fuels ignite readily, and fires start easily from most causes. Unattended brush and campfires are likely to escape. Fires spread rapidly and short-distance spotting is common. High intensity burning may develop on slopes or in concentrations of fine fuel. Fires may become serious and their control difficult, unless they are hit hard and fast while small.</td>
<td></td>
</tr>
<tr>
<td>CLASS 4: Very High Danger (VH)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fires start very easily and spread at a very fast rate</td>
<td>Fires start easily from all causes and immediately after ignition, spread rapidly and increase quickly in intensity. Spot fires are a constant danger. Fires burning in light fuels may quickly develop high-intensity characteristics - such as long-distance</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>CLASS 5: Extreme (E)</th>
<th>Fire situation is explosive and can result in extensive property damage</th>
</tr>
</thead>
<tbody>
<tr>
<td>COLOR CODE: Red</td>
<td>Fires under extreme conditions start quickly, spread furiously, and burn intensely. All fires are potentially serious. Development into high intensity burning will usually be faster and occur from smaller fires than in the Very High Danger class (4). Direct attack is rarely possible and may be dangerous, except immediately after ignition. Fires that develop headway in heavy slash or in conifer stands may be unmanageable while the extreme burning condition lasts. Under these conditions, the only effective and safe control action is on the flanks, until the weather changes or the fuel supply lessens.</td>
</tr>
</tbody>
</table>

Due to the impacts of wildfires on public health, agencies across the nation have adopted the use of the Air Quality Index (AQI) to communicate and provide a consistent approach to air quality measurements and categorization. The AQI primarily focuses on the health effects caused by pollutants in the air such as smoke.

The goal of the AQI is to provide advisories to assist the public in determining when to reduce exposures to inhalation of air pollution as pollution levels rise.
History of the Hazard

The State of California has a long history of chronic and destructive wildfires throughout the state. On average, 8,300 wildfires have caused burnt 928,245 acres across the state over the 20-year period between 2000 and 2020. Orange County also has a long history of wildfire activity primarily in the foothills and mountains of the Santa Ana Mountains, the Chino Hills, and the San Joaquin Hills. Wildfires occurring in Orange County have resulted in hundreds of thousands of acres burned and millions of dollars in damages.

The area immediately surrounding the CSU Fullerton campus is not in direct proximity to fire hazard zones designated as a High Fire Hazard Severity Zones. The campus does not have a history of wildfire activity occurring within proximity to the campus. However, the County is surrounded by areas that are considered to be of high fire threat that would produce vast quantities of smoke and particulates into the air. The Fullerton campus has experienced multiple days of poor air quality due to fires burning in southern California mountains. The 2017, 2018, and 2020 fire seasons in particular illustrated the increase in wildfire generated smoke saturating the air of communities throughout the state including Orange County. CSU Fullerton personnel reported the ongoing development of policies and procedures to address the response to poor air quality days.

81 California Department of Forestry and Fire Protection, Stats and Events, https://www.fire.ca.gov/stats-events/
Table 10-27: Historic Large-Scale Fires Near CSU Fullerton

<table>
<thead>
<tr>
<th>Date</th>
<th>Fire</th>
<th>Location</th>
<th>Declaration</th>
<th>Damages</th>
</tr>
</thead>
<tbody>
<tr>
<td>10/9/2017</td>
<td>Canyon 2</td>
<td>Anaheim Hills</td>
<td>NA</td>
<td>Structures: 25 destroyed</td>
</tr>
</tbody>
</table>

Potential Impacts of the Hazard

The location of the CSU Fullerton campus surrounded by areas of urban development removed from areas with a fire hazard places a minimal direct threat from wildfire to the campus. The greater potential impacts to wildfire exist with members of the campus community who reside or work in these fire hazard zones.

Potential impacts to the campus community resulting from wildfires include:

- Injuries or loss of life
- Campus property destruction or damage
- Residential property destruction or damage
- Commercial property destruction or damage
- Loss of property contents
- Infrastructure damage
- Threat or damage to on campus child care facilities
- Damaged or destroyed lifelines/supply routes
- Damaged or destroyed utilities, on campus power generation
- Damaged or destroyed critical facilities supporting campus emergency support needs
- Loss of community economic base
- Employment losses
- Loss to ground supporting vegetation on hillsides resulting in erosion or landslides in future precipitation events
- Agricultural (crops and livestock) damages or destruction
- Environmental damage
- Societal and community impacts
- Damage to organizations and facilities providing support services to vulnerable populations
- Greater evacuation challenges for those most vulnerable
- Psychological impacts on vulnerable populations
- Disruptions to education delivery to community

Potential impacts resulting from wildfire generated smoke include:

- Dangerous levels of air pollution
- Human Health Effects

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82 City of Fullerton Local Hazard Mitigation Plan, May 21, 2020
Similar health impacts to pets
  - Air conditioning systems overwhelmed
  - Greater demands on air filtration systems
  - Greater demands on healthcare systems
  - Reduced outdoor work productivity
  - Closures of academic sessions

Additionally, there remains a number of secondary impacts from wildfires that could affect the campus community. Utilities feeding areas of Orange County including the campus may be damaged resulting in power outages. Fire related damage in the watersheds will likely cause future landslides, degradation to plants supporting hillsides, and impact the hydroelectric power capabilities. Fires may present threats to areas of recreation, scenic value, and wildlife that are a part of the culture of the campus community. Finally, the campus may experience effects of evacuated individuals arriving on campus from other areas as a location of refuge.

Probability of Future Occurrence of the Hazard

Based on the minimal wildfire threat potential in the area surrounding the CSU Fullerton campus, including the distance to Fire Hazard Severity Zones and density of residential and commercial development, the probability of wildfire related damage is considered **Unlikely**.

Based on the wildfire threat potential in the area surrounding Southern California including the hills and mountains throughout the region, the volume of areas in elevated Fire Hazard Severity Zones throughout the southern portions of the state, and the historic occurrences of smoke, the probability of wildfire generated smoke impacts to air quality is considered **Possible**.

Vulnerability to the Hazard

The CSU Fullerton campus is not likely to be subject to direct impact from wildfire due to the campus location in an urban/suburban area of Fullerton. The vulnerabilities to the effects of wildfire would largely lie within the campus community who may reside or work in locations that are exposed to the Fire Hazard Severity Zones in other areas. Wildfires occurring in other areas of the region may result in the displacement of large numbers of people. These effects may spill onto the campus in the form of evacuees or facility support to emergency resources.

Fire directly threatening the campus would likely take the form of localized fires involving single structures or small areas. Smaller vegetation fires are possible surrounding the campus in the urban forest or fields surrounding the city. These incidents would likely have little impact to the campus.

The primary basis of vulnerability is based on the population affected and the built environment exposed. In general, newer construction will be more fire resistant than older buildings as building and fire codes and construction technology have
improved. Density of buildings and proximity of fuels to buildings or equipment at risk of combustion would additionally influence the fire’s ability to spread to structures.

Some areas of particular vulnerability on the campus includes:

- Students and staff engaging in outdoor activities when the air is determined to be unhealthy are vulnerable to adverse health effects.
- Buildings with ineffective HVAC or do not have HVAC will cause limitations in filtering of air during smoke filled days.
- Power outages or brownouts during days with high levels of smoke will limit shelter in place options during heat events in summer.
- Santa Ana wind events may push large volumes of smoke into Orange County.

The greater concerns regarding vulnerabilities to wildfire on CSU Fullerton are related to the smoke that fires in the area would produce. The recent summer seasons have clearly demonstrated the reality of large wildfires producing enough smoke to fill the air around Orange County even from substantial distances away. These recent fires have displayed how the effects of this smoke impact the general population and especially vulnerable populations. CSU Fullerton students, faculty, and staff both on campus and off campus face these same vulnerabilities related to smoke filled air.

Smoke generated from large wildfires pose a threat in terms of diminished air quality that would be exposed to the population within the area of smoke distribution. Individuals with existing health problems such as respiratory or cardiac illnesses are increasingly vulnerable to wildfire generated smoke. Staff who work in roles requiring outdoor activity will be increasingly exposed during days where the air quality index is considered unhealthy or worse. Student athletes participating in outdoor sports and engaging in aerobic activities are increasingly vulnerable to the effects of wildfire.

The vulnerability to members of the campus community in which wildfire generated smoke on the CSU Fullerton campus will vary depending on when the air quality was to reach unhealthy levels. The risk to the campus population will be lessened during periods when classes are not in session or during periods of breaks. Conversely, during the days and hours that classes are in session and staff are at their workplaces, the human vulnerability increases. However, in region-wide events this vulnerability may be shared with the homes and workplaces of members of the campus community and their families.

Vulnerable populations will likely face disproportionate health safety issues from smoke filled air, experience increased stresses, may require the need to remain away from the campus enclosed at home, and may find difficulty in accessing equipment or supplies to aid in a specific need.

**Estimate of Potential Losses**

Estimates of potential losses will be influenced by a variety of factors. Costs would also be likely to include mitigation or repairs of HVAC systems, sealing of doors and...
windows, and other methods of keeping smoke from entering buildings. Secondary costs would include lost academic days during campus closures, lost staff on campus productivity, and health and medical interventions for affected members of the campus community.

Based on estimate replacement costs of facilities and structures on campus, the maximum total replacement costs due to wildfire are $453,119,067. Due to the lack of a complete inventory of building and facility costs, the total replacement estimate is likely much higher. However, the location of the campus in an urban/suburban setting removed from hazard prone areas makes wildfire related damages unlikely.

Table 1028: Wildfire Hazard Potential (WHP) Zone Estimated Losses

<table>
<thead>
<tr>
<th>WHP Zone</th>
<th>No of Buildings</th>
<th>Maximum Replacement Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Extreme</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Very High</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>High</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Moderate</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Low</td>
<td>2</td>
<td>$1,363,000</td>
</tr>
<tr>
<td>Very Low</td>
<td>2</td>
<td>$2,280,000</td>
</tr>
<tr>
<td>Non-Burnable</td>
<td>34</td>
<td>$449,476,067</td>
</tr>
<tr>
<td>No Building Value Data Provided*</td>
<td>11</td>
<td>Unknown</td>
</tr>
</tbody>
</table>

*Buildings with no value defined are also included in the respective Zones they are found in.

Vulnerability Assessment Conclusions

The occurrence of wildfires has been a frequent event in Orange County, however, wildfire incidents do not typically pose a direct risk to the CSU Fullerton campus. The location of the CSU Fullerton campus surrounded by densely developed residential, commercial, and industrial land uses mitigates any vulnerabilities of wildfire hazards to the campus community or facilities.

Communities located within or near the Wildland Urban Interface may be subject to damaging fires. These same communities may be home to members of the campus community. The students, faculty, and staff of CSU Fullerton who live or work in these hazard areas may experience vulnerabilities to the direct exposure to wildfire not likely at the campus. These effects may create tremendous challenges that could impact their ability to maintain engagement with university academic or professional activities. The potential for large-scale wildfires in the region further generates the added potential for a number of cascading effects such as disruptions to the local
economy, utility failures, disruptions to providing for the needs of the community, and development of public health hazards.

Additionally, the topography of Southern California surrounded by mountains allows for smoke filled air to linger in the valleys of the Los Angeles Basin with the potential for unhealthy air quality depending on wind conditions. Fires in surrounding mountains generating tremendous quantities of smoke present tremendous health related vulnerabilities to members of the campus community. The campus community exposed to these unhealthy air conditions are vulnerable to a variety of potential health related effects.

**Identified Data Limitations**

Lack of comprehensive historic fire occurrences, missing campus structural replacement costs, and complete inventory of building construction features or mitigation efforts to lessen the impact due to fire activity.

**Severe Weather (Wind, Tornado, Hail, Lightning)**

**Description of the Hazard**

Severe weather can be described as a variety of weather or climate events that are beyond or near the ends of the range of observed weather patterns and behavior. These events can include high or extreme winds, storms, lightning, hail, tornadoes, heat waves, unusually cold temperatures, extreme rainfall, and flooding. According to the Intergovernmental Panel on Climate Change (IPCC), to be classified as severe (or extreme), the occurrence of each value of a climate or weather variable (e.g., wind, hail, lightning, tornado, etc.) must be “above (or below) a threshold value near the upper (or lower) ends of the range of observed values of the variable.”

Severe weather in California can be generated by local, regional, and/or global weather and climate influences. From the individual thunderstorm to the Santa Ana wind event to the strong El Niño, damaging weather elements that are produced by and accompany severe weather and climate phenomena (e.g., damaging winds, hail, lightning, and tornadoes) occur throughout California and the California State University (CSU) system.

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Global Scale Influences on Severe Weather in California: El Niño, La Niña, and ENSO

The El Niño-Southern Oscillation (ENSO) is a recurring climate pattern involving changes in the temperature of waters in the central and eastern tropical Pacific Ocean. On periods ranging from about three (3) to seven (7) years, the surface waters across a large swath of the tropical Pacific Ocean warm or cool by anywhere from 1°C to 3°C, compared to normal. This oscillating warming and cooling pattern, referred to as the ENSO cycle, directly affects rainfall distribution in the tropics and can have a strong influence on weather across the United States and other parts of the world.

El Niño and La Niña are extreme phases of the ENSO cycle, with a third phase occurring between them called the Neutral phase. The El Niño phase is characterized by unusually warm ocean temperatures and weaker-than-normal east winds in the Equatorial Pacific, while the La Niña phase is characterized by unusually cold ocean temperatures and stronger-than-normal east winds in the Equatorial Pacific. Both extreme ENSO phases lead to significant differences from the average ocean temperatures, winds, surface pressure, and rainfall across parts of the tropical Pacific. The Neutral phase indicates that conditions are near their long-term average.

The extreme ENSO phases affect the frequency and intensity of weather events across the world, including in California. On average, areas across California experience exceptionally stormy winters with increased precipitation under El Niño conditions, but experience less stormy and drier winters under La Niña conditions. This variability in storminess and precipitation brought on by El Niño and La Niña events affects the both the frequency and intensity of severe weather conditions experienced by all CSU campuses, including CSU Fullerton.

Regional Climate Influences on Severe Weather across California

Most of the weather in California is influenced by the wet-winter/ dry-summer Mediterranean climate pattern. In the summer months, Pacific storm tracks are deflected north due to the position of the Pacific High (i.e., a large-scale atmospheric circulation over the Northeast Pacific Ocean), preventing Pacific storms from reaching California. As a result, most summer storms are generated due to the incursion of moist air from the Gulf of Mexico or the Gulf of California, and occur as scattered, locally heavy showers in the desert and mountain regions of the state. In the winter months, the Pacific High decreases in intensity and moves south, permitting powerful Pacific storms to move into and across the state; these storms can produce extreme winds, heavy rains (including

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85 Retrieved on 07.18.2021 from https://www.weather.gov/mhx/ensowhat
87 Retrieved on 07.17.2021 from https://www.climate.gov/news-features/understanding-climate/el- ni%C3%B1o-and-la-ni%C3%B1a-frequently-asked-questions
88 Retrieved on 07.16.2021 from https://www.pmel.noaa.gov/elnino/what-is-el-nino
“atmospheric river” events), and widespread coastal and inland flooding. (Please see the Flood Hazard profile in this document for information on Floods.) As a result, storm events accompanied by precipitation in California are far more frequent in the winter months than they are in the summer months.90

While the Mediterranean climate pattern influences the seasonal frequency, intensity, geographic spread, and type of some severe weather events CSU campuses experience (including CSU Fullerton), other severe weather phenomena may occur in California at any time of the year. For example, near the coast and over the Central Valley, there appears to be no defined seasonality to thunderstorms, and these storms are usually light and infrequent. Thunderstorms are more intense and more frequent in the intermediate and higher elevations of the Sierra Nevada, and occur with greater frequency during the summer months.91

Types of Storms in California

The 2018 California State Hazard Mitigation Plan (SHMP) defines a storm as a violent atmospheric disturbance occurring over land and/or water that is distinguished by its strength, characteristics, and the scale of the resulting damage.92 The SHMP also lists the following types of storms that produce hazardous conditions and potential damage throughout the state of California.93 These storms affect (in varying degrees) all CSU campuses, including CSU Fullerton.

- **Thunderstorm**: A rain-bearing cloud that also produces lightning. Thunderstorms can produce some of nature’s most destructive and deadly weather including tornadoes, hail, strong winds, lightning and flooding.94 Thunderstorms are caused by an atmospheric imbalance from warm unstable air rising rapidly into the atmosphere. Lightning, which occurs during all thunderstorms, can strike anywhere.95 Thunderstorms can produce some of nature’s most destructive and deadly weather including tornadoes, hail, strong winds, lightning and flooding.96 **Severe thunderstorms** are more intense, violent, and dangerous thunderstorms. The National Oceanic and Atmospheric Administration (NOAA) defines a severe thunderstorm as any storm that produces one or more of the following elements:

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90 Retrieved on 07.17.2021 from https://wrcc.dri.edu/Climate/narrative_ca.php
91 Retrieved on 07.17.2021 from https://wrcc.dri.edu/Climate/narrative_ca.php
Damaging winds or speeds of 58 mph (50 knots) or greater, hail 1 inch in diameter or larger, and/or a tornado.\(^\text{97} \text{ 98}\)

- **Hailstorm**: a type of storm that precipitates round chunks of ice. Hailstorms usually occur during regular thunderstorms.\(^\text{99}\)

- **Wind storm**: marked by high wind with little or no precipitation.\(^\text{100}\)

- **Winter storm**: A storm that can produce a combination of freezing rain, sleet, heavy snow, and/or strong winds.\(^\text{101}\)

- **Coastal storm**: large wind-driven waves and/or storm surge that strike the coastal zone.\(^\text{102}\)

- **Ice storm**: Ice storms are one of the most dangerous forms of winter storms. When surface temperatures are below freezing, but a thick layer of above-freezing air remains aloft, rain can fall into the freezing layer and freeze upon impact into a glaze of ice. In general, 8 millimeters (0.31 inch) of accumulation is all that is required, especially in combination with breezy conditions, to start downing power lines as well as tree limbs. Ice storms also make unheated road surfaces too slick to drive on. Ice storms can vary in time range from hours to days and can cripple small towns and large urban centers alike.\(^\text{103}\)

- **Snowstorm**: A heavy fall of snow accumulating at a rate of more than 5 centimeters (2 inches) per hour that lasts several hours. Snowstorms, especially ones with a high liquid equivalent and breezy conditions, can down tree limbs, cut off power, and paralyze travel over a large region.\(^\text{104}\)

\(^\text{97}\) Retrieved on 07.15.2021 from https://www.noaa.gov/explainers/severe-storms
\(^\text{98}\) Retrieved on 07.15.2021 from https://www.weather.gov/safety/thunderstorm
Severe Weather Hazard Elements: Wind Hazards, Hail, and Lightning

This hazard profile concentrates on the following types of severe weather hazards: wind hazards (including tornadoes), hail, and lightning. These hazards are produced by a variety of weather phenomena, including thunderstorms, coastal storms, winter storms, and topographically-enhanced downslope winds. While storm and downslope wind hazards are responsible for severe weather events across the CSU system, only the wind, tornado, hail, and lightning elements generated by these hazards are covered in this profile. (Storm-related hazards such as flooding and extreme temperatures are covered in other sections of this document.)

Wind Hazards

Wind is the horizontal movement of air past any given point. Wind begins with differences in air pressures; pressure that is higher at one point than another sets up a force, pushing the high towards the low pressure.\(^{105}\) Wind gusts are defined as “rapid fluctuations in the wind speed with a variation of 10 knots or more between peaks and lulls.” \(^{106}\)

Wind hazards in California take several forms: High Wind, Strong Winds, Thunderstorm Winds, Mountain-Valley (Downslope) Winds, and Tornadoes. These hazards are encountered across California, and have the potential to cause harm to or loss of life and/or property throughout California and the CSU system (including CSU Fullerton).

High Winds, Strong Winds, and Thunderstorm Winds

The National Weather Service reports three (3) types of wind events that occur areas over land: High Winds, Strong Winds, and Thunderstorm Winds. Collectively, these reports are used to determine the frequency with which wind hazard events have affected areas across the U.S., including California.

High Winds

High winds are defined as sustained non-convective winds of 35 knots (40 mph) or greater lasting for 1 hour or longer, or gusts of 50 knots (58 mph) or greater for any duration (or otherwise locally/regionally defined). In some mountainous areas, the above numerical values are 43 knots (50 mph) and 65 knots (75 mph), respectively.\(^{107}\)

Strong Winds

Strong winds are defined as non-convective winds gusting less than 50 knots (58 mph), or sustained winds less than 35 knots (40 mph), resulting in a fatality, injury, or damage.\(^{108}\)


Thunderstorm Winds

Thunderstorm winds are winds that arise from thunderstorm convection (occurring within 30 minutes of lightning being observed or detected), with speeds of at least 50 knots (58 mph). They can also be winds of any speed (non-severe thunderstorm winds below 50 knots (58 mph)) producing a fatality, injury, or damage.\(^{109}\)

Please note: Straight-line wind is a term used to define any thunderstorm wind that is not associated with rotation. It is used mainly to differentiate from the rotational winds found in tornado-producing storms.\(^{110}\) However, it is not a term used in the NCEI Storm Events Database, and therefore cannot be used to determine severe weather history of or potential impacts to CSU campuses.

Tornadoes

A tornado is an extreme severe weather wind hazard. A tornado is a rapidly rotating column of air extending from a thunderstorm to the surface of the Earth.\(^{111}\) This column extends between cloud and the Earth’s surface. The damage from tornadoes comes from the strong winds they contain and the flying debris they create. It is generally believed that rotational wind speeds can be as high as 300 mph in the most violent tornadoes.\(^{112}\) On a local scale, tornadoes are the most violent and most destructive of all atmospheric phenomena.\(^{113}\)


Santa Ana Winds. A type of wind hazard that is peculiar to Southern California is called a Santa Ana Wind. Santa Ana winds are strong, topographically-enhanced, extremely dry downslope winds that originate inland and affect coastal southern California and northern Baja California (Mexico).\(^{114}\) They occur when air from a region of high pressure over the dry, desert region of the southwestern U.S. flows westward towards low pressure located off the California coast. This creates dry winds that flow east to west through the mountain passages in Southern California. These winds have a strong seasonal component; they are most common during the cooler months of the year, occurring from September through May. Santa Ana winds typically feel warm (or even hot) because as the cool desert air moves down the side of the mountain, it is compressed, which causes the temperature of the air to rise. If strong enough, Santa Ana winds can cause major property damage, and may present difficulties for airborne and seagoing transportation.

\(^{110}\) Retrieved on 07.15.2021 from https://www.nssl.noaa.gov/education/svrwx101/wind/types/
\(^{111}\) Retrieved on 07.15.2021 from https://www.earthnetworks.com/tornado/
\(^{112}\) Retrieved on 07.15.2021 from https://www.nssl.noaa.gov/education/svrwx101/tornadoes/faq/
\(^{113}\) Retrieved on 07.15.2021 from https://www.weather.gov/bgm/severedefinitions
They also may increase wildfire risk because of the dryness of the winds and the speed at which they can spread a flame across the landscape.\textsuperscript{115} (Note: The Wildfire hazard is profiled elsewhere in this document.)

Figure below illustrates the mechanisms involved in the generation of Santa Ana winds across Southern California.

Figure 10-17: What Drives a Santa Ana Wind?\textsuperscript{116}

\textbf{Diablo Winds.} The Diablo wind is another type of topographically-enhanced downslope wind phenomenon that occurs in the North-Central areas of California. Diablo winds are offshore wind events that flow northeasterly over Northern California’s Coast Ranges, often creating high wind speeds downwind of major canyons and over ridges, and extreme fire danger for the San Francisco Bay Area. Diablo winds are driven by a surface


\textsuperscript{116} Retrieved on 07.14.2021 from https://twitter.com/nwslosangeles/status/933049473034579968
A pressure gradient that forms in response to an inverted pressure trough that develops over California.\textsuperscript{117}

**Sundowner Winds.** Sundowner winds are significant and potentially damaging downslope wind and warming events that periodically occur along a short segment of the southern California coast in the vicinity of Santa Barbara, CA. The unique topography of this coastal region promotes the development of Sundowner wind events: over a length of about 100 km, the coastline is oriented approximately west–east, with the adjoining narrow coastal plain bounded by a steeply rising (to elevations greater than 1200 m) and coast-parallel mountain range. Called Sundowner winds because they often begin in the late afternoon or early evening, their onset is typically associated with a rapid rise in temperature and decrease in relative humidity, and the winds tend to blow from the north from the Santa Ynez Mountains to the coast of Santa Barbara County, California. During the more intense Sundowner wind events, wind speeds can be of gale force 39-54 miles per hour or higher, and can even reach hurricane force (≥ 74 miles per hour) in the most extreme cases. Temperatures over the coastal plain, and even at the coast itself, can rise significantly above 37.8°C (100°F). Seasonally, Sundowner winds peak in March, April, and May, with a minimum during summer and a secondary peak in winter that often corresponds with Santa Ana winds. In addition to causing a dramatic change from the more typical marine-influenced local weather conditions, Sundowner wind episodes have produced significant wind-related property and agricultural damage, as well as conditions of extreme fire danger.\textsuperscript{118} 119 120

**Hail**

Hail is a form of precipitation consisting of solid ice that forms inside thunderstorm updrafts.\textsuperscript{121} It is roughly round in shape and at least 0.2’ in diameter. Hail develops in the upper atmosphere as ice crystals that are bounced about by high velocity updraft winds; the ice crystals accumulate frozen droplets and fall after developing enough weight. The size of hailstones varies and is a direct consequence of the severity and size of the storm that produces them – the higher the temperatures at the Earth’s surface, the greater the strength of the updrafts and the amount of time hailstones are suspended, and therefore the greater the size of the hailstone.\textsuperscript{122}

\textsuperscript{117} Retrieved on 07.13.2021 from https://www.fireweather.org/diablo-winds
\textsuperscript{121} Retrieved on 07.14.2021 from https://www.nssl.noaa.gov/education/svrwx101/hail/
**Lightning**

Lightning is an electrical discharge produced by a thunderstorm. Lightning rapidly heats the air in its immediate vicinity to about 50,000°F - about five times the temperature of the surface of the sun. This compresses the surrounding air and creates a supersonic shock wave, which decays to an acoustic wave that is heard as thunder.\(^1\)\(^2\)\(^3\)

The discharge may occur within or between clouds, between the cloud and air, between a cloud and the ground, or between the ground and a cloud.\(^1\)\(^2\)\(^4\) Lightning that is produced from thunderstorms in which precipitation evaporates before reaching the ground is called “dry lightning.”

**Location of the Hazard**

Severe weather is a non-spatial hazard, and can occur anywhere in the CSU system, including on the CSU Fullerton campus. No one area of the campus – or of the surrounding community – is subject to experiencing severe weather more than any other area.

There is geographic variability among the different types of mountain and valley wind events (as a sub-category of the severe weather hazard). Santa Ana winds occur in Southern California, Diablo winds occur in North-Central California, and Sundowner winds occur almost exclusively in Santa Barbara County, California.

**Extent of the Hazard**

Severe weather hazards are non-spatial hazards that potentially affect all CSU Fullerton campus areas equally. However, the smallest geographic unit of measurement for almost all official severe weather event data is at the county level. Because the severe weather data used do not exist at the campus level, it is assumed that the same (or similar) severe weather risks to CSU Fullerton reflect those of the surrounding community and County. As a result, all assets and people at CSU Fullerton are at risk from the effects of severe weather and can expect to experience at least some (or the complete range of) endemic severe weather hazards. In consideration of the campus’ design, layout, and operations, the severe weather history and degree of severity in the Fullerton area, and the history and degree of severity of each severe weather sub-type identified by the extent scales (below), the campus planning committee ranks the overall extent of the Severe Weather hazard as **MODERATE**. See each sub-hazard below for the planning committee’s sub-type extent ranking.

**Wind Hazard: Non-Rotational**


The Beaufort Scale is an empirical measure that relates wind speed to observed conditions at sea or on land. Its full name is the Beaufort wind force scale. First developed in 1805, it is still used today to estimate wind strengths.

Table 10-29: Beaufort Wind Force Scale

<table>
<thead>
<tr>
<th>Force</th>
<th>Speed (mph)</th>
<th>Speed (knots)</th>
<th>Description</th>
<th>Specifications for use at sea</th>
<th>Specifications for use on land</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0-1</td>
<td>0-1</td>
<td>Calm</td>
<td></td>
<td>Sea like a mirror.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Calm; smoke rises vertically.</td>
</tr>
<tr>
<td>1</td>
<td>1-3</td>
<td>1-3</td>
<td>Light Air</td>
<td>Ripples with the appearance of scales are formed, but without foam crests.</td>
<td>Direction of wind shown by smoke drift, but not by wind vanes.</td>
</tr>
<tr>
<td>2</td>
<td>4-7</td>
<td>4-6</td>
<td>Light Breeze</td>
<td>Small wavelets, still short, but more pronounced. Crests have a glassy appearance and do not break.</td>
<td>Wind felt on face; leaves rustle; ordinary vanes moved by wind.</td>
</tr>
<tr>
<td>3</td>
<td>8-12</td>
<td>7-10</td>
<td>Gentle Breeze</td>
<td>Large wavelets. Crests begin to break. Foam of glassy appearance. Perhaps scattered white horses.</td>
<td>Leaves and small twigs in constant motion; wind extends light flag.</td>
</tr>
<tr>
<td>4</td>
<td>13-18</td>
<td>11-16</td>
<td>Moderate Breeze</td>
<td>Small waves, becoming larger; fairly frequent white horses.</td>
<td>Raises dust and loose paper; small branches are moved.</td>
</tr>
<tr>
<td>5</td>
<td>19-24</td>
<td>17-21</td>
<td>Fresh Breeze</td>
<td>Moderate waves, taking a more pronounced long form; many white horses are formed.</td>
<td>Small trees in leaf begin to sway; crested wavelets form on inland waters.</td>
</tr>
<tr>
<td>6</td>
<td>25-31</td>
<td>22-27</td>
<td>Strong Breeze</td>
<td>Large waves begin to form; the white foam crests are more extensive everywhere.</td>
<td></td>
</tr>
</tbody>
</table>

125 Retrieved on 07.15.2021 from [https://www.rmets.org/resource/beaufort-scale](https://www.rmets.org/resource/beaufort-scale)
126 Retrieved on 07.15.2021 from [https://www.weather.gov/mfl/beaufort](https://www.weather.gov/mfl/beaufort)
127 Retrieved on 07.15.2021 from [https://www.weather.gov/mfl/beaufort](https://www.weather.gov/mfl/beaufort)
<table>
<thead>
<tr>
<th>Category</th>
<th>Wind Speeds</th>
<th>Beaufort Scale</th>
</tr>
</thead>
<tbody>
<tr>
<td>Large branches in motion; whistling heard in telegraph wires; umbrellas used with difficulty.</td>
<td>10-123</td>
<td>1</td>
</tr>
<tr>
<td>Sea heaps up and white foam from breaking waves begins to be blown in streaks along the direction of the wind. Whole trees in motion; inconvenience felt when walking against the wind.</td>
<td>32-38 28-33</td>
<td>2</td>
</tr>
<tr>
<td>Sea heaps and white foam from breaking waves begins to be blown in streaks along the direction of the wind. Whole trees in motion; inconvenience felt when walking against the wind.</td>
<td>39-46 34-40</td>
<td>3</td>
</tr>
<tr>
<td>Moderately high waves of greater length; edges of crests begin to break into spindrift. The foam is blown in well-marked streaks along the direction of the wind.</td>
<td>47-54 41-47</td>
<td>4</td>
</tr>
<tr>
<td>Moderately high waves of greater length; edges of crests begin to break into spindrift. The foam is blown in well-marked streaks along the direction of the wind.</td>
<td>55-63 48-55</td>
<td>5</td>
</tr>
<tr>
<td>High waves. Dense streaks of foam along the direction of the wind. Crests of waves begin to topple, tumble and roll over. Spray may affect visibility. Slight structural damage occurs (chimney-pots and slates removed)</td>
<td>64-72 56-63</td>
<td>6</td>
</tr>
<tr>
<td>Very high waves with long overhanging crests. The resulting foam, in great patches, is blown in dense white streaks along the direction of the wind. On the whole the surface of the sea takes on a white appearance. The tumbling of the sea becomes heavy and shock-like. Visibility affected. Seldom experienced inland; trees uprooted; considerable structural damage occurs.</td>
<td>73+ 64+</td>
<td>7</td>
</tr>
<tr>
<td>Exceptionally high waves (small and medium-size ships might be for a time lost to view behind the waves). The sea is completely covered with long white patches of foam lying along the direction of the wind. Everywhere the edges of the wave crests are blown into froth. Visibility affected. Very rarely experienced; accompanied by widespread damage.</td>
<td>73+ 64+</td>
<td>8</td>
</tr>
<tr>
<td>The air is filled with foam and spray. Sea completely white with driving spray; visibility very seriously affected.</td>
<td>73+ 64+</td>
<td>9</td>
</tr>
</tbody>
</table>
Based on those extent ranking factors identified (above), the planning committee ranks the extent of non-rotational wind hazards as **MODERATE**.

**Extent: Tornado**

Tornadoes have their own severity/extent scale. Until 2007, tornadoes were measured and described according to the Fujita Scale.\(^{128}\)

In February 2007, use of the Fujita Scale was discontinued. In its place, the Enhanced Fujita (EF) Scale is used. The Enhanced Fujita scale considers how most structures are designed and is thought to be a much more accurate representation of the surface wind speeds in the most violent tornadoes. Like the original Fujita scale, the Enhanced Fujita scale is a set of wind estimates (not measurements) based on damage.

It is important to note the **date** that a tornado occurred. Tornadoes that occurred prior to February, 2007 are classified using the original Fujita scale and will not be converted to the Enhanced Fujita Scale.

Table below illustrates the Fujita Scale in use prior to February 2007.

Table 10-30: Fujita Tornado Scale (Pre-February 2007)\(^{129}\)

<table>
<thead>
<tr>
<th>F-Scale Number</th>
<th>Intensity Phrase</th>
<th>Wind Speed</th>
<th>Type of Damage</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>F0</strong></td>
<td>Gale tornado</td>
<td>40-72 mph</td>
<td>Some damage to chimneys; breaks branches off trees; pushes over shallow-rooted trees; damages sign boards.</td>
</tr>
<tr>
<td><strong>F1</strong></td>
<td>Moderate tornado</td>
<td>73-112 mph</td>
<td>The lower limit is the beginning of hurricane wind speed; peels surface off roofs; mobile homes pushed off foundations or overturned; moving autos pushed off the roads; attached garages may be destroyed.</td>
</tr>
<tr>
<td><strong>F2</strong></td>
<td>Significant tornado</td>
<td>113-157 mph</td>
<td>Considerable damage. Roofs torn off frame houses; mobile homes demolished; boxcars pushed over; large trees snapped or uprooted; light object missiles generated.</td>
</tr>
</tbody>
</table>

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\(^{128}\) Retrieved on 07.19.2021 from [https://www.weather.gov/tae/ef_scale](https://www.weather.gov/tae/ef_scale)

<table>
<thead>
<tr>
<th>EF</th>
<th>Description</th>
<th>Wind Speed (mph)</th>
<th>Damage Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>F3</td>
<td>Severe tornado</td>
<td>158-206</td>
<td>Roof and some walls torn off well-constructed houses; trains overturned; most trees in forest uprooted.</td>
</tr>
<tr>
<td>F4</td>
<td>Devastating tornado</td>
<td>207-260</td>
<td>Well-constructed houses leveled; structures with weak foundations blown off some distance; cars thrown and large missiles generated.</td>
</tr>
<tr>
<td>F5</td>
<td>Incredible tornado</td>
<td>261-318</td>
<td>Strong frame houses lifted off foundations and carried considerable distances to disintegrate; automobile sized missiles fly through the air in excess of 100 meters; trees debarked; steel reinforced concrete structures badly damaged.</td>
</tr>
<tr>
<td>F6</td>
<td>Inconceivable tornado</td>
<td>319-379</td>
<td>These winds are very unlikely. The small area of damage they might produce would probably not be recognizable along with the mess produced by F4 and F5 wind that would surround the F6 winds. Missiles, such as cars and refrigerators would do serious secondary damage that could not be directly identified as F6 damage. If this level is ever achieved, evidence for it might only be found in some manner of ground swirl pattern, for it may never be identifiable through engineering studies.</td>
</tr>
</tbody>
</table>

Table below illustrates the Enhanced Fujita (EF) Scale, currently in use. Tornadoes that have occurred since February, 2007 are classified using the Enhanced Fujita Scale.
## Table 10-31: Enhanced Fujita Scale (February 2007 and Later) 130

<table>
<thead>
<tr>
<th>Enhanced Fujita Category</th>
<th>Wind Speed</th>
<th>Potential Damage</th>
</tr>
</thead>
<tbody>
<tr>
<td>EF0</td>
<td>65-85 mph</td>
<td>Light damage. Peels surface off some roofs; some damage to gutters or siding; branches broken off trees; shallow-rooted trees pushed over.</td>
</tr>
<tr>
<td>EF1</td>
<td>86-110 mph</td>
<td>Moderate damage. Roofs severely stripped; mobile homes overturned or badly damaged; loss of exterior doors; windows and other glass broken.</td>
</tr>
<tr>
<td>EF2</td>
<td>111-135 mph</td>
<td>Considerable damage. Roofs torn off well-constructed houses; foundations of frame homes shifted; mobile homes completely destroyed; large trees snapped or uprooted; light-object missiles generated; cars lifted off ground.</td>
</tr>
<tr>
<td>EF3</td>
<td>136-165 mph</td>
<td>Severe damage. Entire stories of well-constructed houses destroyed; severe damage to large buildings such as shopping malls; trains overturned; trees debarked; heavy cars lifted off the ground and thrown; structures with weak foundations blown away some distance.</td>
</tr>
<tr>
<td>EF4</td>
<td>166-200 mph</td>
<td>Devastating damage. Well-constructed houses and whole frame houses completely leveled; cars thrown and small missiles generated.</td>
</tr>
<tr>
<td>EF5</td>
<td>&gt;200 mph</td>
<td>Incredible damage. Strong frame houses leveled off foundations and swept away; automobile-sized missiles fly through the air in excess of 100 m (107 yd); high-rise buildings have significant structural deformation; incredible phenomena will occur.</td>
</tr>
</tbody>
</table>

Based on the extent ranking factors identified (above), the planning committee ranks the extent of tornados as **LOW**.

**Extent: Hail**

The National Oceanic and Atmospheric Administration and the Tornado and Storm Research Organization (TORRO) have combined efforts to create the Hailstorm Intensity Scale. Table below provides details of this scale.

Table 10-32: Combined NOAA/TORRO Hailstorm Intensity Scale

<table>
<thead>
<tr>
<th>Size Code</th>
<th>Intensity Category</th>
<th>Typical Hail Diameter</th>
<th>Approximate Size</th>
<th>Typical Damage Impacts</th>
</tr>
</thead>
<tbody>
<tr>
<td>H0</td>
<td>Hard Hail</td>
<td>Up to 0.33”</td>
<td>Pea</td>
<td>No damage</td>
</tr>
<tr>
<td>H1</td>
<td>Potentially Damaging</td>
<td>0.33” – 0.60”</td>
<td>Marble or Mothball</td>
<td>Slight damage to plants and crops</td>
</tr>
<tr>
<td>H2</td>
<td>Potentially Damaging</td>
<td>0.60” – 0.80”</td>
<td>Dime or grape</td>
<td>Significant damage to fruit, crops, and vegetation</td>
</tr>
<tr>
<td>H3</td>
<td>Severe</td>
<td>0.80” – 1.20”</td>
<td>Nickel to Quarter</td>
<td>Severe damage to fruit and crops, damage to glass and plastic structures, paint and wood scored</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Extent</th>
<th>Damage Type</th>
<th>Diameter Range</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>H4</td>
<td>Severe</td>
<td>1.20” – 1.60”</td>
<td>Half Dollar to Ping Pong Ball</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Widespread glass damage, vehicle body damage</td>
</tr>
<tr>
<td>H5</td>
<td>Destructive</td>
<td>1.60” – 2.0”</td>
<td>Silver Dollar to Golf Ball</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Wholesale destruction of glass, damage to tiled roofs, significant risk of injuries</td>
</tr>
<tr>
<td>H6</td>
<td>Destructive</td>
<td>2.0” – 2.4”</td>
<td>Lime or Egg</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Aircraft body dented; brick walls pitted</td>
</tr>
<tr>
<td>H7</td>
<td>Very Destructive</td>
<td>2.4” – 3.0”</td>
<td>Tennis Ball</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Severe roof damage, risk of serious injuries</td>
</tr>
<tr>
<td>H8</td>
<td>Very Destructive</td>
<td>3.0” – 3.5”</td>
<td>Baseball to Orange</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Severe damage to aircraft body</td>
</tr>
<tr>
<td>H9</td>
<td>Super Hailstorms</td>
<td>3.5” – 4.0”</td>
<td>Grapefruit</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Extensive structural damage, risk of severe or fatal injuries to persons caught in the open</td>
</tr>
</tbody>
</table>

Based on those extent ranking factors identified (above), the planning committee ranks the extent of the hail hazard as **LOW**.
**Extent: Lightning**

The National Weather Service (NWS) uses a Lightning Activity Level (LAL) scale to indicate the frequency and character of cloud-to-ground (C/G) lightning. The scale uses a range of 1 – 6, with 6 being the high end of the scale. Table below provides details of the LAL scale.

Table 10-33: Lightning Activity Level (LAL) Scale

<table>
<thead>
<tr>
<th>Rank</th>
<th>Cloud and Storm Development</th>
<th>Areal Coverage</th>
<th>Counts C/G per 5 Minutes</th>
<th>Counts C/G per 15 Minutes</th>
<th>Average C/G per Minute</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>No Thunderstorms</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>2</td>
<td>Cumulus clouds are common but only a few reaches the towering stage. A single thunderstorm must be confirmed in the rating area. The clouds mostly produce virga, but light rain will occasionally reach ground. Lightning is very infrequent.</td>
<td>&lt;15%</td>
<td>1-5</td>
<td>1-8</td>
<td>&lt;1</td>
</tr>
<tr>
<td>3</td>
<td>Cumulus clouds are common. Swelling and towering cumulus cover less than 2/10 of the sky. Thunderstorms are few, but 2 to 3 occur within the observation area. Light to moderate rain will reach the ground, and lightning is infrequent.</td>
<td>15% to 24%</td>
<td>6-10</td>
<td>9-15</td>
<td>1-2</td>
</tr>
</tbody>
</table>

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132 Retrieved on 07.19.2021 from [https://graphical.weather.gov/definitions/defineLAL.html](https://graphical.weather.gov/definitions/defineLAL.html)
### Lightning Activity Level Scale

<table>
<thead>
<tr>
<th>Rank</th>
<th>Cloud and Storm Development</th>
<th>Areal Coverage</th>
<th>Counts C/G per 5 Minutes</th>
<th>Counts C/G per 15 Minutes</th>
<th>Average C/G per Minute</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>Swelling cumulus and towering cumulus cover 2-3/10 of the sky. Thunderstorms are scattered but more than three must occur within the observation area. Moderate rain is commonly produced, and lightning is frequent.</td>
<td>25% to 50%</td>
<td>11-15</td>
<td>16-25</td>
<td>2-3</td>
</tr>
<tr>
<td>5</td>
<td>Towering cumulus and thunderstorms are numerous. They cover more than 3/10 and occasionally obscure the sky. Rain is moderate to heavy, and lightning is frequent and intense.</td>
<td>&gt;50%</td>
<td>&gt;15</td>
<td>&gt;25</td>
<td>&gt;3</td>
</tr>
<tr>
<td>6</td>
<td>Dry lightning outbreak. (LAL of 3 or greater with majority of storms producing little or no rainfall.)</td>
<td>&gt;15%</td>
<td>None</td>
<td>None</td>
<td>None</td>
</tr>
</tbody>
</table>

Based on those extent ranking factors identified (above), the planning committee ranks the extent of the lightening hazard as **LOW**.

**Extent: Thunderstorms that Generate Wind, Tornado, Hail, and Lightning Hazard Events**

Thunderstorms are not explicitly identified as a severe weather category for this hazard profile. However, they are responsible for most tornado, lightning, and hail hazard events – as well as a significant number of wind hazard events – across California and the CSU system. While individual thunderstorms affect relatively small areas, there are many instances in which thunderstorms can cluster together and/or travel in a line over long distances, producing significant damage over large geographic areas.

A thunderstorm is classified as “severe” when certain meteorological parameters within the thunderstorm are reached (i.e., damaging winds or speeds of 58 mph (50 knots) or greater, hail 1 inch in diameter or larger, and/or a tornado). However, there is currently no
established, objective severity scale for thunderstorms.\textsuperscript{133} \textsuperscript{134} That said, according to the *Glossary of Meteorology* published by the American Meteorological Society (AMS), a thunderstorm is reported as *light, medium, or heavy* according to following five (5) characteristics:

- the nature of the lightning and thunder;
- the type and intensity of the precipitation, if any;
- the speed and gustiness of the wind;
- the appearance of the clouds; and
- the effect upon surface temperature.\textsuperscript{136}

A thunderstorm may also be classified by the nature of the overall weather situation in which the thunderstorm is produced, including:

- **Airmass Thunderstorm**: A thunderstorm produced by local convection within an unstable air mass;\textsuperscript{136}

- **Frontal Thunderstorm**: An individual thunderstorm the initiation of which results from rising motion associated with a front, or a thunderstorm within a convective system generated and organized by frontal rising motion;\textsuperscript{137} or

- **Squall-line Thunderstorm**: An individual thunderstorm included within a squall line (i.e., a continuous or broken line of active deep moist convection frequently associated with thunder). \textsuperscript{138} \textsuperscript{139}

Based on the extent ranking factors identified (above) in relation to campus layout and operations, and past event low degree of severity, the planning committee ranks the extent of the thunderstorm hazard as **LOW**.

\textsuperscript{132} Retrieved on 07.15.2021 from https://www.noaa.gov/explainers/severe-storms
\textsuperscript{134} Retrieved on 07.15.2021 from https://www.weather.gov/safety/thunderstorm
History of the Hazard

Severe weather hazards have been an annual occurrence in Orange County and on the CSU Fullerton campus. Historical data for these hazards are presented below.

Historical Storm Data Collection: NCEI Storm Events Database

Historical information regarding severe weather hazards can be found using The National Centers for Environmental Information (NCEI) Storm Events Database. The Storm Events Database contains searchable, archived National Weather Service (NWS) storm data from January 1950 to April 2021, as entered by NOAA’s National Weather Service (NWS). Due to changes in the data collection and processing procedures over time, there are unique periods of record available depending on the event type. For example, from 1950 through 1954, only tornado events were recorded; from 1955 through 1995, only tornado, thunderstorm wind, and hail events were introduced into the database; from 1996 to present, 45 additional event types are recorded, including high wind, strong wind, and lightning events. To obtain the most accurate portrayal of severe weather event frequency, searches of the Storm Events Database are conducted using data collected since 01/01/1996. As a reminder, all official severe weather event data is at the county level. Severe weather data do not exist at the campus level. That said, it may be the case that the campus to some degree experiences the severe weather events reported for the surrounding community and County.

Wind Hazards (excluding Tornadoes)

Information obtained from the NCEI Storm Event Database website shows the number of events (or occurrences) of wind hazard events in Orange County since 1996. Here, wind hazard events include all “High Wind,” “Strong Wind,” and “Thunderstorm Wind” storm reports.

- **High Wind**: at least 176 events, or approximately 6.95 events per year

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144 National Climatic Data Center. Storm Events Database. Retrieved 07.29.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType%28Z%29=HighWind&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=ORANGE%3A59&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA
- **Strong Wind**: at least 15 events, or 0.59 events per year\(^{145}\)
- **Thunderstorm Wind**: at least 34 events, or approximately 1.34 events per year\(^{146}\)
- **All Wind Hazard events** (excluding Tornadoes): at least 219 events, or approximately ### events per year.\(^{147}\) (Note: This was determined by conducting a simultaneous search of the component wind hazards of high wind, strong wind and thunderstorm wind.)

Overall, in Orange County, there have been at least 219 wind hazard events since 1996, excluding tornadoes.\(^{148}\) That translates to an approximate average historical frequency of occurrence of **8.64** wind hazard events per year.

Please note: Differences between the sums of individual component severe weather hazard event Database searches (i.e., 225 events) and simultaneous Database searches of all severe weather hazard events (i.e., 219 events) may be due to the following factors: (1) multiple event types are in the same record (e.g., "Thunderstorm Wind/Hail" or "Hail/Tornado;" and/or (2) severe weather hazard events such as “Thunderstorm Wind” or “Hail” that are reported for Orange County have actually taken place hundreds of miles away, but are erroneously recorded as events that have occurred in the County.\(^{149}\) When such a discrepancy arises, the more conservative aggregate hazard wind event value (i.e., 219 events) is used to determine the historical frequency of occurrence for the severe weather hazard. The origin of this discrepancy is unknown at this time.

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\(^{145}\) National Climatic Data Center. Storm Events Database. Retrieved 07.29.2021 from [https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28Z%29+Strong+Wind&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=ORANGE%3A59&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA](https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28Z%29+Strong+Wind&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=ORANGE%3A59&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA)

\(^{146}\) National Climatic Data Center. Storm Events Database. Retrieved 07.29.2021 from [https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Thunderstorm+Wind&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=ORANGE%3A59&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA](https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Thunderstorm+Wind&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=ORANGE%3A59&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA)

\(^{147}\) National Climatic Data Center. Storm Events Database. Retrieved 07.29.2021 from [https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28Z%29+High+Wind&eventType=%28Z%29+Strong+Wind&eventType=%28C%29+Thunderstorm+Wind&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=ORANGE%3A59&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA](https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28Z%29+High+Wind&eventType=%28Z%29+Strong+Wind&eventType=%28C%29+Thunderstorm+Wind&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=ORANGE%3A59&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA)

\(^{148}\) National Climatic Data Center. Storm Events Database. Retrieved 07.29.2021 from [https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28Z%29+High+Wind&eventType=%28Z%29+Strong+Wind&eventType=%28C%29+Thunderstorm+Wind&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=ORANGE%3A59&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA](https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28Z%29+High+Wind&eventType=%28Z%29+Strong+Wind&eventType=%28C%29+Thunderstorm+Wind&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=ORANGE%3A59&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA)

Historical Wind Hazard Losses for Orange County since 1996

According to the NCEI Storm Events Database, the wind hazard events that Orange County has experienced since 1996 have been costly. There has been 1 death and 0 injuries, and property and crop damage estimates have totaled approximately $2,417,000 and $21,000, respectively.\(^{150}\)

**Tornado Wind Hazards**

Information from the NCEI Storm Events Database indicates that since 1996, there have been 7 reported events of tornadoes in Orange County, which translates to approximately 0.28 tornado events per year.\(^{151}\)

Four (4) of the tornado reports in Orange County since 1996 have been of tornadoes with a severity rating of F0/EF0. The remaining three (3) tornadoes reported have each had a severity rating of F1/EF1; that translates to approximately 0.12 events of F1/EF1 tornadoes have occurred per year in Orange County.\(^{152}\)

Historical Tornado Hazard Losses for Orange County since 1996

According to the NCEI Storm Events Database, the tornado hazard events that Orange County has experienced since 1996 have been costly. While there have been no reported deaths, injuries, or crop losses, property damage estimates have totaled approximately $600,000.\(^{153}\)

\(^{150}\) National Climatic Data Center. Storm Events Database. Retrieved 07.29.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28Z%29+High+Wind&eventType=%28Z%29+Strong+Wind&eventType=%28C%29+Thunderstorm+Wind&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=ORANGE%3A59&hailfilter=0.00&tornfilter=0.00&windfilter=0.00&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA

\(^{151}\) National Climatic Data Center. Storm Events Database. Retrieved 07.29.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Tornado&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=ORANGE%3A59&hailfilter=0.00&tornfilter=0.00&windfilter=0.00&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA

\(^{152}\) National Climatic Data Center. Storm Events Database. Retrieved 07.29.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Tornado&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=ORANGE%3A59&hailfilter=0.00&tornfilter=0.00&windfilter=0.00&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA

\(^{153}\) National Climatic Data Center. Storm Events Database. Retrieved 07.29.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Tornado&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=ORANGE%3A59&hailfilter=0.00&tornfilter=0.00&windfilter=0.00&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA
**Hail**

Information from the NCEI Storm Events Database indicates that since 1996, there have been 11 reported events of hail in Orange County, which translates to approximately 0.43 hail events per year.\(^{154}\) (Note: The NCEI Storm Event Database search results for hail indicate that there has been a total of 12 reports of hail since 1996. However, one (1) entry is for a 1998 hail event in San Diego County. While Orange County is adjacent to San Diego County, there is no indication in the event details that hail ever reached Orange County during this event. The origin of this reporting discrepancy is unknown at this time.)

**Historical Hail Hazard Losses for Orange County since 1996**

According to the NCEI Storm Events Database, the hail hazard events that Orange County has experienced since 1996 have been costly. There have been 1 death and 0 injuries, property damage estimates have totaled approximately $80,600; no crop damage estimates have been reported.\(^{155}\) (Note: The San Diego County hail event that was included erroneously in the search results for hail events in Orange County accounted for all hail injuries (i.e., 5) and crop damage estimates (i.e., $300,000) presented in the search results.)

**Lightning**

Information from the NCEI Storm Events Database indicates that since 1996, there have been four (4) reported events of lightning in Orange County, which translates to approximately 0.16 lightning events per year.\(^{156}\)

**Historical Lightning Hazard Losses for Orange County since 1996**

According to the NCEI Storm Events Database, the lightning hazard events that Orange County has experienced since 1996 have been costly. While there have been no deaths,
injuries, or crop damage from lightning reported, property damage estimates have
totaled approximately $62,000.\textsuperscript{157}

**All Severe Weather Hazard Events Recorded by the NCEI Storm Events Database**

Information obtained from the NCEI Storm Events Database indicates that there have
been 241 occurrences of the severe weather hazard in Orange County. This translates to
9.51 severe weather hazard occurrences per year.\textsuperscript{158}

Please note: Differences between the sums of individual component severe weather
hazard event Database searches (i.e., 248 events) and simultaneous Database searches of
all severe weather hazard events (i.e., 241 events) may be due to the following factors: (1)
multiple event types are in the same record (e.g., "Thunderstorm Wind/Hail" or
"Hail/Tornado;”) and/or (2) severe weather hazard events such as “Thunderstorm Wind”
or “Hail” that are reported for Orange County have actually taken place hundreds of miles
away, but are erroneously recorded as events that have occurred in the County.\textsuperscript{159} When
such a discrepancy arises, the more conservative aggregate hazard wind event value (i.e.,
241 events) is used to determine the historical frequency of occurrence for the severe
weather hazard. The origin of this discrepancy is unknown at this time.

**Historical, Aggregated Severe Hazard Losses for Orange County since 1996**

According to the NCEI Storm Events Database, the severe weather events that Orange
County has experienced since 1996 have been costly. There have been 2 deaths and 0
injuries, and property and crop damage estimates have totaled approximately $3,160,000
and $21,000, respectively.\textsuperscript{160} It is important to note that for all Orange County severe
weather hazard events recorded on the Storm Events Database, half of all deaths, all crop
damage estimates, and approximately 76.5% of all property damage estimates, have
been caused by wind hazard events alone.

\textsuperscript{157} National Climatic Data Center. Storm Events Database. Retrieved 07.29.2021 from
https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Lightning&beginDate_mm=
01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&c
ounty=ORANGE%3A59&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&stat
efips=6%2CCALIFORNIA

\textsuperscript{158} National Climatic Data Center. Storm Events Database. Retrieved 07.29.2021 from
https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Hail&eventType=%28Z%29
+High+Wind&eventType=%28C%29+Lightning&eventType=%28Z%29+Strong+Wind&eventType=%28C%2
9+Thunderstorm+Wind&eventType=%28C%29+Tornado&beginDate_mm=01&beginDate_dd=01&begin
Date_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=ORANGE%3A59&hailf
ilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA

\textsuperscript{159} Dos Santos, Renato. (2016). Some Comments on the Reliability of NOAA's Storm Events Database.

\textsuperscript{160} National Climatic Data Center. Storm Events Database. Retrieved 07.29.2021 from
https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Hail&eventType=%28Z%29
+High+Wind&eventType=%28C%29+Lightning&eventType=%28Z%29+Strong+Wind&eventType=%28C%2
9+Thunderstorm+Wind&eventType=%28C%29+Tornado&beginDate_mm=01&beginDate_dd=01&begin
Date_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=ORANGE%3A59&hailf
ilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA
Wind Hazards Not Included in the NCEI Storm Events Database

Santa Ana Winds

Santa Ana wind events occur at least twice per month from October through April.\textsuperscript{161} From 1948 to 2012, total of 2056 events on the 65-year record were recorded in the Southern California region, yielding an average of \textbf{32 occurrences per year}. Typical Santa Ana wind events last 1–2 days and represent 27\% of the occurrences, with events lasting up to 6 days accounting for 90\% of all occurrences. The remaining 10\% are made up almost entirely of events lasting between 7 and 12 days.\textsuperscript{162 163}

Figure below shows the mean monthly frequency per season of Santa Ana Wind events detected from 1948 to 2012. Extreme Santa Ana wind events are shown in dark red, and are defined as those events that are above the 90th percentile of all events on record.


Diablo Winds

Diablo wind events occur approximately **2.5 events per year**. These events are most frequent during the fall and early winter seasons, with the highest frequency of events occurring in October. As a result, the highest risk of Diablo-wind-related damage is in the fall and early winter.\(^{166}\)


Figure below shows the monthly frequency of Diablo winds (along with average live fuel moisture content). The Diablo Wind data are derived from a 17-year climatology of San Francisco Bay Area regional surface weather stations.167

Figure 10-19: Monthly Frequency of Diablo Winds and Average Live Fuel Moisture Content (Dashed Line)168

Sundowner Winds

Strong sundowner wind events occur approximately 2-3 times per year. These events can create sharp temperature rises, local gale force winds, and significant weather-related problems. Rare, “explosive” types of sundowner wind events occur about 6 times per century that present dangerous weather situations, generating extremely strong and hot winds that can reach gale force or higher speeds.169

Historical Frequency of All Severe Weather Hazards

Table below shows the average historical frequency of severe weather hazard events for Orange County since 1996.

167 Retrieved on 07.15.2021 from https://www.fireweather.org/diablo-winds
Table 10-34: Severe Weather Hazard Event

Frequencies for Orange County since 1996.

<table>
<thead>
<tr>
<th>Severe Weather Hazard Category</th>
<th>Average Number of Hazard Events Per Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wind (Includes High, Strong and Thunderstorm Winds ONLY)</td>
<td>8.64</td>
</tr>
<tr>
<td>Tornado</td>
<td>0.28</td>
</tr>
<tr>
<td>Hail</td>
<td>0.43</td>
</tr>
<tr>
<td>Lightning</td>
<td>0.16</td>
</tr>
<tr>
<td>Diablo Wind*</td>
<td>2.5</td>
</tr>
<tr>
<td>Santa Ana Wind</td>
<td>32</td>
</tr>
<tr>
<td>Sundowner Wind*</td>
<td>2 to 3</td>
</tr>
</tbody>
</table>

* Note: The Diablo and Sundowner wind hazards are not present in Orange County. They are included here for information purposes only.

Potential Impacts of the Hazard

All assets and people within CSU Fullerton campus areas are at risk from the effects of severe weather.

**Wind Hazards (Including Tornadoes)**

Wind hazard events have the potential to impact people, property, and operations on campuses across the CSU system. People caught in the open during an extreme wind event are exposed to high winds and debris, and could be injured or killed.

The habitability of buildings can be compromised (by damaging roofs, windows, or other weak points in the building envelope), leading to long-term operational issues for the campus. As with most university campuses, space is always at a premium at the CSU Fullerton campus, and the loss of any currently utilized space due to building or structural damage would likely disrupt operations and the University’s mission.

Extreme wind events can result in power failure, which would impact the operation of the campus. Fallen tree limbs and other potential transportation hazards may also cause disruption to the surrounding community and limit ingress/egress to the campus.
According to the 2021 County of Orange and Orange County Fire Authority Local Hazard Mitigation Plan (LHMP), wind hazards (including tornadoes) are considered to be of low significance, and therefore to have a minimal potential impact on the County and (by extension) the CSU Fullerton campus.170

**Hail**

Hail typically impacts property by damaging structures, cars, and utilities as it falls. Dents in cars, broken glass, and holes in roofs are common impacts of hail. Injuries to people from hail are less common, though they can happen, as hail is a hard object falling in an unpredictable manner at a fairly high rate of speed.

According to the 2021 County of Orange and Orange County Fire Authority Local Hazard Mitigation Plan (LHMP), hail hazards are not addressed at all in the Plan; they are considered to be of low significance, and therefore to have a minimal potential impact on the County and (by extension) the CSU Fullerton campus.171

**Lightning**

Lightning strikes the United States about 20-25 million times a year.172 Although most lightning occurs in the summer months, people can be struck at any time of year. Since 1990, lightning has killed an average of 39 people each year in the United States, and hundreds more have been injured.173 Property losses due to lightning have been very costly across the U.S. For example, from 2005 through 2020, U.S. homeowner’s insurance claim payouts for lightning losses totaled approximately $15,334,600,000, or $958,412,500 worth of payouts per year.174 (Commercial claim payouts for lightning losses for the U.S. were not available.)

According to the 2021 County of Orange and Orange County Fire Authority Local Hazard Mitigation Plan (LHMP), lightning hazards are not addressed at all in the Plan; they are considered to be of low significance, and therefore to have a minimal potential impact on the County and (by extension) the CSU Fullerton campus.175

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Probability of Future Occurrence of the Hazard

Areas throughout California, including all California State University (CSU) campuses, experience severe weather events every year, and future occurrences of such events are projected to increase in both their frequency and intensity. The 2021 County of Orange and Orange County Fire Authority Local Hazard Mitigation Plan (LHMP) states that there is a 10-100% probability that wind hazards profiled above for Orange County will occur annually in the future, and but does address the probabilities of annual occurrence for tornadoes, hail, or lightning. However, according to the NCEI Storm Events Database, wind hazards have occurred in Orange County more than once per year. Also, while the severe weather hazard is a non-spatial hazard that affects all areas of the CSU Fullerton campus equally, the smallest geographic unit of measurement for almost all official severe weather event data is at the county level. Because the severe weather data used in this assessment do not exist at the campus level, it is assumed that the severe weather probabilities for the CSU Fullerton campus reflect those of the surrounding community and County identified in the Table below.

Based on the data available from both the 2021 County of Orange and Orange County Fire Authority Local Hazard Mitigation Plan (LHMP) and the NCEI Storm Events Database, the severe weather hazard is expected to occur on (or otherwise impact) the CSU Fullerton campus at least once on an annual basis. Therefore, the probability of future occurrence of the severe weather hazard for CSU Fullerton is HIGHLY LIKELY. See Table below for probabilities of future occurrence for component severe weather hazards for the County, City of Fullerton, and the CSU Fullerton campus.

Table 10-35: Severe Weather Hazard Probabilities of Future Occurrence for Orange County and CSU Fullerton

<table>
<thead>
<tr>
<th>Severe Weather Hazard Category</th>
<th>Average Number of Hazard Events Per Year</th>
<th>Probability of Future Occurrence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wind (Includes High, Strong and Thunderstorm Winds ONLY)</td>
<td>8.64</td>
<td>Highly Likely</td>
</tr>
<tr>
<td>Tornado</td>
<td>0.28</td>
<td>Possible</td>
</tr>
<tr>
<td>Hail</td>
<td>0.43</td>
<td>Possible</td>
</tr>
<tr>
<td>Lightning</td>
<td>0.16</td>
<td>Possible</td>
</tr>
<tr>
<td>Diablo Wind**</td>
<td>2.5</td>
<td>Not Rated</td>
</tr>
</tbody>
</table>

Vulnerability to the Hazard

People, structures, and assets on the CSU Fullerton campus are all vulnerable to the impacts associated with severe weather. Infrastructure can be damaged or destroyed by hail, wind, tornadoes, thunderstorms, and lightning, which can result in service interruptions and outages. Structures can be damaged or destroyed by hail, wind, tornadoes, thunderstorms, and lightning. People can be injured or killed by lightning, flying debris, hail, or extreme wind events. The CSU Fullerton campus also has vehicles, as well as off-campus conference and recreational facilities, that are all vulnerable to a severe weather event.

Estimate of Potential Losses

Severe weather is a non-spatial hazard that affects the entire CSU Fullerton campus. Each of the hazards associated with severe weather can result in losses throughout the planning area.

All structures within the CSU Fullerton campus are at risk from severe weather. There are approximately 49 buildings on the main campus that could be damaged by wind, hail, and/or lightning. If even a fraction of these assets were to be damaged, the resulting estimated losses would still be in the millions of dollars. The total replacement costs due to severe weather hazards are $453,119,067 for 38 buildings, but are unknown for the remaining 11 buildings. An analysis of projected dollar losses to campus buildings from severe weather as a percentage of building replacement costs is also not currently available, though CSU leadership may pursue such data in the future.

The population at the CSU Fullerton campus varies throughout the day. As of Fall, 2019, CSU Fullerton had 39,868 students and 3,736 faculty and staff. All are at risk from severe weather events, with 43,604 being directly vulnerable in this scenario.

Vulnerability Assessment Conclusions

Severe weather presents a variety of hazards to the CSU Fullerton campus. People, assets, infrastructure, and vehicles can all be damaged by this hazard, and losses can quickly begin to rise. In the aggregate, severe weather is a frequently occurring hazard (mostly in the form of wind hazard events) that presents a variety of risks to CSU Fullerton.

| Santa Ana Wind | 32 | Highly Likely |
| Sundowner Wind** | 2 to 3 | Not Rated |
| ** Severe Weather Hazard | | Highly Likely |

** Note: The Diablo and Sundowner wind hazards are not present in Orange County, and therefore are not rated for probability of future occurrence. They are included here for information purposes only.
It is evident that the CSU Fullerton campus has vulnerabilities to and risks from severe weather hazard incidents, and that pre-event planning, communication, and mitigation efforts should be implemented. Public education and outreach regarding areas of shelter that could be used by campus populations during severe weather events is considered by campus leadership to be one viable mitigation option. The campus planning committee will continue to look for feasible and cost-effective options for the mitigation of severe weather risks going forward.

Identified Data Limitations

Numerous federal agencies maintain a variety of records regarding losses associated with hazards. Unfortunately, no single source is considered to offer a definitive accounting of all losses. The Federal Emergency Management Agency (FEMA) maintains records on federal expenditures associated with declared major disasters. The US Army Corps of Engineers (USACE) and the Natural Resources Conservation Service (NRCS) collect data on losses during the course of some of their ongoing projects and studies. Additionally, the National Oceanic and Atmospheric Administration’s (NOAA) National Centers for Environmental Information (NCEI) collects and maintains data about natural hazards in summary format, as well as occurrences, dates, injuries, deaths, and estimated costs for individual storm events. Many of these databases and other data collection services, including the NCEI, have inherent data limitations when searching for information at a scale as small as a single campus.

The best available data and records have been used throughout this section. Where no data or records exist or could be located, that deficiency is noted.
10.4 Social Resilience Assessment

Overview

While every person is vulnerable to risk, individuals from diverse populations such as those with access and functional needs are disproportionately more vulnerable and may be at a higher risk to harm in a disaster event. In addition to physical vulnerabilities, the intersectionality between physical hazard risks and population social vulnerabilities must be considered to holistically address overall campus risk.

As inclusivity is a high priority for CSU, addressing campus risk and resilience must be done through the lens of inclusion and equity. Addressing social vulnerability is an increasingly critical requirement of state and national doctrines and described in Section 4.4 of the HVRA Base Plan. Every individual of the campus’s richly diverse population group needs to have the capacity, skills, and knowledge in order to understand, access, and participate in risk reduction and disaster response in ways that are meaningful to their own unique situation. In a campus community, having strong social support networks and active involvement in community disaster responses may negatively or positively impact these opportunities and reduce the resilience-building process. This section offers a glimpse into the CSU Fullerton campus’s unique social construct, population demographics, strengths and concerns and presents a high-level assessment of the resilience, coping capacities and potential social vulnerabilities of students, staff and faculty. The research variables that were asked are often considered sensitive subjects, and few are traditionally included in emergency management/hazard mitigation planning.

This social resilience assessment of college campuses is the first of its kind in the nation. The research methodology unfolded as the interviews with campuses progressed. The assessment data presented are not definitive or authoritative. The answers, analysis, and suggested trends are strictly indicators for potential social risk. They do not represent an accurate data capture as limitations on the data gathering process influenced an ability to provide accuracy. This assessment provides indications of increased risk, not accuracy of response or a true reflection of the situation of the campus. The information presented is to be considered in the context of the more detailed system-wide CSU social vulnerability assessment that is included in the baseline HVRA.

Campus-Identified Populations of Concern

During the campus interview, the following responses were provided when asked, “In considering the diverse population group(s) amongst student body, faculty and staff, which are of the most concern in your emergency management planning?”
Table 10-36: High level summary of campus populations of concern

<table>
<thead>
<tr>
<th>Question</th>
<th>Campus Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>Which population groups amongst the student body, faculty, and staff,</td>
<td>Populations with access and functional needs</td>
</tr>
<tr>
<td>are of the most concern for physical and social vulnerabilities in</td>
<td></td>
</tr>
<tr>
<td>emergency management planning?</td>
<td></td>
</tr>
<tr>
<td>Which population groups are most difficult to reach in an event?</td>
<td>• DACA students</td>
</tr>
<tr>
<td></td>
<td>• Populations with access and functional needs</td>
</tr>
<tr>
<td></td>
<td>• Students relying on social media for news and updates</td>
</tr>
<tr>
<td>Which population groups have little/limited support networks if</td>
<td>Students with limited support networks</td>
</tr>
<tr>
<td>impacted by an event?</td>
<td></td>
</tr>
</tbody>
</table>
Resilience Variables Related to Campus Emergency Management

The interviewees were asked to reflect on a set of 12 variables for the campus populations of student, faculty and staff: homelessness (housing insecurity), food security, health and wellness, disability/access and functional needs (AFN), racial equity, digital equity, communications, international students, immigrants/immigration status issues (undocumented, DACA, etc.), LGBTQI (Lesbian Gay Bisexual Transgender Questioning (or queer) Intersex), and transportation dependency. They were also offered an opportunity to add any other factor they wanted to include. The following two questions were asked:

- Is this factor a particular issue of concern for emergency management on your campus? Responses were summarized as Very High, High, Medium, Low
- Is this factor reflected in the emergency plans and processes for your campus? Responses were summarized as Yes, No, In Progress, NA

In order to provide a high-level qualitative response for the answers, the approach of averaging response was taken. If conflicting answers were expressed by the interviewees, the answer (code) was averaged out. A detailed explanation of the response averaging approach is included in the base HVRA.
Table 10-37: Graph of campus-specific emergency management issues of concern and inclusion in emergency management plans and processes.

<table>
<thead>
<tr>
<th>Issue of Concern</th>
<th>Plans &amp; Processes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Homelessness (Housing Insecurity)</td>
<td>Low</td>
</tr>
<tr>
<td>Food Security</td>
<td>Low</td>
</tr>
<tr>
<td>Health &amp; Wellness</td>
<td>Low</td>
</tr>
<tr>
<td>AFN</td>
<td>Low</td>
</tr>
<tr>
<td>Digital Equity</td>
<td>Low</td>
</tr>
<tr>
<td>Comms.</td>
<td>Low</td>
</tr>
<tr>
<td>International Students / Immigrants</td>
<td>Low</td>
</tr>
<tr>
<td>DACA</td>
<td>Low</td>
</tr>
<tr>
<td>LGBTQI</td>
<td>Low</td>
</tr>
</tbody>
</table>

Qualitative Narrative: Campus Overview of Potential Resilience Vulnerabilities

The following is an interview note of interest:

- International students have little support networks if impacted because no social network to fall upon; some have language barriers in a crisis and [have difficulty] being able to communicate.

Campus High Hazards and Potentially Vulnerable Populations

This section provides a brief introduction to the link between socially vulnerable populations and a particular hazard type. While extensive research has been conducted on the impacts of hazards, not all linkages have been documented or published, and detail for finding them are beyond the scope of this assessment. It’s important to note, the intersectional nature of what makes an individual’s personal experience and resilience to an event is played out by unique factors for that individual or population. The nuanced social vulnerabilities often come from the social and physical environment in which a person is embedded.
In order to aid in further assessing campus resilience, below is a general description of the known impacts. From some hazards, the descriptions are robust, while others are only brief introductions.

Table 10-38: CSU Fullerton *Highly Likely, Likely and Possible* Hazards

<table>
<thead>
<tr>
<th>Hazard</th>
<th>Future Occurrence Probability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Communicable Disease</td>
<td>Highly Likely</td>
</tr>
<tr>
<td>Drought</td>
<td>Highly Likely</td>
</tr>
<tr>
<td>Earthquake</td>
<td>Possible</td>
</tr>
<tr>
<td>Erosion</td>
<td>Highly Likely</td>
</tr>
<tr>
<td>Extreme Temperature</td>
<td>Highly Likely (Heat Only)</td>
</tr>
<tr>
<td>Hazardous Materials</td>
<td>Possible</td>
</tr>
<tr>
<td>Power Outage</td>
<td>Likely</td>
</tr>
<tr>
<td>Wildfire</td>
<td>Unlikely (Fire); Possible (Smoke)</td>
</tr>
</tbody>
</table>

**Drought**

The 2012-2016 drought had severe effects on two vulnerable sectors of our population: those in low-income brackets, and those, especially Native Americans, who rely on subsistence fishing for their livelihoods.\textsuperscript{176} Water bills increased throughout the state. Due to rising water prices, for the working poor, many have paid four to five percent of their income for water. Since many CSU students are commuters, and many living with families, future drought impacts may potentially affect a percentage of non-resident students. NASA’s modeling shows that future droughts are likely to last longer and be more intense, even leading to “megadroughts” in the western states.\textsuperscript{177} Fresh water supplies are predicted to be full of extremes, with both droughts and extreme precipitation events being more severe. The interrelationship between drought and other hazard conditions may lead to a set of secondary impacts. Drought conditions lead to


water quality issues due to loss of drinking water, increased fire danger that leads to drought-induced fires and elevated AQI levels, as well as extreme heat or prolonged heat events.

**Earthquake**

Impacts on populations from earthquakes are complex, with long-term implications on social stability for all populations. In addition to the physical impact exposure during a no-notice earthquake event and the social and logistical challenges of a recovering community, an earthquake can have lasting impacts long afterwards due to post traumatic stress disorder (PTSD).

Socioeconomic vulnerabilities of populations at risk were analyzed in the hypothetical yet scientifically realistic earthquake sequence that is being used to better understand hazards for the San Francisco Bay region during and after a magnitude-7 earthquake (mainshock) on the Hayward Fault and its aftershocks. In this study, the at-risk populations located in areas of concentrated damage are anticipated to experience longer recovery trajectories, increased long term housing displacement, and transportation impacts due to dependencies on transit dependencies. When neighborhood schools close, families with school age children may move to other areas to keep their children in schools. Persons with access and functions needs are likely to be more dependent on access to functioning medical, social and personal health care services that would be overwhelmed by the event and therefore increasing their vulnerabilities. For the homeless populations, the loss of social community services and damages to shelters could add to protracted relocations. For the young and mobile populations who rent, the major disruption to housing, jobs and transit will also drive relocation. Widespread housing damage and preexisting housing market constraints will make it “extremely challenging” for the socially and economically vulnerable populations to find alternative housing near their home communities. Those who utilize interim and irregular housing for months and years after a disaster are more vulnerable to physical, social, and mental disorders, including suicide, substance abuse, and physical and verbal abuse. Aftershocks and post disaster conditions delay population return and increase outmigration.  

**Erosion**

Risk from erosion relates to earthen and infrastructural losses. The degree of vulnerability to these events and their impacts depends on human behavior and the traditional social factors such as situational awareness, prior knowledge of hazards, 

social capital and decision-making capabilities, as well as increased vulnerability due to social factors, such as racial and economic disparities.

**Extreme Temps**

People susceptible to respiratory ailments (asthma, lower and upper respiratory disease) disproportionately suffer from the effects of fire, smoke, air pollutions, allergens, heat and PSPS. Those with limited income or without resources are affected disproportionately due to the inability to provide safe shelter, air conditioning, cooling, air purification, medical care, and quality foods, and are also least able to obtain information related to climate risks and adaptation strategies.

**Heat**

Heatstroke, cardiovascular disease, respiratory disease and cerebrovascular disease are related to extreme heat events. Increased number of heat waves creates heat-related physical stress on populations and is exacerbated in the metropolitan areas where greater amounts of heat-absorbing surfaces (e.g., asphalt and concrete) trap heat and emit higher temperatures throughout the night.

The heat also extends the geographic range and the distribution of disease-carrying insects and pests. Health professionals are concerned that California’s warming climate will allow species to acclimate. Such vectors include such pests as ticks that carry Lyme disease, and mosquitoes that transmit Zika, dengue fever, West Nile, plague and tularemia. Some others, such as chikungunya, Chagas disease, and Rift Valley fever virus, are threats as well.

Some communities of color and some low-income, homeless, and immigrant populations are more exposed to heat waves, as these groups often reside in urban areas affected by heat island effects. In addition, these populations are likely to have limited adaptive capacity due to a lack of adequately insulated housing, inability to afford or to use air conditioning, inadequate access to public shelters such as cooling centers, and inadequate access to both routine and emergency health care. These social, economic, and health risk factors give rise to the observed increase in deaths and disease from extreme heat in some immigrant and impoverished communities.

Heat stroke, the most serious heat-related illness, occurs when the body is unable to control its temperature. Body temperature rises rapidly, the sweating mechanism fails, and the body cannot cool down. In extreme causes, heat stroke can cause confusion and unconsciousness, so the victim is unable to seek treatment without assistance.

There are several groups of people who are uniquely vulnerable to the effects of extreme heat, such as infants and children, older adults aged 65 and up, athletes and outdoor workers, low-income households, and individuals with certain chronic medical conditions.

When dealing with an extreme heat event, the most common impacts are those generally felt by the people living in the targeted area. For people in particular, heat can kill when the body is pushed beyond its limits. Most heat disorders occur because the victim has
been overexposed to heat. As discussed, the major human risks associated with extreme heat include dehydration, sunburn, fatigue, heat exhaustion, heat stroke, and in severe cases, death.

Some portions of the population are more at risk to the effects of extreme heat. The very young, the elderly, and certain groups with chronic medical conditions (such as asthma or other pulmonary illnesses, heart disease, poor blood circulation, neurological illnesses, and obesity) are generally more vulnerable to the effects of extreme heat, and are more likely to suffer illness or death as a result.

This is especially true if exposure is extended for a period of time and preventative measures are not taken immediately. Distributional implications of impacts, and even less on distributional implications of adaptation actions.” 179

**Hazardous Materials**

The severity of a hazardous materials release depends upon the type of material released, the amount of the release, and the proximity to populations or environmentally sensitive areas such as wetlands or waterways. The release of materials can lead to injuries or evacuation of nearby residents. Wind direction at the time of the release can also have a bearing on the severity (as well as the location and extent) of a hazardous materials release.

The primary threat from the hazardous materials incident hazard is to the structures located along transmission lines and transportation routes or near facilities that use or store hazardous materials. Minor incidents would likely cause no damage and little disruption, assuming they could be contained quickly. Major incidents could have fatal and disastrous consequences. The severity of a hazardous material release relates primarily to its impact on human safety and welfare and on the threat to the environment. Threats to human safety and welfare include:

- Poisoning of water or food sources and/or supply
- Presence of toxic fumes or explosive conditions
- Damage to personal property
- Need for the evacuation of people
- Interference with public or commercial transportation

Environmental risks are not uniformly distributed across groups of people. Age, poverty, and minority status place some groups at a disproportionately high risk for

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Poor access to health information and health care means less health promotion, less risk avoidance, a less healthy diet, and more adverse conditions that increase susceptibility to exposure. Delayed recognition of exposure, diagnosis, and treatment allows effects to accumulate.

**Power Outage/Public Safety Power Shutdowns (PSPS)**

Loss of power creates economic hardship to a region experiencing regular PSPS events, such as those experienced throughout the state over the recent years. Many businesses close, including gas stations, grocery stores, and local retail establishments. These impacts may deeply impact students dependent on support jobs, as well impacting family members of campus staff and faculty. PSPS increases risks to the public due to inability to use medical devices, spoilage of food and medicines, and disruption to infrastructure, such as supply of clean water and electricity used to run home medical equipment, such as lift chairs and ventilators.

**Wildfire**

Increased wildfire threat occurs especially in the end of fall, when conditions are driest, but before the winter rains have come; an east-to-west wind gusts exacerbate fire risk. Wildfire threats have the concomitant threat of Public Safety Power Shutoffs (PSPS). And, in the case of an actual wildfire, danger exists both from fire and from the smoke. Recent wildfires have demonstrated that some demographics are disproportionately affected. Native Americans are six times more likely to be affected than white people. Blacks and Hispanic people are 50 percent more vulnerable. These values take into account the likelihood of a community being affected and the greater difficulty of that community to recover. These statistics reflect the lack of access to resources to pay for insurance, to rebuild and recover, to implement fire safety measures, and to access other resources. Price gouging after a fire (such as documented in Sonoma County after the 2017 Tubbs Fire) further exacerbates the disparity. Furthermore, the disabled and the elderly are at particular risk from extreme wildfire conditions, as they are often not as able to effectively evacuate. Of the 85 people who died in the Camp Fire in Butte in 2018, 62 of them were at least 65 years old.

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180 https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3222496/


Smoke from wildfires creates a significant public health threat. Especially vulnerable are individuals who have heart or lung issues, such as heart disease, lung disease, or asthma. Those most vulnerable include the medically fragile, elderly, and children. Air Quality Indexes track the level of the following: particulate matter, surface levels of ozone, carbon monoxide, sulfur dioxide, and nitrogen dioxide. All of these can cause respiratory distress and harm lungs.

The California Department of Public Health reports the increased public health risks, and risk indicators that include: heat-related ED visits, populations living in wildfire areas, adults with multiple chronic conditions, populations living in poverty, race/ethnicity, outdoor workers, public transit access, air conditioner ownership, and tree canopy.

Hazard Mitigation and Emergency Management Planning

The goal of this high-level assessment is to provide a starting point to encourage further exploring campus social risks and vulnerabilities, as well as to inform and to enhance holistic emergency management and hazard mitigation decision making, planning processes, and future adaptive risk management strategies. By including the social resilience factors, mitigation investments may move beyond standardized planning and regulations, structure, and infrastructure projects, and natural systems protections to embrace a more expanded, customized emergency operations plan and an education and outreach program unique to the campus.

A more robust social resilience inquiry is strongly encouraged to develop an accurate picture, based on methodical and scientific research-based data. Such an effort would be envisioned through both nuanced discussions with a variety of campus stakeholders and the invitation of nontraditional stakeholders to join in a collaborative resilience partnership. Such a forward-leaning effort would be directly in keeping with CSU’s commitment to inclusion and equity in risk reduction.

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2 Retrieved on 07.19.2021 from https://www2.calstate.edu/csushystem/about-the-csu/facts-about-the-csu/enrollment/Pages/default.aspx


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Section 11
Humboldt State University

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11.1 University Profile

University History

Humboldt State University is a public institution of higher learning and part of the 23-campus California State University system. The University was founded in 1913 as a teacher’s college, and over the last 100 years, Humboldt State grew from an institute of higher education focused solely on teacher education to an accredited comprehensive university with extensive research facilities. CSU Humboldt has been known as Humboldt State University since 1974. Since 2013, Humboldt State has been designated as a Hispanic-Serving Institution (HSI).

University Governance

The campus president is the chief executive officer who oversees the administration of the entire university. The president manages campus operations and fundraising, sets campus priorities, and oversees the hiring and support of staff and faculty. The president also maintains a close working relationship with the CSU’s systemwide office, reporting to the chancellor and participating in the systemwide Executive Council.

The provost is the chief academic officer of the university, overseeing all academic affairs and programs of the university. The provost reports directly to the president.

The president and provost are directly supported by the Office of Academic Affairs Leadership Team, which advises and assists the Provost and Vice President of Academic Affairs in the determination of fund and personnel allocations and other administrative matters for the academic sector. Additionally, it serves as a channel of communication both to and from the faculty members in the various colleges. The Leadership Team consists of the University Provost and Vice-Provost, as well as Vice-Presidents, Deans, and Directors of various Humboldt State’s executive departments.

The president is also supported by three (3) Advisory Groups. They are: The Diversity, Equity and Inclusion Council (DEIC), the President’s Community Advisory Committee (PCAC), and the Native American Advisory Council.

The Diversity, Equity and Inclusion Council (DEIC) works in partnership with the Office of Diversity, Equity and Inclusion (ODEI) to provide advisory council and leverage expertise to create institutional and systemic change collectively. The DEIC assists the ODEI in making recommendations and raising awareness of ways to improve Humboldt State’s diversity, equity and inclusion efforts.

The President’s Community Advisory Committee (PCAC) members are appointed by the President to bring their professional perspectives to help inform decision making. Members provide important advice to help guide University priorities, community outreach and relations, governmental affairs, athletics, and other university matters. Membership is based on professional affiliation or leadership role, and members hold two-year staggered terms.
The Native American Advisory Council serves as a communication conduit and assists in developing mutually beneficial partnerships among Humboldt State University, the Native American community, and Tribal Nations. The Council provides perspectives and advice on the University’s collaborations with Native American communities, tribal nations, and tribal organizations in the region. Council members advise the President on matters of importance to Native communities as they relate to the University.

University Mission

The campus mission is, “Humboldt State University is a comprehensive, residential campus of the California State University. We welcome students from California and the world to our campus. We offer them access to affordable, high-quality education that is responsive to the needs of a fast-changing world. We serve them by providing a wide array of programs and activities that promote understanding of social, economic and environmental issues. We help individuals prepare to be responsible members of diverse societies.”

Humboldt State’s Values present 12 principles to reach its mission by focusing on providing the possible education relevant to today’s world, prioritizing teaching excellence, dynamic approach to cutting edge education, intellectual growth, debate and dialogue, responsible action, environmentally, economically and socially responsible in the quest for viable and sustainable communities. Additionally, curriculum is relevant, collaborative and responsive to our geographical location, learning from Native cultures, the unique ecosystem and special communities of the region, community involvement and inclusivity. The university is divided into three colleges: the College of Arts, Humanities, and Social Sciences; the College of Natural Resources and Sciences; and the College of Professional Studies. It offers 48 types of bachelor’s degrees, 12 different master’s degrees, 61 minors, and 13 credentialed programs.

University Location

Humboldt State University is located in Arcata, California (population 18,801), a coastal city in northern California’s Humboldt County (population 135,558). It is the northernmost campus of the CSU’s 23 campuses. The campus is situated on a hillside at the edge of a coast redwood forest, and has commanding views overlooking Arcata, much of Humboldt Bay, and the Pacific Ocean.

University Population

Humboldt State University typically exceeds 6,900 students with over 6,400 as undergrads. Humboldt State University offers 51 majors and 12 graduate programs in three Colleges. Humboldt State University employs 534 faculty members. White students make up 43% of Humboldt State University students, with Latino students making up the second most populous group at 34%.
11.2 Interim Final Rule for Hazard Vulnerability and Risk Assessment

Requirement §201.6(c)(2): The plan shall include a risk assessment that provides the factual basis for activities proposed in the strategy to reduce losses from identified hazards. Local risk assessments must provide sufficient information to enable the jurisdiction to identify and prioritize appropriate mitigation actions to reduce losses from identified hazards.

Requirement §201.6(c)(2)(i): [The risk assessment shall include a] description of the type...location and extent of all natural hazards that can affect the jurisdiction. The plan shall include information on previous occurrences of hazard events and on the probability of future hazard events.

Requirement §201.6(c)(2)(ii): [The risk assessment shall include a] description of the jurisdiction’s vulnerability to the hazards described in paragraph (c)(2)(i) of this section. This description shall include an overall summary of each hazard and its impact on the community.

Requirement §201.6(c)(2)(ii): [The risk assessment] must also address National Flood Insurance Program (NFIP) insured structures that have been repetitively damaged floods.

Requirement §201.6(c)(2)(ii)(A): The plan should describe vulnerability in terms of the types and numbers of existing and future buildings, infrastructure, and critical facilities located in the identified hazard area.

Requirement §201.6(c)(2)(ii)(B): [The plan should describe vulnerability in terms of an] estimate of the potential dollar losses to vulnerable structures identified in paragraph (c)(2)(ii)(A) of this section and a description of the methodology used to prepare the estimate..

Requirement §201.6(c)(2)(ii)(C): [The plan should describe vulnerability in terms of] providing a general description of land uses and development trends within the community so that mitigation options can be considered in future land use decisions.

Requirement §201.6(c)(2)(iii): For multi-jurisdictional plans, the risk assessment must assess each jurisdiction’s risks where they vary from the risks facing the entire planning area.

11.3 Hazard Identification and Risk Assessment

Overview of Humboldt State University History of Hazards

Numerous federal agencies maintain a variety of records regarding losses associated with hazards. Unfortunately, no single source is considered to offer a definitive
accounting of all losses. The Federal Emergency Management Agency (FEMA) maintains records on federal expenditures associated with declared major disasters. The US Army Corps of Engineers (USACE) and the Natural Resources Conservation Service (NRCS) collect data on losses during the course of some of their ongoing projects and studies. Additionally, the National Oceanic and Atmospheric Administration’s (NOAA) National Centers for Environmental Information (NCEI) database collects and maintains data about natural hazards in summary format. The data includes occurrences, dates, injuries, deaths, and estimated costs. Many of these databases and other data collection services, including the NCEI, have inherent data limitations when searching for information at a university scale.

The best available data and records were used throughout this assessment.

Hazard Identification

As part of the initial hazard identification process, the Campus Assessment Team considered potential hazards with the most chance to significantly affect the planning area. The hazards include those that have occurred in the past and may occur in the future. A variety of sources were used to develop the list of hazards considered including national, regional, and local sources such as emergency operations plans, FEMA’s *How-To Series*, websites, published documents, databases, and maps, as well as discussion among the Campus Assessment Team members.

In the initial phase of the planning process, the Campus Assessment Team considered XX hazards and the risks they create for the University and its material assets, population, and operations. The hazards initially considered, and the determinations as to the treatment of those hazards, are shown in Table 11-1 (following).

Table 11-1: Hazard Identification Determinations

<table>
<thead>
<tr>
<th>Hazard</th>
<th>Determination (Yes/No)</th>
<th>Reason for Determination</th>
<th>Future Occurrence Probability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Communicable Disease</td>
<td>Yes</td>
<td>Hazard of concern for campus</td>
<td>Highly Likely</td>
</tr>
<tr>
<td>Dam and Levee Failure</td>
<td>Yes</td>
<td>Hazard of concern for campus</td>
<td>Unlikely</td>
</tr>
<tr>
<td>Drought</td>
<td>Yes</td>
<td>Hazard of concern for campus</td>
<td>Highly Likely</td>
</tr>
<tr>
<td>Earthquake</td>
<td>Yes</td>
<td>Hazard of concern for campus</td>
<td>Possible</td>
</tr>
<tr>
<td>Erosion</td>
<td>Yes</td>
<td>Hazard of concern for campus</td>
<td>Highly Likely</td>
</tr>
<tr>
<td>Extreme Temperature</td>
<td>Yes</td>
<td>Not a hazard of concern for campus</td>
<td>Unlikely (Heat); Unlikely Cold)</td>
</tr>
<tr>
<td>Hazard Type</td>
<td>Yes</td>
<td>Hazard of concern for campus</td>
<td>Probability</td>
</tr>
<tr>
<td>---------------------</td>
<td>-----</td>
<td>-------------------------------</td>
<td>----------------</td>
</tr>
<tr>
<td>Flood</td>
<td></td>
<td></td>
<td>Possible</td>
</tr>
<tr>
<td>Hazardous Materials</td>
<td>Yes</td>
<td></td>
<td>Possible</td>
</tr>
<tr>
<td>Landslide</td>
<td>Yes</td>
<td></td>
<td>Possible</td>
</tr>
<tr>
<td>Power Outage</td>
<td>Yes</td>
<td></td>
<td>Likely</td>
</tr>
<tr>
<td>Sea Level Rise</td>
<td>Yes</td>
<td>Hazard of concern for campus</td>
<td>Highly Likely</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(profile found in System-Wide</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>HVRA)</td>
<td></td>
</tr>
<tr>
<td>Tsunami</td>
<td>Yes</td>
<td></td>
<td>Likely</td>
</tr>
<tr>
<td>Volcano</td>
<td>Yes</td>
<td></td>
<td>Unlikely</td>
</tr>
<tr>
<td>Wildfire</td>
<td>Yes</td>
<td></td>
<td>Unlikely (Fire); Possible (Smoke)</td>
</tr>
</tbody>
</table>

**Future Occurrence Probability**

In order to determine the probability of future occurrences of each hazard profiled, the following scale was developed:

- **Highly Likely**- 76%-100% that the hazard would occur annually.
- **Likely**- 50%-75% that the hazard would occur annually.
- **Possible**- 11%-49% that the hazard would occur each annually.
- **Unlikely**- 0%-10% that the hazard would occur each annually.
Communicable Disease

Description of the Hazard

Communicable diseases are illnesses that occur due to infectious agents or their toxic products and are infectious due to their potential of transmission from one person or species to another by a replicating agent.¹ They may be transmitted from a reservoir to a susceptible host either directly as from an infected person or animal or indirectly through the agency of an intermediate plant or animal host, vector, or the inanimate environment. Communicable diseases are clinically evident illness resulting from the presence of pathogenic microbial agents, including pathogenic viruses, pathogenic bacteria, fungi, protozoa, multi-cellular parasites, and aberrant proteins known as prions.² The degree of spread of a communicable disease depends on both the ability of an organism to enter, survive and multiply in the host and the comparative ease with which the disease is transmitted to other hosts.³

Some ways in which communicable diseases spread are by:

- Travel through the air, such as tuberculosis, measles, or COVID-19;
- Physical contact with an infected person, such as through touch (staphylococcus), sexual intercourse (gonorrhea, HIV), fecal/oral transmission (hepatitis A), or droplets (influenza, TB, COVID-19);
- Contact with a contaminated surface or object (Norwalk virus), food (salmonella, E. coli), blood (HIV, hepatitis B), or water (cholera); and
- Bites from insects or animals capable of transmitting the disease (mosquito: malaria and yellow fever; flea: plague)⁴

Collectively, the twenty-three (23) campuses and Chancellor’s Office of the California State University (CSU) system have identified nine (9) communicable disease hazards that have had significant impacts on their respective student, faculty, and staff populations. Of these communicable diseases, COVID-19 is considered to be the most prominent and widespread agent across all CSU campuses. (See Table 11-2 below.)


Table 11-2: Communicable Diseases Identified CSU Campuses.

<table>
<thead>
<tr>
<th>Collective List of Communicable Diseases Identified by All CSU Campuses</th>
<th>Number of CSU Campuses (Including Chancellor’s Office) Identifying Communicable Disease Having Significant Impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>COVID-19 (SARS-CoV-2)</td>
<td>24</td>
</tr>
<tr>
<td>Meningitis</td>
<td>7</td>
</tr>
<tr>
<td>Measles</td>
<td>6</td>
</tr>
<tr>
<td>Influenza (Including H1N1/Swine Flu)</td>
<td>6</td>
</tr>
<tr>
<td>Tuberculosis</td>
<td>5</td>
</tr>
<tr>
<td>Norovirus</td>
<td>4</td>
</tr>
<tr>
<td>Mumps</td>
<td>2</td>
</tr>
<tr>
<td>E. Coli</td>
<td>2</td>
</tr>
<tr>
<td>Sexually Transmitted Diseases (STDs)</td>
<td>2</td>
</tr>
</tbody>
</table>

(Source: Interviews with CSU campus staff at CSU campuses and at CSU Chancellor’s Office.)

With the exception of COVID-19, there is variability among CSU campuses regarding which communicable diseases have had the greatest impact on individual campus communities. Table 11-3 shows the communicable disease hazards that have had the greatest impact on each CSU campus.
Table 3: Communicable Disease Hazards at CSU Campuses with Greatest Impact.

<table>
<thead>
<tr>
<th>CSU Campus</th>
<th>Identified Communicable Disease Hazards with the Greatest Impact on CSU Campus</th>
</tr>
</thead>
<tbody>
<tr>
<td>CSU Bakersfield</td>
<td>COVID-19, Meningitis</td>
</tr>
<tr>
<td>CSU Channel Islands</td>
<td>COVID-19, Measles</td>
</tr>
<tr>
<td>Chico State</td>
<td>COVID-19, Tuberculosis</td>
</tr>
<tr>
<td>CSU Dominguez Hills</td>
<td>COVID-19</td>
</tr>
<tr>
<td>Cal State East Bay</td>
<td>COVID-19, Meningitis</td>
</tr>
<tr>
<td>Fresno State</td>
<td>COVID-19, Meningitis, Tuberculosis</td>
</tr>
<tr>
<td>Cal State Fullerton</td>
<td>COVID-19, Influenza</td>
</tr>
<tr>
<td>Humboldt State</td>
<td>COVID-19, Measles, Norovirus, Influenza, STDs</td>
</tr>
<tr>
<td>Cal State Long Beach</td>
<td>COVID-19</td>
</tr>
<tr>
<td>Cal State LA</td>
<td>COVID-19, E. coli, Measles</td>
</tr>
<tr>
<td>Cal Maritime</td>
<td>COVID-19</td>
</tr>
<tr>
<td>CSU Monterey Bay</td>
<td>COVID-19</td>
</tr>
<tr>
<td>CSUN (Northridge)</td>
<td>COVID-19, Measles</td>
</tr>
<tr>
<td>Cal Poly Pomona</td>
<td>COVID-19, Influenza (Swine Flu - H1N1)</td>
</tr>
<tr>
<td>Sacramento State</td>
<td>COVID-19</td>
</tr>
<tr>
<td>Cal State San Bernardino</td>
<td>COVID-19, Tuberculosis</td>
</tr>
<tr>
<td>San Diego State</td>
<td>COVID-19, Meningitis, Mumps</td>
</tr>
<tr>
<td>San Francisco State</td>
<td>COVID-19</td>
</tr>
<tr>
<td>San José State</td>
<td>COVID-19, H1N1</td>
</tr>
<tr>
<td>Cal Poly San Luis Obispo</td>
<td>COVID-19, Meningitis, Norovirus</td>
</tr>
<tr>
<td>CSU San Marcos</td>
<td>COVID-19</td>
</tr>
<tr>
<td>Sonoma State</td>
<td>COVID-19, H1N1, Norovirus</td>
</tr>
<tr>
<td>Stanislaus State</td>
<td>COVID-19, Tuberculosis</td>
</tr>
<tr>
<td>Office of the Chancellor</td>
<td>COVID-19</td>
</tr>
<tr>
<td>CSU System-Wide</td>
<td>COVID-19, Meningitis, Measles, Tuberculosis, Influenza-Swine Flu-H1N1, Mumps, Norovirus, E. coli, STDs</td>
</tr>
</tbody>
</table>

(Source: Interviews with CSU campus staff at CSU campuses and at CSU Chancellor’s Office.)
Descriptions of Identified Communicable Disease Hazards at Humboldt State

Humboldt State has identified five (5) communicable disease hazards that have had the greatest impact on campus – COVID, Measles, Norovirus, Influenza, and STDs. The following are brief descriptions of the communicable disease hazards at Humboldt State.

COVID-19 (SARS-CoV-2)

Coronaviruses are a family of viruses that can cause illnesses such as the common cold, severe acute respiratory syndrome (SARS) and Middle East respiratory syndrome (MERS). In 2019, a new coronavirus was identified as the cause of a disease outbreak that originated in China. This virus is now known as the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2). The disease it causes is called Coronavirus Disease 2019 (COVID-19). In March 2020, the World Health Organization (WHO) declared the COVID-19 outbreak a pandemic.

Signs and symptoms of coronavirus disease 2019 (i.e., COVID-19) may appear two to 14 days after exposure. Common signs and symptoms can include fever, cough, and tiredness. Early symptoms of COVID-19 may also include a loss of taste or smell.

The virus that causes COVID-19 spreads easily among people, and more continues to be discovered over time about how it spreads. Data has shown that the COVID-19 virus spreads mainly from person to person among those in close contact (within about 6 feet, or 2 meters). The virus is transmitted by respiratory droplets being released when someone with the virus coughs, sneezes, breathes, sings or talks. These droplets can be inhaled or land in the mouth, nose or eyes of a person nearby. In some situations, the COVID-19 virus can spread by a person being exposed to small droplets or aerosols that stay in the air for several minutes or hours (i.e., airborne transmission). It’s not yet known how common it is for the virus to spread this way. The COVID-19 virus can also spread if a person touches a surface or object with the virus on it and then touches his or her mouth, nose or eyes; however, this is not considered to be a main way it spreads.

The severity of COVID-19 symptoms can range from very mild to severe. Some people may have only a few symptoms, and some people may have no symptoms at all. However, some people may experience worsened symptoms, such as worsened shortness of breath and pneumonia. People who are older have a higher risk of serious illness from COVID-19, and the risk increases with age. People who have existing medical conditions also may have a higher risk of serious illness from COVID-19. In some cases, the disease can cause severe medical complications and may even lead to death. 5

Meningitis

Meningitis is an inflammation of the fluid and membranes (meninges) surrounding the brain and spinal cord. The swelling from meningitis typically triggers signs and symptoms such as headache, fever and a stiff neck. Early meningitis symptoms may mimic the flu (influenza). Symptoms may develop over several hours or over a few days.

Most cases of meningitis in the United States are caused by a viral infection, but bacterial, parasitic and fungal infections are other causes. Some cases of meningitis improve without treatment in a few weeks. Others can be life-threatening and require emergency antibiotic treatment. Bacterial meningitis is particularly serious and can be fatal within days without prompt antibiotic treatment. Delayed treatment also increases the risk of permanent brain damage or death.6

Measles

Measles (also known as rubeola) is a highly contagious childhood infection caused by a virus. The measles virus replicates in the nose and throat of an infected child or adult. Then, when someone with measles coughs, sneezes or talks, infected droplets spray into the air, where other people can inhale them. The infected droplets may also land on a surface, where they remain active and contagious for several hours. The virus is contracted by putting touching one’s nose, mouth, or eyes after touching the infected surface.

Measles can be serious and even fatal for small children. The disease still kills more than 100,000 people a year worldwide, most under the age of 5. However, as a result of high vaccination rates in general, measles hasn’t been widespread in the United States for more than a decade. 7

Influenza (Including sub-type H1N1/Swine Flu)

Influenza is a viral infection that attacks the respiratory system (i.e., nose, throat, and lungs). Influenza viruses travel through the air in droplets when someone with the infection coughs, sneezes or talks. Influenza is transmitted either by inhaling virus-laden droplets directly, or by coming into physical contact with an object (e.g., telephone or computer keyboard) and then transferring the virus to the eyes, nose or mouth. People with the virus are likely contagious from about a day before symptoms appear until about five days after symptoms begin.

Common signs and symptoms of the flu include: fever, aching muscles, hills and sweats, headache, dry and persistent cough, shortness of breath, tiredness and  


weakness, runny or stuffy nose, sore throat, and eye pain. (Vomiting and diarrhea are also influenza signs and symptoms, but these are more common in children than in adults.)

Influenza viruses are constantly changing, with new strains appearing regularly. As a result, antibodies against influenza viruses that have been encountered in the past may not offer protection from new influenza strains, as the new strains can be very different viruses from previous strains. 8

H1N1 Flu (Swine Flu)

The H1N1 flu, commonly known as swine flu, is a type of influenza A virus and is one of several flu viruses strains that can cause the seasonal flu. It is primarily caused by the H1N1 strain of the flu (influenza) virus. Symptoms of the H1N1 flu are the same as those of the seasonal flu.

The H1N1 virus is a combination of viruses from pigs, birds and humans that causes disease in humans. The virus enters your body when you inhale contaminated droplets or transfer live virus from a contaminated surface to your eyes, nose or mouth. It then infects the cells that line your nose, throat and lungs. 9

Tuberculosis

Tuberculosis (TB) is a potentially serious infectious disease that mainly affects the lungs. Tuberculosis is caused by bacteria that spread from person to person through microscopic droplets released into the air. This can happen when someone with the untreated, active form of tuberculosis coughs, speaks, sneezes, spits, laughs or sings.

Although tuberculosis is contagious, it's not easy to catch. It is more likely for someone to get tuberculosis from a close family member or coworker than from a stranger. Most people with active TB who have had appropriate drug treatment for at least two weeks are no longer contagious.

Many strains of tuberculosis resist the drugs most used to treat the disease. People with active tuberculosis must take several types of medications for many months to eradicate the infection and prevent development of antibiotic resistance.10

Norovirus

Norovirus is a highly contagious virus commonly spread through food or water that is contaminated by fecal material during food preparation or by contaminated surfaces.


Specifically, this virus can be transmitted through: consuming contaminated food, drinking contaminated water, and touching one’s hand to one’s mouth after the hand has been in contact with a contaminated surface or object.

Norovirus can also be transmitted through close contact with an infected person.

Norovirus infections occur most frequently in closed and crowded environments such as hospitals, nursing homes, child care centers, schools and cruise ships. Noroviruses are difficult to kill off because they can withstand hot and cold temperatures and most disinfectants.

Symptoms such as diarrhea, stomach pain and vomiting typically begin 12 to 48 hours after exposure, and usually last one to three days. Most people recover from norovirus completely without treatment. However, for some people — especially infants, older adults and people with underlying disease — vomiting and diarrhea can be severely dehydrating and require medical attention. 11

Mumps

Mumps is a viral infection that primarily affects saliva-producing (salivary) glands that are located near the ears. Mumps can cause swelling in one or both of these glands, and is contracted by breathing in saliva droplets from an infected person who has just sneezed or coughed. Mumps can also be contracted from sharing utensils or cups with someone who has mumps.

Complications of mumps, such as hearing loss, are potentially serious but rare. There’s no specific treatment for mumps.

Mumps outbreaks far less common than they used to be, but can affect people who aren’t vaccinated – especially in close-contact settings such as schools or college campuses.12

E. Coli

Escherichia coli (E. coli) bacteria normally live in the intestines of healthy people and animals. Most types of E. coli are harmless or cause relatively brief diarrhea. But a few strains, such as E. coli O157:H7, can cause severe stomach cramps, bloody diarrhea and vomiting. The E. coli O157:H7 strain belongs to a group of E. coli that produces a powerful toxin that damages the lining of the small intestine. Potential sources of exposure to E. coli O157:H7 include contaminated food or water – especially raw vegetables and undercooked ground beef – and person-to-person contact.


Signs and symptoms of E. coli O157:H7 include diarrhea (which may range from mild and watery to severe and bloody), stomach cramping, pain or tenderness, and nausea and vomiting. Infection can occur anytime from one day to one week after exposure to the bacteria, but usually begin three or four days after exposure.13

**Sexually Transmitted Diseases (STDs)**

Sexually transmitted diseases (STDs) are generally acquired by sexual contact. STDs can be caused by: bacteria (gonorrhea, syphilis, chlamydia), parasites (trichomoniasis), or viruses (human papillomavirus, genital herpes, HIV). The organisms (bacteria, viruses or parasites) that cause STDs may pass from person to person in blood, semen, or vaginal and other bodily fluids. Sometimes STDs can be transmitted non-sexually, such as from mother to infant during pregnancy or childbirth, or through blood transfusions or shared needles.

STDs can have a range of signs and symptoms, including: sores or bumps on the genitals or in the oral or rectal area, painful or burning urination, pain during sex, soreness or discharge in genital areas, sore, swollen lymph nodes, particularly in the groin but sometimes more widespread, fever, lower abdominal pain, or rash over the trunk, hands or feet. Signs and symptoms may appear a few days after exposure, or it may take years before any noticeable problems occur, depending on the organism. STDs don’t always cause symptoms, and may go unnoticed until complications occur or a partner is diagnosed.14

**Location of the Hazard**

Communicable diseases have the potential to affect the entire Humboldt State planning area equally. As a result, the communicable disease hazard can be found at the Humboldt State University campus located in Arcata, CA (Humboldt County). Because of the ubiquitous nature of many communicable diseases, students, faculty, staff at (and visitors to) Humboldt State are at risk of exposure to the communicable disease hazard. 15

**CSU Student Housing Locations and Populations**

Although CSU-campus-owned student housing opportunities have been severely limited due to the COVID-19 pandemic, this situation is temporary. Eventually, students will be allowed back on campus at full capacity, and many of these students will be living in campus-owned housing. When this occurs, over 53,000 students (i.e.,

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15 California State University. About CSU. Retrieved 04.30.2021 from: https://www2.calstate.edu/csu-system/about-the-csu;
just over 11% of the CSU total enrollment) will be at increased risk of exposure to communicable disease hazards, owing to the “close-quarters” living arrangements in student housing. For Humboldt State, approximately 9% of its 6,983 enrolled students or 628 students reside in student housing. Table 11-4 shows the number of students that were living in CSU-campus-owned housing in Fall, 2019, prior to the COVID-19 pandemic.

Extent of the Hazard

Various communicable diseases are categorized by the Center for Disease Control and Prevention (CDC) by levels of containment called Biosafety Levels (or BSLs). The higher the BSL, the greater the level of containment and level of effort necessary to prevent transmission of the disease, and therefore the greater the hazard. Biosafety Levels prescribe procedures and levels of containment for a particular microorganism or material (including research involving recombinant or synthetic nucleic acid molecules) and procedures associated with that containment. BSLs also consider primary barriers (e.g., biosafety cabinets), secondary barriers, facility design, air handling, laboratory security, etc. BSLs are graded from 1 to 4; as the BSL increases so does the relative risk of the agent/procedures as well the stringency of procedures and facility design.

Figure 11-1 describes the different BSLs, and provides examples of communicable diseases that would typically fall in to these classifications, as well as the typical protections that would be necessary to prevent transmission of each of the diseases.

17 California State University. CSU Campus Match. Retrieved 04.30.2021 from: https://www2.calstate.edu/attend/campuses/campus-match/Pages/campus-match.aspx
The Extent of Humboldt State Communicable Disease Hazards Except COVID-19:

Before the COVID-19 pandemic, there were cases of Measles, Norovirus, Influenza, STDs at Humboldt State. Measles would be classified at the BSL-2 containment level, Norovirus would be classified at the BSL-2 containment level, Influenza would be classified at the BSL-2 or BSL-3 containment level (depending on the strain), and STDs would be classified at either the BSL-2 or BSL-3 containment level (depending on the STD). 19

The Extent of Humboldt State COVID-19 Communicable Disease Hazard:

As a microorganism, the SARS-CoV-2 (COVID-19) virus requires a high level of containment. It is therefore classified at BSL-3. 20

History of the Hazard

Over an approximately one-year period, from mid-March, 2020 to March 23, 2021, there were a reported 108 cases of COVID-19 at Humboldt State. CSU-campus-specific

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COVID-19 case data for Humboldt State can be found in the “History of the Hazard” section below.

Most communicable disease data are maintained by at the state and at the county levels and are not generally available at the municipal or campus levels, unless (a) the CSU campus falls under the jurisdiction of a city-level health department, or (b) a geographically specific outbreak occurs on campus or in the local community. The exception to this is the current COVID-19 pandemic, where both campus and County-level case data have been collected. As a result, it is important to provide COVID-19 case statistics for both CSU campuses and the counties where CSU campus assets are located.

Tables 11-5 and 11-6 show campus-level and county-level COVID-19 case data for Humboldt State. These case data are updated on at least a weekly basis. (Please note that the COVID-19 case numbers here may not reflect the most recent updates.)

Table 11-4: Humboldt State COVID-19 Case Data (as of (03/19/2021)21

<table>
<thead>
<tr>
<th></th>
<th>Active Cases</th>
<th>Recovered Cases</th>
<th>Number of Test Results</th>
<th>Positivity Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>HSU Students</td>
<td>2</td>
<td>96</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>HSU Employees</td>
<td>0</td>
<td>10</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Humboldt County</td>
<td>100</td>
<td>3,284</td>
<td>78,531</td>
<td>4.33%</td>
</tr>
</tbody>
</table>

**HSU Students**: These results are for students (on- and off-campus residents and athletes) who were tested at HSU’s Student Health Center only. Figures do not include results of tests conducted by a private lab, and may not reflect the total number of affected students.

**HSU Employees**: Humboldt County Public Health will only notify HSU if an employee has tested positive for COVID-19 and had contacts with the campus community that could have led to transmission. HSU will report when we are notified of positive cases in employees, but this may not reflect a total number of affected employees.

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Table 11-5: Humboldt County COVID-19 Case Data (as of 03/19/2021):22

<table>
<thead>
<tr>
<th>Cases</th>
<th>3,419</th>
</tr>
</thead>
<tbody>
<tr>
<td>Deaths</td>
<td>35</td>
</tr>
</tbody>
</table>

Potential Impacts of the Hazard

Communicable disease outbreaks and pandemics potentially have (and will continue to have) direct impact on life, health, and safety across the CSU system, including Humboldt State. The extent of this impact is contingent on the type of infection or contagion, the severity of the outbreak, and the speed at which it is transmitted. Property and infrastructure integrity may be affected if large portions of the campus population contract communicable diseases at the same time and are therefore unable to perform maintenance, operations, and educational tasks. This would be particularly disruptive if those impacted are first responders or other essential personnel. Long-term outbreaks affecting large numbers of Humboldt State students could result in cancelled classes, delayed matriculation, or other disruptions to the CSU System’s mission. This has already occurred with the current COVID-19 pandemic and could occur again with more virulent strains of communicable diseases, including COVID-19.

Communicable disease hazards found across the CSU system (including Humboldt State) vary both by level of containment (BSL) (described previously) and by level of individual/public health risk, or Risk Group (RG) level. While BSLs describe the procedures and required levels of containment in a laboratory setting, Risk Groups (RGs) reflect the potential effects of disease exposure on humans or animals. Like BSLs, RGs range from Level 1 (RG1) to Level 4 (RG4), with Level 1 (RG1) posing minimal risk to healthy individuals and public health and Level 4 (RG4) posing a very serious or extreme risks to individuals and public. BSLs generally correlate with Risk Group (RG) Levels (e.g., a RG2 agent is worked with at BSL-2), but there are exceptions (e.g., production volumes, high-risk procedures, etc.).23

The World Health Organization’s (WHO) Laboratory Biosafety Manual, 3rd ed., NIH Guidelines, categorizes Risk Groups (RGs) in the following way:

22 Humboldt County Health. Retrieved on 03.19.2021

Table 11-6: WHO Risk Group Characterization

<table>
<thead>
<tr>
<th>Risk Group (RG)</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>RG1</td>
<td>Rarely associated with disease in healthy adult humans or animals and pose no-to-little public health risk (e.g., Saccharomyces cerevisiae, E. coli K-12 strain derivatives often used for recombinant/molecular biology, many environmental organisms)</td>
</tr>
<tr>
<td>RG2</td>
<td>Associated with mild to moderate disease for which preventative measures or post exposure treatments are often available; public health impact is limited (e.g., Streptococcus pyogenes, Salmonella, hepatitis B virus)</td>
</tr>
<tr>
<td>RG3</td>
<td>Associated with serious to lethal human disease for which preventative vaccines or post-exposure therapies may be scarce. Public health impact is limited-to-moderate (e.g., Mycobacterium tuberculosis, hantaviruses, West Nile virus, SARS)</td>
</tr>
<tr>
<td>RG4</td>
<td>Associated with serious to lethal human disease for which preventative vaccines or post exposure therapies are not usually available. Public health impact is high (e.g., Ebola virus, Marburg virus, smallpox virus, etc.)</td>
</tr>
</tbody>
</table>

Table 11-8 describes the four (4) Risk Group Levels (RGs), and provides examples of communicable diseases that would typically fall into these classifications, and the typical protections that would be necessary to prevent transmission of the disease. It is important to note that all but two (2) communicable disease hazards identified by CSU campuses fall under either the lower-risk RG1 or RG2 categories. COVID-19 and tuberculosis are the two (2) communicable diseases fall under the higher-risk RG3 category. However, with the advent of the recently-developed COVID-19 vaccine, and with the expectation of an increasingly robust vaccine supply, it is possible that the RG level for COVID-19 could be lowered in the future, thereby reducing both the extent and the potential impact of COVID-19.

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### Table 11-7: Risk Group Levels (RGs) with Example Diseases and Recommended Precautions

<table>
<thead>
<tr>
<th>Level</th>
<th>Examples</th>
<th>Typical Protection to Prevent Transmission</th>
</tr>
</thead>
<tbody>
<tr>
<td>RG 1</td>
<td>E. Coli</td>
<td>Precautions are minimal, most likely involving gloves and some sort of facial protection. Usually, contaminated materials are left in open (but separately indicated) waste receptacles. Decontamination procedures for this level are similar in most respects to modern precautions against everyday viruses (i.e.: washing one's hands with anti-bacterial soap, washing all exposed surfaces of the lab with disinfectants, etc.).</td>
</tr>
<tr>
<td>RG 2</td>
<td>Chicken Pox, Hepatitis A, B, C, Lyme disease, Salmonella, Mumps, Measles, Malaria, Scrapie, Dengue Fever, HIV</td>
<td>These bacteria and viruses cause mild disease in humans or are difficult to contract via aerosol. Routine diagnostic work with clinical specimens can be done safely at BSL-2, using BSL-2 practices and procedures.</td>
</tr>
</tbody>
</table>

---

These bacteria and viruses cause severe to fatal disease in human, but vaccines or other treatments do exist to combat them. Laboratory personnel have specific training in handling pathogenic and potentially lethal agents and are supervised by competent scientists who are experienced in working with these agents. This is considered a neutral or warm zone.

These viruses and bacteria cause severe to fatal disease in humans, for which vaccines or other treatments are not available. When dealing with biological hazards at this level the use of a Hazmat suit and a self-contained oxygen supply is mandatory. The entrance and exit of a BSL-4 lab will contain multiple showers, a vacuum room, an ultraviolet light room, autonomous detection system, and other safety precautions designed to destroy all traces of the biohazard. Multiple airlocks are employed and are electronically secured to prevent both doors opening at the same time. All air and water service going to and coming from a BSL-4 lab will undergo similar decontamination procedures to eliminate the possibility of an accidental release.

**Probability of Future Occurrence of the Hazard**

There are significant data limitations regarding non-COVID-19 communicable disease cases, as the information thereof is outdated, anecdotal, and/or inadequate. As a result, it is not feasible to provide quantitative probabilities of future occurrence for non-COVID-19 communicable disease hazards. However, based on the limited data, it is feasible to present qualitative probabilities of future occurrence based on ranges of communicable disease frequency.

Table 11-9 shows a probability scale of future occurrence for the nine (9) communicable disease hazards profiled in this assessment. This scale is divided into four (4) levels of probability:
Table 11-8: Likelihood of Future Hazard Occurrence

<table>
<thead>
<tr>
<th>Likelihood</th>
<th>Parameters for Determining Likelihood</th>
</tr>
</thead>
<tbody>
<tr>
<td>Highly Likely</td>
<td>76 – 100% probability that hazard will occur annually (high to very high frequency)</td>
</tr>
<tr>
<td>Likely</td>
<td>50 – 75% probability that hazard will occur annually (moderate to high frequency)</td>
</tr>
<tr>
<td>Possible</td>
<td>11 – 49% probability that hazard will occur annually (low to moderate frequency)</td>
</tr>
<tr>
<td>Unlikely</td>
<td>0 – 10% probability that hazard will occur annually (very low to low frequency)</td>
</tr>
</tbody>
</table>

Due to significant data limitations surrounding non-COVID communicable diseases, the probability of future occurrence of CSU-system-wide communicable disease is measured by the proportion of campuses that have identified a particular communicable disease as having an impact on the campus community. In this measure, the more frequent a communicable disease is seen as impactful CSU-wide, the greater the probability of future occurrence.

Note: Each communicable disease’s system-wide probability ranking (below) reflects the ranking at the individual CSU campus level unless noted otherwise.

Table 11-9: Probability of Future Occurrence of Communicable Disease Hazard for CSU System

<table>
<thead>
<tr>
<th>Collective List of Communicable Diseases Identified by All CSU Campuses</th>
<th>Number of CSU Campuses (Including Chancellor’s Office) Identifying Communicable Disease Having Significant Impact</th>
<th>Proportion of CSU Campuses Identifying Communicable Disease as Having Significant Impact System-Wide</th>
<th>CSU System-Wide Probability Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>COVID-19 (SARS-CoV-2)</td>
<td>24</td>
<td>1.00</td>
<td>Highly Likely</td>
</tr>
<tr>
<td>Meningitis</td>
<td>7</td>
<td>0.29</td>
<td>Possible</td>
</tr>
<tr>
<td>Measles</td>
<td>6</td>
<td>0.25</td>
<td>Possible</td>
</tr>
<tr>
<td>Influenza (Including H1N1/Swine Flu)</td>
<td>6</td>
<td>0.25</td>
<td>Possible</td>
</tr>
</tbody>
</table>
### Vulnerability to the Hazard

Vulnerability to a communicable diseases hazard resides in the population of a given area – both human and animal – not in the infrastructure or physical assets. While CSU assets and infrastructure could be impacted indirectly by the communicable disease hazard, these impacts would be secondary to the impact that the communicable disease hazard would have on students, faculty, staff, and visitors at Humboldt State campus.

CSU campus settings are geographically diverse, with locations ranging from small towns to medium-sized cities to densely populated urban areas. Hundreds of thousands of people work, study, and/or pass through CSU campuses on any given day. As of Fall 2019, Humboldt State University had 6,983 students as well as additional faculty and staff. Each of these persons is vulnerable to communicable disease, particularly if it is a pathogen that individual has not been immunized against, or for which no immunization exists. Prolonged outbreaks could result in a loss of services, failure of infrastructure (from lack of operators or maintenance), and closure of facilities. This exact scenario has played out to some degree in the current COVID-19 pandemic on the campus.

### Estimate of Potential Losses

#### COVID-19 Pandemic Health Impact on CSU Campuses and Surrounding Communities

The most prescient metric for estimating losses from COVID-19 is loss of life. The nationwide campus-related COVID-19 death rate of 0.02% remains well below the average COVID-19 death rate in the U.S. However, due to data limitations, there is no information on CSU-campus-specific deaths by COVID-19 or by any other

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communicable diseases. In fact, COVID-19 is the only communicable disease for which case reports have been readily available for CSU campuses.

At some point in the future, CSU campuses will return to full capacity. Without adequate surveillance regarding campus access and student and employee interaction, CSU campuses (including Humboldt State) are at risk of developing an extreme incidence of COVID-19 and may become “super-spreaders” for adjacent communities. The emergence of more virulent COVID-19 variants would only add to the potential for high negative impacts on life safety, operations, and service delivery across the CSU system. (Other communicable diseases would also re-emerge, but with low to moderate negative impacts on life safety, operations, and service delivery.)

**Economic Impact of COVID-19 Pandemic on CSU Financial Health**

During the first few months of the COVID-19 pandemic in 2020, the CSU system suffered tremendous negative fiscal impacts. From March through July of 2020 alone, over $146 million worth of revenue losses were sustained across the CSU system due to refunds to students for parking, housing and dining service fees during Spring Semester, 2020. Several CSU campuses saw refund losses surpass $10 million. (See Figure 11-2 below for the economic impact to Humboldt State)

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Mitigative Relief from Federal Assistance

The $1.5 billion in total federal assistance sent to the CSU system will help relieve the losses of revenues from services like dorms, parking and dining services during a year of mainly empty campuses. (See Table CD.10) However, because of staggering COVID-related revenue losses, the CSU system is planning for three (3) years of fiscal duress.

<table>
<thead>
<tr>
<th>Institution</th>
<th>December 2020 Stimulus</th>
<th>CARES Act</th>
<th>APLU Projection of HEERF Total ARP Act Funding Allocation</th>
<th>Total Estimated Federal COVID Relief Funding</th>
</tr>
</thead>
<tbody>
<tr>
<td>California Polytechnic State University</td>
<td>$20,752,799</td>
<td>$14,725,000</td>
<td>$37,000,928</td>
<td>$72,478,727</td>
</tr>
<tr>
<td>California State Polytechnic University, Pomona</td>
<td>$48,614,353</td>
<td>$31,102,000</td>
<td>$86,044,649</td>
<td>$165,761,002</td>
</tr>
<tr>
<td>California State University Channel Islands</td>
<td>$14,288,099</td>
<td>$8,512,000</td>
<td>$24,915,170</td>
<td>$47,715,269</td>
</tr>
<tr>
<td>California State University Maritime Academy</td>
<td>$1,381,700</td>
<td>$1,204,000</td>
<td>$2,472,622</td>
<td>$5,058,322</td>
</tr>
<tr>
<td>California State University - Sacramento</td>
<td>$59,891,260</td>
<td>$35,643,000</td>
<td>$104,900,133</td>
<td>$200,434,393</td>
</tr>
</tbody>
</table>


<p>| California State University, Bakersfield | $22,855,632 | $12,483,000 | $40,285,565 | $75,624,197 |
| California State University, Chico | $31,603,856 | $20,019,000 | $55,754,538 | $107,377,394 |
| California State University, Dominguez Hills | $31,843,563 | $18,312,000 | $55,915,410 | $106,070,973 |
| California State University, East Bay | $24,243,652 | $14,394,000 | $42,929,208 | $81,566,860 |
| California State University, Fresno | $52,725,317 | $32,557,000 | $92,926,594 | $178,208,911 |
| California State University, Fullerton | $67,736,949 | $41,088,000 | $120,859,884 | $229,684,833 |
| California State University, Long Beach | $67,421,424 | $41,202,000 | $119,508,329 | $228,131,753 |
| California State University, Los Angeles | $61,905,561 | $40,067,000 | $108,543,672 | $210,516,233 |
| California State University, Monterey Bay | $13,455,716 | $8,705,000 | $23,922,768 | $46,083,484 |
| California State University, Northridge | $74,004,088 | $47,458,000 | $131,021,450 | $252,483,538 |</p>
<table>
<thead>
<tr>
<th>Institution</th>
<th>Financial Information 1</th>
<th>Financial Information 2</th>
<th>Financial Information 3</th>
<th>Financial Information 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>California State University, San Bernardino</td>
<td>$42,438,131</td>
<td>$27,924,000</td>
<td>$74,982,459</td>
<td>$145,344,590</td>
</tr>
<tr>
<td>California State University, San Marcos</td>
<td>$26,602,684</td>
<td>$15,542,000</td>
<td>$46,496,808</td>
<td>$88,641,492</td>
</tr>
<tr>
<td>California State University, Stanislaus</td>
<td>$22,007,207</td>
<td>$12,928,000</td>
<td>$38,636,391</td>
<td>$73,571,598</td>
</tr>
<tr>
<td>Humboldt State University</td>
<td>$16,130,016</td>
<td>$11,146,000</td>
<td>$28,831,619</td>
<td>$56,107,635</td>
</tr>
<tr>
<td>San Diego State University</td>
<td>$45,914,127</td>
<td>$30,394,000</td>
<td>$80,592,385</td>
<td>$156,900,512</td>
</tr>
<tr>
<td>San Francisco State University</td>
<td>$47,404,409</td>
<td>$30,000,000</td>
<td>$83,075,470</td>
<td>$160,479,879</td>
</tr>
<tr>
<td>San Jose State University</td>
<td>$46,631,939</td>
<td>$30,977,000</td>
<td>$82,976,130</td>
<td>$160,585,069</td>
</tr>
<tr>
<td>Sonoma State University</td>
<td>$13,980,795</td>
<td>$9,153,000</td>
<td>$24,732,994</td>
<td>$47,866,789</td>
</tr>
<tr>
<td>CSU System-Wide Totals</td>
<td>$853,833,277</td>
<td>$535,535,000</td>
<td>$1,507,325,177</td>
<td>$2,896,693,454</td>
</tr>
</tbody>
</table>

**Vulnerability Assessment Conclusions**

Before the COVID-19 pandemic, populations at all CSU campuses and CSU-affiliated facilities were substantial. Collectively, as of Fall 2019, CSU campuses had 480,541 students and 53,763 faculty and staff. All were at risk from the communicable disease events, with 534,304 people being directly vulnerable. The COVID-19 pandemic has caused campus population numbers to plummet to a small fraction of full capacity.
At some point in the future, campus population numbers will return to their pre-pandemic levels, and students, faculty, and staff will again be vulnerable to the communicable disease hazard. If just 10% of the total CSU population were to become ill with a highly infective communicable disease like influenza or another strain of SARS, this would mean that approximately 53,430 people would be sick at the same time. This scenario would likely overwhelm available on-campus medical services could even overwhelm portions of the larger community’s medical resources – especially if there were large numbers of infected people with immune system compromises or other underlying health problems. See Table CD.11 (below) for the “10% outbreak scenario” projections both for each CSU campus and for the entire CSU system.
Table 11-11: Scenario of Communicable Disease Hazard Affecting 10% of the CSU Population.

<table>
<thead>
<tr>
<th>CSU Campus</th>
<th>Approximate Enrollment Population (Fall 2019)33</th>
<th>Approximate Total FT/PT Faculty/Staff Population (Fall 2019)34</th>
<th>Total Combined Approximate Student and Faculty/Staff Population</th>
<th>10% Outbreak Scenario (Students and Faculty/Staff Combined)</th>
</tr>
</thead>
<tbody>
<tr>
<td>CSU Bakersfield</td>
<td>11,199</td>
<td>1,277</td>
<td>12,476</td>
<td>1,248</td>
</tr>
<tr>
<td>CSU Channel Islands</td>
<td>7,093</td>
<td>994</td>
<td>8,087</td>
<td>809</td>
</tr>
<tr>
<td>Chico State</td>
<td>17,019</td>
<td>1,969</td>
<td>18,988</td>
<td>1,899</td>
</tr>
<tr>
<td>CSU Dominguez Hills</td>
<td>17,027</td>
<td>1,761</td>
<td>18,788</td>
<td>1,879</td>
</tr>
<tr>
<td>Cal State East Bay</td>
<td>14,705</td>
<td>1,764</td>
<td>16,469</td>
<td>1,647</td>
</tr>
<tr>
<td>Fresno State</td>
<td>24,139</td>
<td>2,534</td>
<td>26,673</td>
<td>2,667</td>
</tr>
<tr>
<td>Cal State Fullerton</td>
<td>39,868</td>
<td>3,736</td>
<td>43,604</td>
<td>4,360</td>
</tr>
<tr>
<td>Humboldt State</td>
<td>6,983</td>
<td>1,171</td>
<td>8,154</td>
<td>815</td>
</tr>
<tr>
<td>Cal State Long Beach</td>
<td>38,074</td>
<td>4,004</td>
<td>42,078</td>
<td>4,208</td>
</tr>
<tr>
<td>Cal State LA</td>
<td>26,361</td>
<td>2,821</td>
<td>29,182</td>
<td>2,918</td>
</tr>
<tr>
<td>Cal Maritime</td>
<td>911</td>
<td>329</td>
<td>1,240</td>
<td>124</td>
</tr>
<tr>
<td>CSU Monterey Bay</td>
<td>7,123</td>
<td>1,059</td>
<td>8,182</td>
<td>818</td>
</tr>
<tr>
<td>CSUN (Northridge)</td>
<td>38,391</td>
<td>3,832</td>
<td>42,223</td>
<td>4,222</td>
</tr>
</tbody>
</table>


<table>
<thead>
<tr>
<th>Institution</th>
<th>Total Students</th>
<th>Undergraduate Students</th>
<th>Graduate Students</th>
<th>Total Semester Credit Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cal Poly Pomona</td>
<td>27,914</td>
<td>2,650</td>
<td>30,564</td>
<td>3,056</td>
</tr>
<tr>
<td>Sacramento State</td>
<td>31,156</td>
<td>3,228</td>
<td>34,384</td>
<td>3,438</td>
</tr>
<tr>
<td>Cal State San Bernardino</td>
<td>20,311</td>
<td>2,118</td>
<td>22,429</td>
<td>2,243</td>
</tr>
<tr>
<td>San Diego State</td>
<td>35,081</td>
<td>3,702</td>
<td>38,783</td>
<td>3,878</td>
</tr>
<tr>
<td>San Francisco State</td>
<td>28,880</td>
<td>3,401</td>
<td>32,281</td>
<td>3,228</td>
</tr>
<tr>
<td>San José State</td>
<td>33,282</td>
<td>3,568</td>
<td>36,850</td>
<td>3,685</td>
</tr>
<tr>
<td>Cal Poly San Luis Obispo</td>
<td>21,242</td>
<td>2,871</td>
<td>24,113</td>
<td>2,411</td>
</tr>
<tr>
<td>CSU San Marcos</td>
<td>14,519</td>
<td>1,687</td>
<td>16,206</td>
<td>1,621</td>
</tr>
<tr>
<td>Sonoma State</td>
<td>8,649</td>
<td>1,338</td>
<td>9,987</td>
<td>999</td>
</tr>
<tr>
<td>Stanislaus State</td>
<td>10,614</td>
<td>1,276</td>
<td>11,890</td>
<td>1,189</td>
</tr>
<tr>
<td>Office of the Chancellor</td>
<td>0</td>
<td>673</td>
<td>673</td>
<td>67</td>
</tr>
<tr>
<td><strong>CSU System-Wide</strong></td>
<td><strong>480,541</strong></td>
<td><strong>53,763</strong></td>
<td><strong>534,304</strong></td>
<td><strong>53,430</strong></td>
</tr>
</tbody>
</table>

*Please Note: Enrollment figures do not include non-specific CSU campus International Programs (455 students) or CALStateTEACH Program (933 students).*

While the case numbers of COVID-19 have been significantly lower (about 1% of the total CSU population) than those in the 10% scenario, the degree of virulence and resultant morbidity and mortality caused by COVID-19 have led to widespread campus shutdowns, educational disruption, and economic harm to the CSU system, including Humboldt State. In short, the real-time COVID-19 communicable disease outbreak scenario has proven far more devastating than the 10% simulated scenario.

**Identified Data Limitations**

There is a wealth of technical information available for communicable disease. However, there is also limited non-COVID-19 communicable disease data available regarding risk or vulnerability of specific populations throughout the CSU. Much of the data that does exist is protected by privacy policies, and therefore cannot be obtained for more specific populations. As a result, performing a detailed quantitative assessment for this hazard is difficult.
Data that could be collected prior to the next update in order to improve this methodology includes:

- Data regarding infection rates at the campus level and for specific populations;
- Data regarding communicable disease case numbers and outcomes, by CSU campus;
- Data regarding projected population changes;
- Data regarding absenteeism; and
- Data regarding increased operating costs as a result of absenteeism (i.e., temporary shifting of duties resulting in business interruption).

**Dam and Levee Failure**

Description of the Hazard

A dam failure represents the structural collapse of a dam that stores water in a reservoir behind the dam. These failures are typically the result of structural age, damage to the structure caused by earthquake or flooding, inadequate discharge or spillway capacity, inadequate maintenance, improper construction materials, or extreme inflow of water into the reservoir. Prolonged precipitation may result in overtopping of the dam resulting in structural compromise. The tremendous energy generated by a sudden breach of the dam will have significant downstream effects. Flood damage resulting from dam failures potentially will result in economic losses, environmental damage, destruction of agriculture, and human casualties. This type of incident is extremely dangerous as it can occur rapidly, with no warning resulting in an inability to effectively evacuate threatened communities.

A levee failure is similar to dam failures as the result will be a breach causing flooding on the dry side of the levee. Levees are embankments whose primary purpose is to furnish flood protection from seasonal high water or divert the flow of water. Most levees in California are intended to withstand peak water levels generated by heavy precipitation or rapid snowmelt in a watershed. Other levees are designed to withstand fluctuating water levels on a continuous basis such as those in the California Delta exposed to tidal influences. Levees routinely extend for lengthy distances immediately protecting communities. Levees can be found throughout the state but are most prominent in the Sacramento and San Joaquin Valleys.

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Levee failures can vary from over toppings to small uncontrolled discharge to catastrophic failure. Areas downstream of the failure will be subject to inundation dependent on the volume of water released. These levee failures are also typically the result of structural age, damage to the structure caused by earthquake or flooding, slumping, seepage underneath the levee, high velocity flows eroding the levee, inadequate capacity, inadequate maintenance, improper construction materials, or extreme inflow of water into the system. Flood damage resulting from levee failures potentially will result in economic losses, environmental damage, destruction of agriculture, and human casualties.

A Dam or levee failure flooding will vary depending on a number of factors including the extent of the collapse or breach, the volume of water behind the structure, and the nature of the exposed downstream features. This unpredictable flooding presents a threat to life and property in addition to critical infrastructure. Lifelines and supply routes will likely be damaged or made impassible by flood erosion or standing water. Water quality and health concerns would likely be cascading effects of dam or levee failures.

Location of the Hazard

Humboldt County is home to a variety of flood control facilities and levee systems throughout the county. Arcata sits between the Arcata Bay and the outlet of the Mad River into the Pacific Ocean. There are dam and levee facilities in Humboldt County to the north, west, and south of the Arcata including levees that separate the tidal influences of the bay from the community.
The county is additionally downstream of facilities located in other counties. The primary dam facility that could present a threat to the Humboldt State University campus community is in neighboring Trinity County containing significant amounts of water. The Robert W Matthews Dam regulates the Mad River 70 miles upstream eventually feeding into the Pacific Ocean. The Mad River is 2 ¼ miles north of the campus. A failure of this facility is expected to produce inundations that cover sizable areas through the Mad River Valley including Blue Lake and north Arcata. The Humboldt State University campus is not located within the Robert W Matthews Dam inundation area but the sole transportation routes to the north and east of the Eureka region are found within the inundation zone.

Figure 11-4: RW Matthews Dam Breach Inundation Map

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36 California Department of Water Resources, Dam Breach Inundation Map Publisher, https://fmds.water.ca.gov/webgis/?appid=dam_prototype_v2
Levees have been constructed to protect portions of Humboldt County outside of Arcata. A series of levees have been constructed to protect lands alongside the Arcata Bay providing protection from tidal and coastal influences. Additionally, levees line parts of the Mad River north of Arcata. The Humboldt State University campus is not located in a levee protected area.
Figure 11-5: Dams and Levees near Humboldt State University

Extent of the Hazard

Dams are classified according to the hazard that they pose to life and property in the event of failure, rather than the likelihood of that failure.

- **High hazard potential dams** may result in loss of human life, and will likely result in economic, environmental, or lifeline losses.
- **Significant hazard potential dams** are not expected to result in loss of life, but are expected to cause economic, environmental, and lifeline losses.

- **Low hazard potential dams** are not expected to result in loss of life, and there is a low expectation of economic, environmental, or lifeline losses. What losses do occur are generally limited to the dam owner.

Dams classified as high hazard are required to have Emergency Action Plans (EAP). EAPS are formal documents that identify potential emergency conditions at the dam and specify preplanned actions to be followed in case of failure. An EAP is required for all high hazard dams and is recommended for all significant hazard dams.

Table 11-12: Humboldt County Dams Upstream from Humboldt State University

<table>
<thead>
<tr>
<th>River</th>
<th>Dam</th>
<th>Storage</th>
<th>Hazard Severity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mad</td>
<td>Robert W Matthews (Trinity County)</td>
<td>60,200af</td>
<td>High Hazard</td>
</tr>
</tbody>
</table>

The Humboldt State University campus lies outside of the inundation zone of the dams listed above. In the event of a catastrophic failure of the identified dams, the Humboldt State University campus is expected to remain out of the inundation area. The inundation area is expected to spread water in areas north of the campus and remain near the Mad River and downstream agricultural fields in proximity to the campus. However, there are transportation corridors including US Highway 101 that lie within the dam inundation zones that could compromise transportation routes and areas the campus community reside or work. Based on these conditions, the planning committee ranks the extent of the dam failure hazard on campus as **Low**.

**Extent – Levee Failure**

Levees are used along numerous flood control channels and other waterways including the Mad River and the Arcata Bay. The Humboldt State University campus lies outside of the levee flood protected area. In the event any of these channels were flowing at elevated levels and a failure of a levee were to occur, the campus would not be directly impacted but the community surrounding the campus would likely experience flood related damages. This specific hazard could alter the ability of the campus to maintain operations. US Highway 101 crosses through the levee protected zones in addition to the dam inundation zone creating a potential for community-wide isolation from access, evacuation, resources, and other services from outside of the Eureka area. Based on these conditions, the planning committee ranks the extent of the dam failure hazard as **Low to Moderate**.

History of the Hazard

There are no records of dam or levee failures in areas that present a threat to the Humboldt State University campus. Humboldt County has not identified a history of dam or levee failures elsewhere in the County.

Potential Impacts of the Hazard

**Dam Failure Impacts**

While the campus is not within a dam inundation zone, transportation routes, critical infrastructure, and campus community members may reside within inundation zones. Water that is released due to a dam that has failed generates tremendous energy and force causing a flood that will be catastrophic to life and property. Water levels from the failed dam could be significantly higher than those experienced in worst case scenario flood events. Areas closer to the failed dam will be more likely to experience complete devastation while other areas within the inundation zone will see varying levels of flood waters. The extent of the impacts of a failed dam would vary based on a number of factors such as the volume of water released, the base flow of the river, the time of the failure, the amount of warning provided, and the distance from the dam. Impacts resulting from a dam failure include:

- Loss of life
- Property destruction or damage
- Loss of property contents
- Infrastructure damage
- Flooded or destroyed lifelines/supply routes
- Damaged or destroyed utilities
- Loss of community economic base
- Employment losses
- Agricultural (crops and livestock) damages or destruction
- Environmental damage
- Floods generating threats to public health
- Flood generated debris
- Damage or destruction of academic materials, fine arts, and research
- Damage or destruction of university computer systems and networks
- Damaged university infrastructure
- Reduced or eliminated student engagement with academic programs
- Reductions in campus revenues
Levee Failure Impacts

A levee failure may result in substantial amounts of water to enter into developed areas protected by the levee. The force and volume of water that is generated by a levee failure may cause extensive structural damage in close proximity to the breach and effects of flooding spreading well beyond the point of the failure. The extent of the impacts would vary based on a number of factors such as the volume of water released, the time of the failure, the amount of warning provided, the location of the breach, elevation, and distance from the breach. Potential impacts resulting from a levee failure include:

- Loss of life
- Property destruction or damage
- Loss of property contents
- Infrastructure damage
- Public health hazards resulting from mold, mildew, and disease due to flood water
- Flooded or destroyed lifelines/supply routes
- Damaged or destroyed utilities
- Loss of community economic base
- Employment losses
- Agricultural (crops and livestock) damages or destruction
- Environmental damage
- Prolonged periods of necessary dewatering
- Disruptions to education delivery to community
- Damage or destruction of academic materials, fine arts, and research
- Damage or destruction of university computer systems and networks
- Damaged university infrastructure
- Reduced or eliminated student engagement with academic programs
- Reductions in campus revenues

Probability of Future Occurrence of the Hazard

Humboldt County remains at risk from dam and levee failure. The location of the Humboldt State University campus downstream on the Mad River from the Matthews Dam containing Ruth Reservoir demonstrates that the potential exists for future dam or levee related issues. However, the dam inundation zone follows the Mad River not in immediate proximity to the campus. The campus is 1 ½ miles from the boundary of the dam inundation zone. Access routes to and from the campus would be impacted.
by a collapse of this facility. There are no identified levees in proximity to the campus and thus the campus is outside of any levee protected zone. There are no official recurrence intervals that have been calculated for dam or levee failures. However, based on consistent dam and levee monitoring and maintenance protocols, and on historical experience occurrences, the likelihood of this hazard is Low.

The probability of future occurrence for both dam and levee failures is Unlikely.

**Vulnerability to the Hazard**

Given High Priority dam monitoring and maintenance practices in place, a catastrophic dam or levee failure is highly unlikely. In addition, the campus does not lie within an inundation zone. However, in the unlikely event of a catastrophic failure, the effects of flooding from compromised dams and levees on campus would most likely be limited to indirect or secondary effects in terms of disruption to regional transportation networks and services, and the amount of time to respond to the needs of the campus community prior to inundation will be limited. The distributed placement of levees mostly near development may expose significant vulnerabilities to other areas of the region even if the campus is unaffected.

Vulnerability to a dam or levee failure near the Humboldt State University campus will vary depending on the degree of breach or structural failure and when the failure was to occur. The risk to the campus population will be lessened during periods when classes are not in session or during periods of breaks.

Some areas of particular vulnerability to dam failure from the Matthews Dam on the campus includes:

- Limited vulnerabilities to the main campus.
- US Highway 101 vulnerable to the effects of dam inundation flows crossing the Mad River limiting access to the Trinidad Marine Laboratory
- US Highway 101 and State Route 299 vulnerable to the effects of dam inundation limits the access to and from the campus servicing northern routes into Oregon and eastern routes into Redding
- Native American lands lie within the dam inundation directly impacting those campus community members residing in these areas
- Campus community members residing in areas north of the Mad River such as McKinleyville and Calville may be isolated from campus

Finally, certain campus populations will experience greater challenges to a post-flood / failure environment. Vulnerable populations will likely need to navigate through flood generated debris, face extreme health safety issues from flood waters, experience extreme stresses of a disaster, an inability to communicate to or gain access to support networks, and find difficulty in accessing equipment or supplies to aid in a specific need.
Estimate of Potential Losses

Estimates of potential losses will be influenced by a variety of factors. The volume and force of the water will determine the scale of damages affecting campus infrastructure, equipment, and other impacted features. The proximity to the failure and elevation above flood waters will affect the level of damage and individuals exposed. The time of the academic year, the day of week, and hour in which the failure was to occur will influence the number of people on campus and potential casualties. Losses will be generated by the physical damages, the loss of revenue, loss of academic research, loss of building contents, and community wide economic reductions.

Based on estimate replacement costs of facilities and structures on campus, the total replacement costs are $117,600,736. However, it is unlikely for a dam or levee failure event to cause catastrophic destruction at Humboldt State.

Vulnerability Assessment Conclusions

While the occurrence of dam and levee failures have not been historically relevant near the Humboldt State campus, the potential for hazards related to the region’s levees and dams still exist. However, the presence of earthquake faults in proximity to the existing dam and levee structures presents a valid danger to downstream locations in the event of an earthquake. In the unlikely event of a high priority dam’s total failure, the consequences would be catastrophic to downstream communities. The potential for dam or levee failure further generates the added potential for a number of cascading effects such as disruptions to the local economy, utility failures, disruptions to providing for the needs of the community, and development of public health hazards. These effects would be exacerbated by effects of seasonal flooding, ongoing heavy precipitation, or excessive run-off from the watershed contributing to the river system. The potential for widespread flooding and damage of structures due to the force of water has exponentially powerful impacts on particular populations among the campus community including those with access or functional needs, international students, the homeless, and students residing in the residence halls.

Identified Data Limitations

Missing campus structural replacement costs and complete inventory of building construction features or mitigation efforts to lessen the impact due to flood inundation.
**Drought**

**Hazard Description**

Drought is defined as a condition where moisture levels fall significantly below normal for an extended period of time over a large area that adversely affects plants, animal life, and humans. Drought is a gradual phenomenon. Although droughts are sometimes characterized as emergencies, they differ from typical emergency events. Most natural disasters, such as floods or forest fires, occur relatively rapidly and afford little time for preparing for disaster response. Droughts occur slowly, over a multi-year period, and it is often not obvious or easy to quantify when a drought begins and ends.

Throughout California, one dry year does not normally constitute a drought. California’s extensive system of water supply infrastructure (reservoirs, groundwater basins, and conveyance assets) mitigates the effect of short-term dry periods for most water users. Defining when a drought begins is a function of drought impacts to water users. Drought in one location may not constitute a drought for all water users, as some users in relative proximity may have a different water supply. For example, individual water suppliers may use a combination of sources such as rainfall/runoff, water in storage, or expected supply from a water wholesaler to define their water supply conditions.

Drought can be characterized as one or more of the four following types:

- **Meteorological drought** is defined on the basis of the degree of dryness (in comparison to some “normal” or average amount) and the duration of the dry period. A meteorological drought must be considered as region-specific since the atmospheric conditions that result in deficiencies of precipitation are highly variable from region to region.

- **Hydrological drought** is associated with the effects of periods of precipitation (including snowfall) shortfalls on surface or subsurface water supply (e.g., streamflow, reservoir and lake levels, ground water). The frequency and severity of hydrological drought is often defined on a watershed or river basin scale. Although all droughts originate with a deficiency of precipitation, hydrologists are more concerned with how this deficiency plays out through the hydrologic system. Hydrological droughts are usually out of phase with or lag the occurrence of meteorological and agricultural droughts. It takes longer for precipitation deficiencies to show up in components of the hydrological system such as soil moisture, streamflow, and ground water and reservoir levels. As a result, these impacts are out of phase with impacts in other economic sectors.

- **Agricultural drought** focus is on soil moisture deficiencies, differences between actual and potential evaporation, reduced ground water or reservoir levels, and so forth. Plant water demand depends on prevailing weather conditions, biological characteristics of the specific plant, its stage of growth, and the physical and biological properties of the soil.
- **Socioeconomic drought** refers to when physical water shortage begins to affect health, well-being, and quality of life of people, or when the drought starts to affect the supply and demand of an economic product that relies on water.

The drought issue in California is further compounded by water rights. The central challenge is how to prioritize water usage among a broad variety of contexts. It is for this reason that water is a commodity possessed and utilized under a variety of legal doctrines. As such, many competing sets of interests create a dynamic prioritization process between, for example, farming and federally protected fish habitats and water supply for municipal/public use (including usage for Humboldt State) versus water usage for wildfire abatement or natural resource protection.

**Location of the Hazard**

Drought conditions have been identified in Humboldt County and the City of Arcata where Humboldt State is located. Drought is not a location-specific hazard and affects the entire planning area equally. Drought location is not isolated to each campus footprint but occurs as a geographic sub-set of drought conditions occurring at larger scales. From 2000-2020, drought conditions existed continuously somewhere in the state, with 80-100% of the state impacted for 12 of the last 20 years. 38

**Extent of the Hazard**

Given the historical occurrence of severe drought impacts throughout the planning area and across the state and the potential future impact exacerbated by climate change, the CSU Planning Committee recognizes that drought will continue to pose a high degree of risk, potentially impacting crops, livestock, water resources, the natural environment at large, buildings and infrastructure (from land subsidence), and local economies. In addition, although drought affects the entire planning equally, the potential impacts may be variable and specific to each campus/jurisdiction, depending on contextual factors such as the degree of assets and activities, historically impacted by drought within each jurisdiction. In addition, land subsidence has occurred and will continue in areas where the groundwater basin has been subject to overdraft and long-term recharge is inadequate to maintain the water table elevation, leaving underground voids. Subsidence levels in California have been measured up to 30-feet with subsidence bowls covering hundreds of square miles. As such, drought-related subsidence may result in serious structural damage to buildings, roads, irrigation ditches, underground utilities, and pipelines. These are applicable concerns for the Humboldt State campus over the long term.

The U.S. Drought Monitor developed tables of impacts reported during past droughts in California in order to depict the extent of drought risk for each level of drought on the U.S. These possible extent conditions for California complement the general impacts column of the U.S. Drought Monitor Classification Scheme.

Table 11-13: Impacts of Drought Levels as Determined by US Drought Monitor

<table>
<thead>
<tr>
<th>Category</th>
<th>Impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>D0</td>
<td>Soil is dry; irrigation delivery begins early</td>
</tr>
<tr>
<td></td>
<td>Dryland crop germination is stunted</td>
</tr>
<tr>
<td></td>
<td>Active fire season begins</td>
</tr>
<tr>
<td></td>
<td>Winter resort visitation is low; snowpack is minimal</td>
</tr>
<tr>
<td>D1</td>
<td>Dryland pasture growth is stunted; producers give supplemental feed to cattle</td>
</tr>
<tr>
<td></td>
<td>Landscaping and gardens need irrigation earlier; wildlife patterns begin to change</td>
</tr>
<tr>
<td></td>
<td>Stock ponds and creeks are lower than usual</td>
</tr>
<tr>
<td>D2</td>
<td>Grazing land is inadequate</td>
</tr>
<tr>
<td></td>
<td>Producers increase water efficiency methods and drought-resistant crops</td>
</tr>
<tr>
<td></td>
<td>Fire season is longer, with high burn intensity, dry fuels, and large fire spatial extent; more fire crews are on staff</td>
</tr>
<tr>
<td></td>
<td>Wine country tourism increases; lake- and river-based tourism declines; boat ramps close</td>
</tr>
<tr>
<td></td>
<td>Trees are stressed; plants increase reproductive mechanisms; wildlife diseases increase</td>
</tr>
<tr>
<td></td>
<td>Water temperature increases; programs to divert water to protect fish begin</td>
</tr>
<tr>
<td></td>
<td>River flows decrease; reservoir levels are low and banks are exposed</td>
</tr>
<tr>
<td>D3</td>
<td>Livestock need expensive supplemental feed, cattle and horses are sold; little pasture remains, producers find it difficult to maintain organic meat requirements</td>
</tr>
<tr>
<td></td>
<td>Fruit trees bud early; producers begin irrigating in the winter</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Federal water is not adequate to meet irrigation contracts; extracting supplemental groundwater is expensive</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dairy operations close</td>
</tr>
<tr>
<td>Marijuana growers illegally tap water out of rivers</td>
</tr>
<tr>
<td>Fire season lasts year-round; fires occur in typically wet parts of state; burn bans are implemented</td>
</tr>
<tr>
<td>Ski and rafting business is low, mountain communities suffer</td>
</tr>
<tr>
<td>Orchard removal and well drilling company business increase; panning for gold increases</td>
</tr>
<tr>
<td>Low river levels impede fish migration and cause lower survival rates</td>
</tr>
<tr>
<td>Wildlife encroach on developed areas; little native food and water is available for bears, which hibernate less</td>
</tr>
<tr>
<td>Water sanitation is a concern, reservoir levels drop significantly, surface water is nearly dry, flows are very low; water theft occurs</td>
</tr>
<tr>
<td>Wells and aquifer levels decrease; homeowners drill new wells</td>
</tr>
<tr>
<td>Water conservation rebate programs increase; water use restrictions are implemented; water transfers increase</td>
</tr>
<tr>
<td>Water is inadequate for agriculture, wildlife, and urban needs; reservoirs are extremely low; hydropower is restricted</td>
</tr>
<tr>
<td>Fields are left fallow; orchards are removed; vegetable yields are low; honey harvest is small</td>
</tr>
<tr>
<td>Fire season is very costly; number of fires and area burned are extensive</td>
</tr>
<tr>
<td>Many recreational activities are affected</td>
</tr>
<tr>
<td>Fish rescue and relocation begins; pine beetle infestation occurs; forest mortality is high; wetlands dry up; survival of native plants and animals is low; fewer wildflowers bloom; wildlife death is widespread; algae blooms appear</td>
</tr>
<tr>
<td>Policy change; agriculture unemployment is high, food aid is needed</td>
</tr>
<tr>
<td>Poor air quality affects health; greenhouse gas emissions increase as hydropower production decreases; West Nile Virus outbreaks rise</td>
</tr>
<tr>
<td>Water shortages are widespread; surface water is depleted; federal irrigation water deliveries are extremely low; junior water rights are curtailed; water prices are extremely high; wells are dry, more and deeper wells are drilled; water quality is poor;</td>
</tr>
</tbody>
</table>
Although drought conditions have not been reported at the campus level, historically, drought has been so prevalent in California that its presence is almost continuous, including Humboldt County and the Humboldt State footprint. According to the US Drought Monitor, Time Series data, Humboldt County experienced x periods of drought from 2000-2021, including the severe statewide event from 2012-2017.

Figure 11-6: Periods of Drought in Sonoma County, California, 2000 – 202140

According to the National Drought Mitigation Center, over 3,500 reports and publications covering 370 drought-related events took place across the state (many of which were statewide events) between 2000-2020. In addition, the National Center for Environmental Information (NCEI) reports more than 500 events statewide during this same time period. These events produced a comprehensive range of impacts to water supply, regulations and allocations to businesses and municipalities, budgets and resources for firefighting, water law and policy, and physical impacts to built and natural environments. As such, data records of previous occurrences can be viewed as separate time and event demarcations for a hazard almost continuously in effect across the state with cascading impact potential.

According to the Department of Water Resources, droughts exceeding three years are relatively common in Southern California, but relatively rare in Northern California - the region is the geographic source of much of the state’s developed water supply. The 1929-34 drought established the criteria commonly used in designing storage capacity and yield of large Northern California reservoirs. 41

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According to the US Drought Monitor’s time series data, from 2000-2021 (with the exception of a 2–3-month period in 2000 and 2011), some degree of drought conditions have been continuously in effect somewhere in California. In fact, 80% - 100% of the state has been subjected to drought conditions for 12 of the last 20 years, with the most severe drought being the 100% state-wide event from 2012-2017.

Figure 11-7: Periods of Drought in State of California, 2001 – 2021

Given the extent of the drought risk in California, the following drought event was selected as an exemplar due to its broad and significant impacts on the state, and according to the US Drought Monitor’s Time Series data, on Humboldt County which encompasses the planning area:

2012 – 2017 – Drought produced severe impacts to water wells throughout the state of California, with a high number of wells running dry. Land subsidence due to increased groundwater pumping also occurred in numerous areas of the state such as the San Joaquin and Central Valleys. Crop damage was widespread as well. Water allotments were drastically reduced in many towns and water agencies, with extremely high costs for procuring water. In addition, job loss occurred with many families requiring food supply assistance, and water supply assistance provided to home-owners with dry wells. According to a report released by UC Davis Center for Watershed Sciences, the 2014-2017 period of the California drought cost the state’s agriculture industry about $1 billion in lost revenue, with a total statewide economic cost of the drought calculated to be $2.2 billion. The report says, ‘it is responsible for the greatest water loss ever seen in California agriculture - about one third less than normal”. The report calls the groundwater situation in California "a slow-moving train wreck." Spring snowpack at Donner Summit reached record low levels in 2014, exceeded in 2015 by a remarkable April 1 snow-water-equivalent value of only 5% of average. Decreased precipitation since contributed to near-record low levels in the Shasta Reservoir. The ongoing drought has contributed to declines in crop values across the state. For

example, crops including cotton, corn silage and barley (the field crop category) fell by 42 percent. 43

Potential Impacts of the Hazard

Drought impacts are wide-reaching and may be economic, environmental, and/or societal. This assessment of its impact recognizes that historic occurrences of drought throughout the planning area are a sub-set of larger and inter-connected local and regional droughts, and that the (related) historic impacts provide a sound basis for understanding potential (future) impacts.

The most significant potential impact associated with drought across the region and the county surrounding Humboldt State campus planning area is a reduction in water availability for the municipal area tied to the campus. Other potential impacts include crop loss and damage to trees and other natural resources (See Tree Mortality below). The footprint of Humboldt State to some extent includes these vulnerable resources based on the campus landscape (trees) and the presence (and footprint size) of agricultural research crops and field stations.

As a secondary impact of drought, wildfire is directly attributable to dry atmospheric conditions. Wildfires almost always coincide with drought in California, though not limited to such. 44 However, the wildfire hazard is analyzed separately in this plan. (See Section X for coverage of the wildfire hazard).

In reviewing the occurrences of drought for Humboldt County, the US Drought Monitor and the National Drought Mitigation Center report that tens of millions of trees died during the (2012 - 2017) state-wide drought disaster. Though data sources do not provide data for tree mortality specific to Humboldt State, the broad geographic extent of the impact makes it likely that tree mortality occurred to some degree on the campuses. Due to the lasting and ongoing effects of drought on the landscape, trees will continue to be impacted within the municipalities, counties and regions wherein lies the CSU campus system as long as drought conditions continue to occur in the future.

Given the absence of data, in order for the CSU Committee to assess the impact of tree mortality, it is useful to view it as a risk sub-set to the probability, location, extent, severity and duration of the drought hazard within each campus-located municipality, county and region. Regarding potential impacts, standing dead trees could fall, posing a risk to people, buildings, power lines, roads and other infrastructure. In addition, drought-impacted trees become susceptible to diseases and insect infestations (bark


beetle) further adding to the risk of tree mortality and related potential impacts. No data is currently available for tree mortality on campus, however, the CSU Planning Team will pursue data on this issue in the future.

As a potential tertiary impact, prolonged and repeated drought conditions over time can produce land subsidence and the risk of damage to building foundations and infrastructure on campus resulting from ground instability and collapse. Land subsidence is defined as the vertical sinking of the land over manmade or natural underground voids. Subsidence is often the direct result of groundwater over-extraction in response to drought conditions, as well as oil and gas extraction. Weight can accelerate the process of subsidence resulting from surface development and infrastructure such as roads and buildings, vibrations from construction blasting and heavy truck or train traffic. For example, the State Water Project’s 444-mile-long California Aqueduct has required repairs such as the raising of canal linings, bridges, and water control structures on the Aqueduct – in the Central Valley a five-mile reach of the Eastside Bypass was impacted by subsidence, and the Department of Water Resources estimated that it may cost in the range of $250 million to acquire flowage easements and levee improvements to restore the design capacity of the subsided area. 45

At present, drought related damage to campus buildings and infrastructure at Humboldt State has not been reported, but the potential for such impacts is possible. With regard to overall potential impact, water supply/availability for Humboldt State is ultimately tied to broader inter-dependent, and more intensive modes of water use at local and regional scales such as agriculture and ranching, wildfire protection, larger metropolitan/municipal usage, manufacturing and commerce, tourism, recreation, and wildlife preservation. During drought periods, the State of California’s regulated water allocations are modified and often reduced, which can result in reduced water availability for all usage contexts, including Humboldt State. A reduction of electric power generation and water quality deterioration are also potential impact factors.

Table 11-14: Summary of Drought Impacts on Water Resources

<table>
<thead>
<tr>
<th>Resource</th>
<th>Type of Impact</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sea Level</td>
<td>Direct</td>
<td>Sea level is rising and will likely impact coastal areas</td>
</tr>
<tr>
<td>Soil Moisture</td>
<td>Direct</td>
<td>Prolonged dry seasons can lead to decreases in soil moisture; drier vegetation</td>
</tr>
<tr>
<td>Vegetation</td>
<td>Indirect</td>
<td>Longer and more intense fire season with increased extent of area burned</td>
</tr>
<tr>
<td>Stream Conditions</td>
<td>Direct</td>
<td>Increases in water temperature; potential effects on fish</td>
</tr>
<tr>
<td>Snowpack</td>
<td>Indirect</td>
<td>Increases in temperature will lead to decreases in snowpack</td>
</tr>
<tr>
<td>Runoff</td>
<td>Direct</td>
<td>Warmer temperatures are likely to lead to a shift in peak runoff from spring to winter and a likely decrease in summer base flow</td>
</tr>
<tr>
<td>Hydropower</td>
<td>Indirect</td>
<td>Decreased summer flows resulting from earlier snowmelt and a shift in peak runoff could affect hydropower generation during summer months</td>
</tr>
<tr>
<td>Precipitation</td>
<td>Direct</td>
<td>Warmer winter temperatures will result in a greater percentage of precipitation falling as rain rather than as snow</td>
</tr>
<tr>
<td>Groundwater</td>
<td>Indirect</td>
<td>Reduction in snowpack and extended periods of drought are likely to increase dependency on groundwater</td>
</tr>
</tbody>
</table>

Probability of Future Occurrence of the Hazard

**Highly Likely** — The US Drought Monitor’s time series data (2000-2020) indicates that some degree of drought has nearly a 100% probability of occurrence somewhere in the state in any given year. Given that Humboldt State lies within a drought

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impacted region, it is prudent to extend this likelihood of occurrence to the planning area.

Vulnerability to the Hazard

In California, rising temperatures are projected to increase the average lowest elevation at which snow falls, reducing water storage in the snowpack, particularly at those lower mountain elevations which are now on the margins of reliable snowpack accumulation. Higher spring temperatures will also result in earlier melting of the snowpack. The shift in snow melt to earlier in the season is critical for California’s water supply because flood control rules require that water be allowed to flow downstream and that water cannot be stored in reservoirs for use in the dry season. As such, state-level drought risk factors that have led to drought’s state-wide severity and extent, and potential impacts also create drought vulnerabilities at the level of the Humboldt State campus.

Moreover, climate change will likely adversely impact the vulnerability of watersheds and ecosystems in their ability to deliver important ecosystem services. These changes may limit the natural capacity of healthy forests to capture water and regulate stream flows. Sierra Nevada mountain winters and springs are warming, and on average, precipitation as snowfall relative to rain is decreasing. A warming climate with reduced snowpack will result in earlier snowmelt and will subsequently reduce downstream water availability during summer and early fall.

As such, the state, the county and the Humboldt State planning area stakeholders potentially have less capacity to address future drought risks due to projected temperature increases and shortages in water; ground-water withdrawals have been occurring at a deficit rate of 1 – 2-million-acre feet per year, where the impacts of drought include decreased availability of water for agriculture and environmental uses. 47 In forested and other vegetated areas, prolonged drought decreases the moisture content of forest fuels and increases the risk of high severity wildfires.

It should be pointed out that California is the single most productive agricultural state and its agricultural industry relies heavily on reservoir water supplied by snowmelt and rainfall runoff. Yearly variations in snowpack depths have implications for water availability as snowmelt from the winter snowpack feeds a network of reservoirs. Spring snowpack at Donner Summit reached record low levels in 2014, exceeded in 2015 by a remarkable April 1 snow-water-equivalent value of only 5% of average.

Decreased precipitation since 2011 has contributed to near-record low levels in the Shasta Reservoir. 48

**Vulnerability of Populations**

The historical and potential impacts of drought on California’s population include agricultural sector job loss, secondary economic losses to local businesses and public recreational resources, increased cost to local and state government for large-scale water acquisition and delivery, and water rationing and water wells running dry for individuals and families. As drought is often accompanied by prolonged periods of extreme heat, negative health impacts such as dehydration can also occur, where children and elderly are most susceptible. Air quality often declines in times of drought which can affect those with respiratory ailments. These same vulnerabilities apply to the students, faculty and staff of the Humboldt State campus.

**Property Vulnerability**

Vulnerabilities include crop loss, injury and death of livestock and pets, and damage to infrastructure, homes and other buildings resulting from the secondary drought impact of land subsidence. The related drought impacts of tree mortality and land subsidence pose risks to vulnerable critical infrastructure and property. These same vulnerabilities apply to the properties of the Humboldt State campus.

**Natural Environment Vulnerabilities**

Drought vulnerabilities in the natural environment are widespread throughout public and private lands within the state, including tree mortality, impacts to all flora and fauna, and destabilization (subsidence) of land along streams and rivers, and within watersheds.

The core issue shaping drought vulnerability throughout California (including Humboldt State) is water supply and demand. Several factors play into the issue including groundwater basins, surface water run-off, public and agricultural demand, and surface water storage water sheds. A USGS led analysis was first conducted in 2010 through the Forest and Rangeland Assessment and ongoing through the USGS Forest and Rangeland Ecosystem Science Center to identify threats and assets where water supply would benefit from environmental management designed to protect or enhance water resources, the key effort which, in part, both defines and mitigates the severity of drought risk and vulnerabilities.

With regard to overall threat and asset findings shaping the potential severity of drought on campus, it is tied to the watersheds in the Sierra region which contribute most greatly to the county’s and the state’s water supply, but are under threat from climate change, wildfire and development. In addition, groundwater basins in the San

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Joaquin Valley and Sacramento Valley bioregions are an abundant resource that is heavily threatened by over pumping.

**Critical Facilities Vulnerabilities**

Drought vulnerabilities for Humboldt State’s critical facilities include water shortfalls for facility operations and critical functions, and potential structural destabilization and damage resulting from land subsidence.

**Estimate of Potential Losses**

An estimate of potential losses from drought has not been calculated for the campus or the CSU system as a whole. However, drought related losses to the City of Arcata and Humboldt County, such as crop loss and cost increases for water resources have re-occurred over time. Please consult city and county level government, and/or state agricultural agencies for data on the financial impacts from drought.

**Vulnerability Assessment Conclusions**

The CSU Planning Committee understands that the high degree of vulnerability posed by drought will be exacerbated by greater climate variation in the future and therefore greater variation and uncertainty regarding the availability of water supplies which are already under tremendous stress. In response to such vulnerability, state legislation passed in 2014 requires local governments to regulate pumping and recharge to better manage groundwater supplies, and groundwater-dependent regions are required to halt overdraft and bring basins into sustainable levels of pumping and recharge by the early 2040s. That said, the Committee will continue to work with local, regional and state partners and stakeholders to explore solutions for mitigating the drought hazard on its campuses by accessing the best available data and resources on climate change and its relationship to drought.

**Identified Data Limitations**

Data is limited concerning campus-related agricultural assets as well as data on campus tree mortality.
Earthquake

Description of the Hazard

An earthquake is a sudden motion or shaking caused by the release of pressure accumulated along the edge of tectonic plates covering the earth. These huge plates are constantly moving and move ever so slowly under, over, or by passing one another. This movement is gradual however the plates may lock together accumulating enormous amounts of energy. When this energy builds, stress develops, and the adjoining plates will eventually break free and result in ground shaking – an earthquake.

Large earthquakes may result in fissuring, ground settlement, and/or vertical or horizontal displacement. Earthquakes occur without warning and can result in extensive damages and human casualties. Damages associated to earthquake generated ground shaking is normally confined to a narrow area along fault trend from the earthquake epicenter. However, seismic waves may generate ground shaking resulting in damages in areas outside of the fault trend.

In addition to ground motion, there are several secondary hazards that can result from an earthquake including:

Fault Rupture – The rupture of faults is the differential movement of the two sides of the earth’s plates at the point of the fault. Horizontal or vertical displacement may be significant and occur over great distances. The movement and energy that occurs along a fault is released in waves resulting in ground shaking. The intensity of ground shaking varies based on the magnitude of the earthquake, the proximity to the earthquake epicenter, the composition of the ground sediment or rock the waves travel through, and the depth of the earthquake.

Liquefaction – In addition to the primary fault rupture that occurs right along a fault during an earthquake, the ground many miles away can also fail during intense shaking. As seismic waves travel through saturated granular soil; the soil begins to liquefy and act as a fluid. Soil strength and stability is lost causing the effects of ground shaking to intensify and for ground deformation to occur. These water saturated soils when shaken quickly lose the ability to support buildings, bridges, utilities, and other structures. Areas susceptible to liquefaction include places where sandy sediments have been deposited by rivers along their course or by wave action along beaches. The greater the magnitude of an earthquake and longer duration of strong ground shaking will result in an enhanced potential for liquefaction to occur. Settlement can cause damage when the amount settlement varies significantly across the length of a structure. Lateral spreading occurs when liquefaction occurs on gently sloping ground and the liquefied material at depth allows the area to slide, often toward a vertical discontinuity or “free face” such as a creek or stream channel. Liquefaction can occur in susceptible soils below bodies of water, and settlement and lateral spreading can damage structures built on or adjacent to these areas. Transportation bridges across water bodies, wharves, piers and other structures at
ports and harbors, and underwater utility lines can be severely damaged by this hidden hazard.

**Subsidence** - Changes in the local environment that cause subsidence or sinkholes are called triggering mechanisms. Water is the primary factor that affects the local environment and causes subsidence. Water level decline, changes in groundwater flow, increased loading, and deterioration (such as abandoned mines) are all triggering mechanisms. Water level decline may occur naturally, or it may be the result of human action. Factors that lead to water decline are pumping (from wells), localized drainage (for construction activities), dewatering, or drought. Changes in groundwater flow can result from an increase in the velocity of groundwater movement, and increase in the frequency of water table fluctuations, and changes in discharge (either increase or decrease). Increased loading can cause pressure in the soil, leading to the failure of underground cavities and space, such as caves. Vibrations from earthquakes, heavy machinery, and blasting may result in structural collapse, followed by surface resettlement.

**Location of the Hazard**

The State of California is particularly vulnerable to earthquake activity due to California’s location residing between two large tectonic plates. Humboldt State University is located on the northern California coast on a coastal plain between Arcata Bay and the Mad River. In general, fault systems surround and traverse throughout the Eureka/Arcata region and Humboldt County including the area of Humboldt State University. Throughout the populated areas of Arcata and Eureka and surrounding cities, the ground is saturated with sediment eroded from the hills by means of multiple stream channels. Liquefaction zones rated at moderate susceptibility exist in the majority of Arcata.

The Pacific Plate and the North American Plate come together at the San Andreas/Mendocino Fault 45 miles south of the Humboldt State University campus. In addition to the San Andreas Fault, Humboldt County is home to or near multiple additional fault systems with the potential to generate strong ground shaking. The campus is additionally in close proximity to a series of parallel fault systems that surround the campus. The Fickle Hill, Mad River, McKinleyville, and Trinidad Faults all extend in a southeast to northwest direction from less than ¼ mile north to 5 miles north of the Humboldt State University campus. South of the campus there are additional parallel fault systems including the Little Salmon, Table Bluff, Russ, and Bear River Faults. These fault systems are from 11 to 30 miles south of the campus. The entire Humboldt County Area is saturated with numerous additional faults mostly paralleling the San Andreas Fault to the northwest. These fault systems are located on each side of the campus.
Figure 11-8: Faults located near Humboldt State University

Portions of the Humboldt State University campus reside on areas designated to be liquefaction zones. Campus facilities that are potentially located within the liquefaction zone include the Canyon Complex Residence Halls, Creekview Complex Residence Halls, and the J Parking Lot. Liquefaction zones also exist at the Sunset Avenue overpass over US Highway 101, throughout north Arcata, and surrounding Arcata Bay to include the City of Arcata south of 11th Street.

Extent of the Hazard.

The extent or severity of earthquake damage is expressed in terms of magnitude, intensity and duration. The amount of energy released during an earthquake is normally conveyed as a magnitude measured from a seismogram. Magnitude is expressed in numbers and decimals representing the physical size of the earthquake. The strength and effect of the shaking on the surface of the earth is classified as the intensity. Intensity is further defined from the effects the earthquake has on people, structures, and the natural environment. The intensity of an earthquake in terms of
measuring magnitude and evaluating its effects is generally expressed using the Modified Mercalli (MM) Intensity Scale. Duration is the length of time the earthquake’s energy is released.

The Richter magnitude scale (below) was developed in 1935 by Charles F. Richter of the California Institute of Technology as a mathematical device to compare the size of earthquakes. The Richter Scale is the best-known scale for measuring the magnitude of earthquakes. The magnitude value is proportional to the logarithm of the amplitude of the strongest wave during an earthquake. A recording of 7, for example, indicates a disturbance with ground motion 10 times as large as a recording of 6. The energy released by an earthquake increases by a factor of 31 for every unit increase in the Richter scale.

<table>
<thead>
<tr>
<th>Magnitude</th>
<th>Mercalli Intensity</th>
<th>Potential Damage</th>
<th>Global Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 2.0</td>
<td>I</td>
<td>None</td>
<td>Continually</td>
</tr>
<tr>
<td>2.0 - 2.9</td>
<td>I to II</td>
<td></td>
<td>&gt; 1IM per year</td>
</tr>
<tr>
<td>3.0 - 3.9</td>
<td>II to IV</td>
<td></td>
<td>&gt; 100,000 per year</td>
</tr>
<tr>
<td>4.0 - 4.9</td>
<td>IV to VII</td>
<td>Light</td>
<td>10K to 15 K per year</td>
</tr>
<tr>
<td>5.0 - 5.9</td>
<td>VI to VII</td>
<td>Moderate</td>
<td>1K to 1,500 per year</td>
</tr>
<tr>
<td>6.0 - 6.9</td>
<td>VII to X</td>
<td>Heavy</td>
<td>100 to 150 per year</td>
</tr>
<tr>
<td>7.0 - 7.9</td>
<td>VII &lt;</td>
<td>Very Heavy</td>
<td>10 - 20 per year</td>
</tr>
<tr>
<td>8.0 - 8.9</td>
<td>VII &lt;</td>
<td></td>
<td>1 per year</td>
</tr>
<tr>
<td>&gt; 9.0</td>
<td>VII &lt;</td>
<td></td>
<td>1 per 10-50 years</td>
</tr>
</tbody>
</table>

The Modified Mercalli Intensity Scale provides descriptive values of earthquake intensity that may provide greater meaning to the broader population as the description of intensity refers to the effects actually experienced. This scale uses an arbitrary ranking based on observed earthquake effects. The scale is composed of increasing levels of intensity ranging from shaking that is not recognizable to intense shaking resulting in catastrophic damages and casualties. The Modified Mercalli Intensity Scale is demonstrated below:
<table>
<thead>
<tr>
<th>Intensity</th>
<th>Shaking</th>
<th>Description / Damage</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Not felt</td>
<td>Not felt except by a very few under especially favorable conditions.</td>
</tr>
<tr>
<td>II</td>
<td>Weak</td>
<td>Felt only by a few persons at rest, especially on upper floors of buildings.</td>
</tr>
<tr>
<td>III</td>
<td>Weak</td>
<td>Felt quite noticeably by persons indoors, especially on upper floors of buildings. Many people do not recognize it as an earthquake. Standing motor cars may rock slightly. Vibrations similar to the passing of a truck. Duration estimated.</td>
</tr>
<tr>
<td>IV</td>
<td>Light</td>
<td>Felt indoors by many, outdoors by few during the day. At night, some awakened. Dishes, windows, doors disturbed; walls make cracking sound. Sensation like heavy truck striking building. Standing motor cars rocked noticeably.</td>
</tr>
<tr>
<td>V</td>
<td>Moderate</td>
<td>Felt by nearly everyone; many awakened. Some dishes, windows broken. Unstable objects overturned. Pendulum clocks may stop.</td>
</tr>
<tr>
<td>VI</td>
<td>Strong</td>
<td>Felt by all, many frightened. Some heavy furniture moved; a few instances of fallen plaster. Damage slight.</td>
</tr>
<tr>
<td>VII</td>
<td>Very strong</td>
<td>Damage negligible in buildings of good design and construction; slight to moderate in well-built ordinary structures; considerable damage in poorly built or badly designed structures; some chimneys broken.</td>
</tr>
<tr>
<td>VIII</td>
<td>Severe</td>
<td>Damage slight in specially designed structures; considerable damage in ordinary substantial buildings with partial collapse. Damage great in poorly built structures. Fall of chimneys, factory stacks, columns,</td>
</tr>
</tbody>
</table>

monuments, walls. Heavy furniture overturned.

| IX | Violent | Damage considerable in specially designed structures; well-designed frame structures thrown out of plumb. Damage great in substantial buildings, with partial collapse. Buildings shifted off foundations. |
| X | Extreme | Some well-built wooden structures destroyed; most masonry and frame structures destroyed with foundations. Rails bent. |

The graph below illustrates the increasing intensity of energy that is released and as the measured magnitude increases. While each whole number increases in magnitude represents a tenfold increase in the measured amplitude, it represents an increasing rate of 32 times more energy released in the same increase in magnitude. As the magnitude of an earthquake is measured higher, the intensity of the earthquake worsens progressively from one category to the next.
The Humboldt County Operational Area Hazard Mitigation Plan describes the probability of an earthquake Magnitude of 6.7 or greater in Northern California over the next 30 years is 95%. The Plan indicates that in the Eureka area earthquake activity is a regular occurrence. Based on the earthquake shaking potential in the Humboldt County area, the proximity to the fault systems illustrated above, and the proximity to liquefaction zones, the planning committee ranks the extent of the earthquake hazard on campus as Moderate.

History of the Hazard

The State of California has a long history of chronic and destructive earthquakes throughout the state. On average, earthquakes strong enough to result in structural damages occur three to four times a year in California, while earthquakes Magnitude 6.0 to 6.9 occur once every two to three years. Likewise, Humboldt County also has a long history of earthquake activity. The entire area of Humboldt County is at risk to seismic activity and has a history of significant earthquakes resulting in damages.

---

Table 11-17: Historic Earthquakes Near Eureka, CA

<table>
<thead>
<tr>
<th>Date</th>
<th>Location</th>
<th>Magnitude</th>
<th>Damages</th>
</tr>
</thead>
<tbody>
<tr>
<td>11/8/1980</td>
<td>Eureka</td>
<td>7.0</td>
<td>Moderate. $3 million</td>
</tr>
<tr>
<td>4/25/1992</td>
<td>Point Mendocino</td>
<td>7.2</td>
<td>Moderate, $75 million (DR-943-CA)</td>
</tr>
<tr>
<td>3/16/2000</td>
<td>Punta Gorda</td>
<td>5.6</td>
<td>Minor</td>
</tr>
<tr>
<td>1/13/2001</td>
<td>Ferndale</td>
<td>5.2</td>
<td>Minor</td>
</tr>
<tr>
<td>9/20/2001</td>
<td>Punta Gorda</td>
<td>5.1</td>
<td>Minor</td>
</tr>
<tr>
<td>6/17/2002</td>
<td>Eureka</td>
<td>5.3</td>
<td>Minor</td>
</tr>
<tr>
<td>8/15/2003</td>
<td>Ferndale</td>
<td>5.3</td>
<td>Minor</td>
</tr>
<tr>
<td>6/14/2005</td>
<td>Trinidad</td>
<td>7.2</td>
<td>Off coast, minor damages</td>
</tr>
<tr>
<td>3/25/2006</td>
<td>Punta Gorda</td>
<td>5.0</td>
<td>Minor</td>
</tr>
<tr>
<td>7/16/2006</td>
<td>Punta Gorda</td>
<td>5.0</td>
<td>Minor</td>
</tr>
<tr>
<td>2/26/2007</td>
<td>Ferndale</td>
<td>5.4</td>
<td>Minor</td>
</tr>
<tr>
<td>1/9/2010</td>
<td>Ferndale</td>
<td>6.5</td>
<td>Minor</td>
</tr>
<tr>
<td>2/13/2012</td>
<td>Weitchpec</td>
<td>5.6</td>
<td>Minor</td>
</tr>
<tr>
<td>3/10/2014</td>
<td>Ferndale</td>
<td>6.8</td>
<td>Off coast, minor damages</td>
</tr>
<tr>
<td>7/29/2017</td>
<td>Ferndale</td>
<td>5.1</td>
<td>Minor</td>
</tr>
</tbody>
</table>

Potential Impacts of the Hazard

The shaking of the ground from earthquakes can result in building collapse, bridge failure, utility disruptions and other structural collapse. Large earthquakes can additionally cause natural gas lines to break resulting in structure fires. The proximity to the unstable soils surrounding the campus presents a potential for liquefaction creating greater ground instability during seismic events. A major earthquake in the Eureka area would likely result in region-wide social disruptions in addition to structural damages. The region-wide structural damages may disrupt lifelines and supply chain routes limiting the campus from effective evacuation routes and receiving necessary supplies or equipment. The few roadways into and out of the Eureka area are vulnerable to seismic shaking and the resulting landslides that could occur.

Most injuries resulting from earthquakes are from collapsing walls, flying glass, or other objects moved by ground shaking. The lack of warning allows individuals

51 Humboldt County Operational Area Hazard Mitigation Plan, January 2020
minimal time to react and find areas of safety. A moderate earthquake occurring near Eureka could cause injuries or fatalities to members of the campus community or support networks the campus relies on. These earthquake effects might be aggravated by collateral incidents such as fire, flooding, hazardous material spills, dam/levee compromises, and other cascading events. A catastrophic earthquake near Eureka or Arcata could result in extensive casualties, expansive structural damages, panic, widespread utility outages, communication failures, and secondary emergencies such as fire. A catastrophic earthquake would certainly affect the broader North Coast region limiting immediate assistance that the campus may normally expect.

Local impacts to the Humboldt State University campus caused by an earthquake could include:

- Damage and secondary fires to commercial buildings to the west of campus
- Potential hazardous material releases on and off campus
- Infrastructure damage to freeway system, US Highway 101 is critical link to communities along the coast
- Structural damage to bridges over waterways, flood control channels, and roadways
- Potential for movement of soils along hillsides
- Potential for earthquake generated tsunami threatening the Humboldt and Arcata Bays including the dock location of the R/V Coral Sea and Marine Laboratory in Trinidad
- Isolation of the Trinidad based Marine Laboratory
- Potential isolation of campus from community
- Potential isolation among on-campus residents
- Structural damage to Mad River levees
- Structural damage to levees lining the Arcata Bay
- Structural damage to campus academic and support buildings
- Loss of academic research, documentation, equipment, and materials
- Structural damage to residence halls resulting in displaced student populations
- Structural damage to nearby residences especially older construction
- Community members arriving on campus for refuge from damaged homes
- Damaged university communications, computer systems, and networks
- Considerable stress and fear among community
- Closure or reduction of service to campus operations
- Potential reduced capacity to provide services to campus community
Reduction of campus revenue

Probability of Future Occurrence of the Hazard

The Working Group on California Earthquake Probabilities (WGCEP), a collaboration between the United States Geological Survey (USGS), the Southern California Earthquake Center (SCEC), and the California Geological Survey (CGS) develops Uniform California Earthquake Forecasts (UCERFs) using the best currently available science and technology. The UCERF version 3 provides a three-dimensional view of the likelihood a region in California will experience a Magnitude 6.7 or greater earthquake in the next 30 years. The likelihood for the Humboldt County fault systems surrounding the Eureka region is included in the following table.

Table 11-18: Major Potentially Active Faults in Proximity to Humboldt State University52

<table>
<thead>
<tr>
<th>Fault Zone</th>
<th>Recurrence</th>
<th>Maximum Magnitude</th>
<th>UCERF3 Likelihood</th>
</tr>
</thead>
<tbody>
<tr>
<td>Eaton Roughs</td>
<td>Historic: Unknown</td>
<td>6.7 to 7.6</td>
<td>6-8%</td>
</tr>
<tr>
<td>Garberville</td>
<td>Historic: Unknown</td>
<td>6.5 to 7.0</td>
<td>3%</td>
</tr>
<tr>
<td>Little Salmon</td>
<td>Historic: 400-800</td>
<td>6.5 to 7.0</td>
<td>4-10%</td>
</tr>
<tr>
<td>Mad River</td>
<td>Historic: 3500</td>
<td>6.7 to 7.4</td>
<td>1%</td>
</tr>
<tr>
<td>Mendocino</td>
<td>Historic: Unknown</td>
<td>6.7 to 7.9</td>
<td>19-22%</td>
</tr>
<tr>
<td>McKinleyville</td>
<td>Historic: 3500</td>
<td>6.7 to 7.4</td>
<td>1%</td>
</tr>
<tr>
<td>Table Bluff</td>
<td>Historic: Unknown</td>
<td>6.5 to 7.0</td>
<td>1-2%</td>
</tr>
<tr>
<td>Trinidad</td>
<td>Historic: 150-200</td>
<td>6.7 to 7.4</td>
<td>2-4%</td>
</tr>
</tbody>
</table>

The Humboldt County Operational Area Hazard Mitigation Plan describes the probability of an earthquake Magnitude of 6.7 or greater in Northern California over the next 30 years is 95%. The Plan further illustrates that specific to the Eureka area

52 Humboldt County Operational Area Hazard Mitigation Plan 2019, January 2020

earthquake activity is a regular occurrence and the region could see a Magnitude earthquake in the future. 54

Based on the earthquake shaking potential in the Humboldt County area, the proximity to the fault systems illustrated above, and the proximity to liquefaction zones, the probability of seismic ground shaking that would generate damage is considered **Possible**.

**Vulnerability to the Hazard**

A considerable challenge regarding earthquakes is they generally occur without warning. The fault systems surrounding the region all cross major transportation routes potentially reducing the availability of access and the supply chain. The geographic location of Humboldt State University places the campus in a mostly rural community near residential, commercial, and industrial areas that is lightly populated. Earthquake effects experienced in the neighboring local community will likely spill over onto the campus.

The known fault systems generating the threat to the Northern California Coast region generally surround the area and some cross near the Humboldt State University campus. The campus resides in a region that is exposed to fault systems on all sides. The proximity and potential for large earthquake development from these surrounding systems expose significant vulnerabilities. The potential for earthquake damaged structures being left uninhabitable including campus residence halls will result in numerous displaced individuals and households. The lack of earthquake insurance will cause extreme financial burdens on those affected. Campus buildings and equipment would be vulnerable to damages from building, seismic shaking, secondary fires, and secondary building floods from broken pipes.

Elements of the vulnerability to a major earthquake on the Humboldt State University campus will vary depending on when the earthquake were to strike. The risk to the campus population will be lessened during periods when classes are not in session or during periods of breaks. Conversely, during the days and hours that classes are in session and staff are at their workplaces, the human vulnerability increases. Generally, people are safer when at home in wood frame structures as earthquakes tend to generate less structural damage to wood construction than in commercial or industrial facilities. The greater number of people on campus at the time of an earthquake will result in more people being exposed to effects from damaged campus facilities or equipment and require greater evacuation assistance. However, in region-wide events this vulnerability may simply shift to the homes and workplaces of members of the campus community and their families.

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54 California Earthquake Authority, California Earthquake Risk Map & Faults By County, https://www.earthquakeauthority.com/California-Earthquake-Risk/Faults-By-County
The aftermath of a major earthquake will likely result in widespread search and rescue operations for trapped and injured individuals. The demand on emergency services will be great, potentially requiring the campus community to be prepared for these scenarios and initiate response actions as needed. There will be needs for emergency medical care, shelter, water, and food for individuals who have been displaced by the earthquake. In earthquakes causing significant damages, there may be a necessity to provide assistance with sheltering and care of those unable or unwilling to return to their homes. Damages to the homes of the members of the campus community may place greater demands on campus resources and capabilities in the short-term period following a seismic event.

There may be a need to evacuate members of the campus community from the campus and to other locations that are deemed to be safer locations. This may be heightened as much of the lower campus has been identified as being within a liquefaction zone. As the Humboldt State University campus is downstream from dam facilities, the decision to evacuate will need to take into account whether flood control facilities are filled with water and the actual threat to the dam or levees.

The North Coast and Eureka / Arcata in particular are lightly populated with modest services immediately available. Humboldt County is served by only two primary surface transportation routes. US Highway 101 extends south to San Francisco and north to Oregon. California State Route 299 is a two-lane undivided highway that connects to Redding. The closest robust out of area services are 143 miles to the east in Redding or Santa Rosa 220 miles to the south. US 101 is often impacted by landslides in heavy weather events. A major earthquake has the potential for rendering these critical lifelines and supply routes inoperable and forcing the campus community to be self-reliant for a period of time.

Finally, certain campus populations will experience greater challenges to a post-earthquake environment. There are significant numbers of members of the community who live in areas most vulnerable to earthquake effects. 63% of Humboldt County residents live in high-risk earthquake areas, 58% of these who live on soils that are vulnerable to dangerous shaking have household incomes less than $50,000 per year, and 13% of those are over the age of 65. 55 Vulnerable populations including those that rely on specific services, require electrical power, homeless students, experience disabilities, non-English speakers, those whose age make evacuating difficult, and others will be most affected. These individuals will likely need to navigate through earthquake generated debris, extreme stresses of a disaster, an inability to communicate to or gain access to support networks, and find difficulty in accessing equipment or supplies to aid in a specific need.

Estimate of Potential Losses

55 Humboldt County Operational Area Hazard Mitigation Plan 2019, January 2020
Estimates of potential losses will be influenced by a variety of factors. The intensity of the earthquake will determine what scale of damages affecting campus infrastructure, equipment, and other impacted features. Losses will be generated by the physical damages, the loss of revenue, loss of academic research, loss of building contents, and community wide economic reductions.

Based on estimate replacement costs of facilities and structures on campus, the maximum total replacement costs due to earthquake are $117,600,736.

Table 11-19: HAZUS Peak Ground Acceleration Zone (PGA) Estimated Losses

<table>
<thead>
<tr>
<th>PGA Zone Designation</th>
<th>Intensity</th>
<th>No of Buildings</th>
<th>Maximum Replacement Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Extreme</td>
<td>X+</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Violent</td>
<td>IX</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Severe</td>
<td>VIII</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Very Strong</td>
<td>VII</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Strong</td>
<td>VI</td>
<td>90</td>
<td>$116,898,655</td>
</tr>
<tr>
<td>Moderate</td>
<td>V</td>
<td>1</td>
<td>$702,081</td>
</tr>
<tr>
<td>Light</td>
<td>IV</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Weak</td>
<td>II-III</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Not Felt</td>
<td>I</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>NA</td>
<td>NA</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>No Building Value</td>
<td>NA</td>
<td>27</td>
<td>Unknown</td>
</tr>
</tbody>
</table>

*Buildings with no value defined are also included in the respective Zones they are found in.

Vulnerability Assessment Conclusions

It is difficult to predict the severity of casualties, property, and cascading impacts generated by future seismic events affecting the greater Eureka region, the North Coast, and the Humboldt State University campus. Each of the earthquake generated effects will vary widely based on the intensity of the earthquake, location of the epicenter, proximity to people and development, time of day and year, the soil composition under the impacted structures, building construction, among others. In any case, the potential for a major earthquake exists affecting the campus and causing extensive challenges to the Humboldt State University campus and community.

In the event that a major earthquake was to strike along the many fault systems surrounding Arcata and Eureka, the effects could be significant to the campus community and campus operations. The widespread impacts generated by a major
earthquake would extend the effects of casualties, damages, and other impacts to the broader Northern California Coast region creating large-scale regionwide needs for critical assistance and a heavy demand on limited emergency resources. The threat and impacts presented to the campus will be shared with the campus community from their homes and places of work. The campus will likely be required to address critical needs independently during early phases of the disaster.

Vulnerabilities will be seen in the physical infrastructure on the campus and the human population of the campus community. Campus infrastructure is vulnerable to severe shaking particularly in areas where the ground is loose or susceptible to liquefaction. Specifically older buildings, masonry constructed buildings, and other structures susceptible to shaking related damage are the most vulnerable. Communication systems, computer networks, and other electronic systems may be vulnerable when overwhelmed by increased demand during emergencies or by shaking related damages. The people of the campus community are vulnerable to effects of intense shaking in the form of injuries from falling debris, exposure to secondary floods or fires, loss of employment, extreme disaster induced stress, and loss of access to critical services or social contacts.

The campus population are additionally vulnerable to the effects of major ground shaking that are far reaching. The psychological and social impacts a major earthquake will give rise to will potentially harm individuals and cause tremendous fear. The willingness to return indoors may be hampered especially as after-shocks continue. These effects are magnified for populations having specific vulnerabilities or access limitations. Populations having various limitations or specific needs may be vulnerable to reduced or eliminated access to essential services that have been rendered incapable to respond.

Identified Data Limitations

Missing campus structural replacement costs and an inventory of building construction types to include status of earthquake retrofitting. HAZUS generated analysis is focused on the broader community level versus finetuning the analysis to the micro-level for facilities such as a university campus.
Erosion

Description of the Hazard
The US Geological Survey (USGS) defines erosion as “the process whereby materials of the earth’s crust are loosened, dissolved, or worn away and simultaneously moved from one place to another.” Erosion may occur in areas of streams and rivers, along bluffs, around immovable objects (such as buildings or bridge abutments), or as a cascading result of other natural hazards, such as earthquakes or wildfires. When erosion occurs along bodies of water, the removal of material causes the shore to move further landward.

Forces such as sea level rise and changes in sediment supply impact erosion gradually and can be difficult to recognize. In contrast, the impacts of short-term events, such as storms and flooding, can be severe and are immediately recognizable. Along the Pacific coast, rain, wind, and waves can induce significant short-term erosion.

Location of the Hazard
Erosion is a hazard in coastal communities, where sea level rise and storms contribute to de-sedimentation and the retreat of coastal cliffs, bluffs, and beaches. While coastal erosion can happen in any storm, it is more likely during El Nino events, which occur every 5-7 years. For the purpose of this campus-level analysis, the erosion hazard poses a consistent risk across those areas of the campus with erosion-prone characteristics.

Other incidents of erosion, such as occurs around buildings, are relatively non-spatial and can occur in any locations with conducive soil structure and a source of movement, such as water or wind. An area’s potential for erosion is determined by several factors, including rainfall, topography, soil characteristics, and vegetative cover.

Extent of the Hazard
Erosion is occurring on the Pacific coastline west of CSU Humboldt. While there is no published scale of severity or extent for this geologic hazard on the CSU Humboldt campus, erosion is likely to occur if conditions are favorable, and given that such conditions have been identified on campus, as well as the history of occurrence (albeit limited) the planning committee ranks the extent of this hazard as Low to Moderate.

History of the Hazard

Erosion hazards have been recorded at the Telonicher Marine Lab and along the coastline. There are no other recorded incidents of erosion on the CSU Humboldt campus.

Coastal erosion can result in severe impacts to infrastructure, including the undermining of foundations, exposure of underground infrastructure, and breaches of natural or constructed protections. The latter can expose communities to the destructive forces of floodwaters, surge, and debris impacts. On campus, areas of erosion can create pedestrian and transportation hazards, and structures may become unsafe if erosion is not controlled. Public health and safety, structures, and infrastructure can all be negatively impacted, damaged, or destroyed by the erosion hazard.

**Probability of Future Occurrence of the Hazard**

Erosion is an on-going and dynamic process that occurs regularly. As climate change raises sea levels and induces more frequent and intense weather events, coastal and other erosion may generally become more widespread or severe. As a result, and in consideration of the potential extent of erosion on campus, the probability of at least a limited degree of erosion taking place in the future is **High** over the long term.

**Vulnerability to the Hazard**

Topography, soil structure, land use, and precipitation are all factors of erosion. CSU Humboldt infrastructure and buildings located on steep slopes, in areas with little vegetation, or in areas with conducive soil types are more vulnerable to erosion.

In the wider Arcata community, erosion vulnerabilities include agricultural sector job loss, degradation of riverine ecosystems and coastlines, and loss of water quality.

**Estimate of Potential Losses**

The historic and potential impacts of erosion on property statewide include reduced agricultural productivity, lower surface water quality, and damaged drainage networks.

Current modeling is not precise enough to allow for an assessment of potential losses to buildings and infrastructure on campus.

**Vulnerability Assessment Conclusions**

While the ability to predict future erosion on the CSU Humboldt campus is limited, the core issues shaping erosion vulnerability on campus are flora and landscaping. If left unchecked, erosion can cause significant damage to campus infrastructure and the surrounding environment.

**Identified Data Limitations**
The complex interactions between soil erosion factors make predictive modeling, determination of hazard areas, and quantification of loss difficult. Localized data on this hazard is also limited, resulting in more generalized findings.

**Extreme Temperatures (Includes Extreme Cold and Extreme Heat)**

**Heat**

**Description of the Hazard**

What is considered an excessively hot temperature varies according to the normal climate for that region. However, when temperatures are extremely high, people are at higher risk for heat-related illnesses, such as dehydration, heat exhaustion, heat stroke, and in severe cases, death.57

Hazards from extreme heat are made worse when high temperatures are accompanied by high levels of humidity, which is defined as the amount of moisture in the air.58 As the temperature climbs, the air is able to hold more moisture. High humidity prevents the human body from cooling down naturally, which leads people to perceive that the temperatures “feels” hotter. The combination of temperature and humidity is known as the heat index.59

Heat stroke, the most serious heat-related illness, occurs when the body is unable to control its temperature. Body temperature rises rapidly, the sweating mechanism fails, and the body cannot cool down.60 In extreme causes, heat stroke can cause confusion and unconsciousness, so the victim is unable to seek treatment without assistance.

There are several groups of people who are uniquely vulnerable to the effects of extreme heat, such as infants and children, older adults aged 65 and up, athletes and outdoor workers, low-income households, and individuals with certain chronic medical conditions.61

**Location of the Hazard**


59 Ibid.


Extreme heat events are a non-spatial hazard and may occur throughout the Humboldt State campus.

Extent of the Hazard

Extreme heat has a wide range of extent and severity markers and characteristics. Monthly average maximum temperatures in June through October range approximately from the low 60s to mid-60s in Arcata, California, where Humboldt State is located. According to data from the National Climatic Data Center (NCDC), the highest daily temperature recorded at the Arcata Eureka Airport was 96° F on September 2, 2017. This was during a statewide heat wave that caused all-time record highs and record highs for September. That said, given the limited history of events and low probability of future events due to the campus’ cooler coastal climate, the planning committee ranks the extent of the hazard as Low.

The National Weather Service issues a Heat Advisory when the heat index value is expected to reach 100° – 104° F within the next 12 to 24 hours. Excessive Heat Warnings are issued when there is an anticipated heat index of 105° F or greater that will last for two (2) or more hours. Excessive Heat Warnings are issued by the county when any location in the county is expected to reach that criteria. In anticipation of an Excessive Heat Warning, an Excessive Heat Watch may be issued 1 to 2 days in advance, when the Heat Warning criteria is 50 – 79% likely to occur.

Figure 11-10 (following) depicts the National Weather Service’s methodology for determining the heat index, using the % humidity and the actual temperature.

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As the heat index rises, so does the potential danger to people and animals. Table xx (following) shows the health hazards associated with extreme heat.
<table>
<thead>
<tr>
<th>Category</th>
<th>Heat Index</th>
<th>Health Hazards</th>
</tr>
</thead>
<tbody>
<tr>
<td>Extreme Danger</td>
<td>130° F or higher</td>
<td>Heat stroke / sunstroke is likely with continued exposure.</td>
</tr>
<tr>
<td>Danger</td>
<td>105° – 129° F</td>
<td>Sunstroke, heat cramps, and/or heat exhaustion is likely with prolonged exposure and/or physical activity.</td>
</tr>
<tr>
<td>Extreme Caution</td>
<td>90° – 104° F</td>
<td>Sunstroke, heat cramps, and/or heat exhaustion is possible with prolonged exposure and/or physical activity.</td>
</tr>
<tr>
<td>Caution</td>
<td>80° – 89° F</td>
<td>Fatigue is possible with prolonged exposure and/or physical activity.</td>
</tr>
</tbody>
</table>

Based on no record of extreme heat events on campus, and only 1 event county-wide, along with the County’s established protocols of providing the public with advanced notice of heat events with directives for mitigating impacts, the planning committee ranks the extent of this hazard on campus as Low.

**History of the Hazard**

Based on data gathered from the National Centers for Environmental Information (NCEI) Storm Events Database, there has been only one heat event (July 10, 2002) that has affected Humboldt County since 1990. However, this event did not impact the Arcata area of the county. According to NCDC data, the maximum recorded temperature that day at the Eureka airport was 65° F.

**Potential Impacts of the Hazard**

During an excessive heat event, Humboldt State may experience impacts from extreme heat due to cancelled classes or postponed outdoor events in order to protect students, faculty, and staff from the weather.

In addition to the threat extreme heat poses to humans, high temperatures also pose a threat to utility production, which in turn threaten facilities and operations that rely on utilities. As temperatures rise, more people stay indoors, increasing the demand for air conditioning, fans, and other electronics. This puts a strain on the electrical grid, which can cause temporary outages. These outages can impact operations throughout campus, resulting in interruptions and delays in service. Outages may also negatively impact research efforts on campus, as the inability to maintain a steady, constant temperature may impact research specimens and experimental results.

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Probability of Future Occurrence of the Hazard

No extreme heat events have impacted the City of Arcata in three decades. Using the scale provided, it is unlikely that the hazard will occur annually. Notably, the Humboldt County Hazard Mitigation Plan also does not include excessive heat as a potential hazard for the county or its jurisdictions.64

Vulnerability to the Hazard

When dealing with an extreme heat event, the most common impacts are those generally felt by the people living in the targeted area. For people in particular, heat can kill when the body is pushed beyond its limits. Most heat disorders occur because the victim has been overexposed to heat. As discussed, the major human risks associated with extreme heat include dehydration, sunburn, fatigue, heat exhaustion, heat stroke, and in severe cases, death.

Some portions of the population are more at risk to the effects of extreme heat. The very young, the elderly, and certain groups with chronic medical conditions (such as asthma or other pulmonary illnesses, heart disease, poor blood circulation, neurological illnesses, and obesity) are generally more vulnerable to the effects of extreme heat, and are more likely to suffer illness or death as a result.65 This is especially true if exposure is extended for a period of time and preventative measures are not taken immediately.

CSU Humboldt is aware that they are unlikely to face an extreme heat event. Accordingly, most campus buildings do not have air conditioning. This could be problematic for the campus even if Humboldt County were to face even a mild heat wave, as there would be limited ways for students and staff to cool down, and vulnerable populations would be at higher risk of heat-related conditions.

Although this is not a hazard that the campus will experience regularly, CSU Humboldt may want to consider investing in back-up cooling options.

Estimate of Potential Losses

Based on the previous historical occurrences, annualized losses are considered to be negligible. In an extreme heat event, loss of human life or health impacts are a greater concern than is property damage, and in Humboldt County, heat events are rare.

Vulnerability Assessment Conclusions


While the ability to predict future heat events at the CSU Humboldt campus is limited, the effects of climate change may provide some information. According to the Environmental Protection Agency (EPA), Southern California has warmed approximately 1.5 degrees on average over the last century, with less rainfall. This may lead to stronger and more frequent heat events, drought, and an increased risk of wildfires.\textsuperscript{66}

**Cold**

**Description of the Hazard**

What is considered an excessively cold temperature varies according to the normal climate for that region. However, when temperatures are far below normal, with higher wind speeds, heat leaves the human body more rapidly, which increases the possibility of negative effects from these extreme temperatures.\textsuperscript{67}

The greatest danger from extreme cold is to people, as prolonged exposure can cause frostbite or hypothermia, and can become life threatening. When someone is suffering from hypothermia, body temperatures can become so low that they affect the brain, making it difficult for the victim to think clearly or move well. In the case of frostbite, the frozen tissue becomes numb and the victim may be unaware that anything is wrong until someone else notices.\textsuperscript{68} This makes hazards from extreme cold particularly dangerous, as people may not understand what is happening to them or what to do about it.

The primary hazards from extreme cold are frostbite and hypothermia. Frostbite is caused by freezing of the skin and underly tissue. It causes a loss of feeling and color in the affected areas of the body, and most often affects the nose, chin, fingers, or toes.\textsuperscript{69} It can be permanently damaging if not treated promptly and can lead to infection, nerve damage, or amputation in severe cases.\textsuperscript{70} The risk of frostbite is increased in people with preexisting conditions, the elderly, people with reduced blood circulation, and people who are not dressed warmly enough for the conditions.


\textsuperscript{67} National Weather Service. *Stay Safe in the Extreme Cold*. Retrieved 01.29.21 from: https://www.weather.gov/dlh/extremecold


\textsuperscript{69} Mayo Clinic. *Frostbite: Overview*. Retrieved 01.29.21 from: https://www.mayoclinic.org/diseases-conditions/frostbite/symptoms-causes/syc-20372656

\textsuperscript{70} Ibid.
Hypothermia occurs when the body loses heat faster than it can produce heat, causing a dangerously low body temperature. A normal body temperature is around 98.6° F. Hypothermia occurs when your body temperature falls below 95° F. As this happens, the heart and other essential organs cannot work properly. If hypothermia is not treated, it can lead to heart failure, respiratory failure, and eventually to death.

Excessive or extreme cold can accompany severe winter weather, or it can occur without severe weather. For this reason, extreme cold is a separate hazard from severe winter storms.

Location of the Hazard

Extreme cold events are a non-spatial hazard, and may occur throughout the Humboldt State campus.

Extent of the Hazard

Extreme cold has a wide range of extent and severity markers and characteristics. Average nighttime winter temperatures in the City of Arcata are typically in the low 40s. According to data from the National Climatic Data Center (NCDC), the lowest daily temperature recorded in Arcata was 11° F on February 25, 2008. That said, given the limited history of freeze/frost events, no history of extreme cold, and low probability of future events, the planning committee ranks the extent of the hazard as Low.

The National Weather Service issues Extreme Cold Warnings when the temperature feels like it is -30° F or colder across a wide area for a period of at least several hours. When possible, these advisories are issued a day or two in advance of the conditions.

The most common extent/severity marker for extreme cold is the Wind Chill scale. Figure xx (following) depicts the National Weather Service’s methodology for determining the wind chill, using wind speed and actual temperature. Although wind chill is not necessarily related to extreme cold as a single cause, the advisory system that the NWS currently uses relies on wind chill to relay warning and advisory information to the public. Extreme cold severity is a function of wind chill and other factors, such as precipitation amount (rain, sleet, ice, and/or snow).

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In 2011, the National Weather Service introduced an experimental program that issued warnings for extreme cold events, independent of other severe weather warnings. The test areas included North and South Dakota and Minnesota. However, in 2012, after a single season of use, the program was abandoned, based on reports of confusion among test audiences. Based on the fact that Humboldt County has had just three cold/wind chill or frost/freeze events dating back to 1998 and extreme cold events, the planning committee ranks the extent of the hazard as Low.

History of the Hazard

Based on data gathered from the National Centers for Environmental Information (NCEI) Storm Events Database, Humboldt County has had three cold/wind chill or frost/freeze events dating back to 1998, but no extreme cold hazards. [Records for this hazard were first recorded in 1996].

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Potential Impacts of the Hazard

Should an extreme cold event occur, Humboldt State might experience impacts due to cancelled classes.

In addition to the threat posed to humans, extreme cold weather poses a significant threat to utility production, which in turn threatens facilities and operations that rely on utilities, specifically climate stabilization. As temperatures drop and stay low, increased demand for heating places a strain on the electrical grid, which can lead to temporary outages. These outages can impact operations throughout the campus, which can result in interruptions and delays in services. These outages may also negatively impact research efforts throughout the campus, as the inability to maintain a steady, constant temperature may result in unintended effects on research specimens.

Probability of Future Occurrence of the Hazard

The City of Arcata has experienced cold/wind chill and freeze/frost events, but has never experienced an extreme cold event. Due to the City’s location and its temperate climate, it is unlikely that this hazard will occur annually at Humboldt State.

Vulnerability to the Hazard

When dealing with an extreme cold event, the most common impacts are those generally felt by the people living in the targeted area. For people in particular, extreme cold can kill when the body is pushed beyond its limits. Most danger due to the cold is because the victim has been overexposed to low temperatures. As discussed, the major human risks associated with extreme cold include frostbite, hypothermia, and in severe cases, death.

Some portions of the population are more at risk to the effects of extreme cold. The elderly, those with certain preexisting conditions (hypothyroidism, diabetes, and high blood pressure, just to name a few), those with poor blood circulation, and people who are not dressed warmly enough for the cold are generally more vulnerable and are more likely to suffer illness or death as a result. This is especially true if exposure is extended for a period of time and preventative measures are not taken immediately.

CSU Humboldt is aware that they face little potential for extreme cold events. In the case of occasional freeze/frost events, if the temperature drops below 32° for six hours or more, the campus will issue warnings to students and staff about keeping the heat running at a certain temperature in order to protect pipes from freezing and bursting.

Based on the previous historical occurrences of extreme heat events, annualized losses are considered to be negligible. In an extreme heat event, loss of human life or health impacts are a greater concern than is property damage.

**Vulnerability Assessment Conclusions**

While the ability to predict future extreme cold events at the CSU Humboldt campus is limited, the effects of climate change may provide some information. According to the Environmental Protection Agency (EPA), areas in northern California have warmed approximately 1.5 degrees on average over the last century, with less rainfall. This may lead to fewer frost/freeze events in the future.75

**Identified Data Limitations**

Numerous public and private actors conduct research, acquire data and disseminate meteorological information and forecasting to the general public, including the CSU university system. Currently, it is assumed that, apart from regular access to climate change models on changes to temperature extremes over time, the CSU community maintains sufficient access to the data needed to plan for, respond to, and mitigate the effects of extreme heat and cold.

**Flood**

**Description of the Hazard**

The incredible geographic diversity in California presents tremendous challenges for flood planning and response. The state is home to extensive mountain ranges such as the Sierra Nevada, Cascades, Klamath, Coastal Ranges, and the Southern California Transverse Range all creating tremendous watersheds. Large river systems drain the mountains traveling through populated communities including the Sacramento and San Joaquin Rivers draining into the California Delta. The state has a complex system of reservoirs, dams, and levees providing water storage and flood protection. Finally, California’s 840-mile coastline exposes the coastal regions to tidal influences.

Floods are characterized by the rising and overflowing of excess water from a water source such as a stream, river, lake, canal, or coastal body onto an area of normally dry floodplain. A floodplain is a lowland area downstream and adjacent to water bodies that are subject to flood events. Flooding is a naturally occurring event that become hazardous when populations and property are affected.

Flooding can result from excessive precipitation from weather systems generating prolonged rainfall, excessive snowmelt from watersheds upstream from the floodplain, infrastructure failure, exceeding the capacity of dams or levees, tidal influences, or a combination from any of the previous factors.

Floods represent one of the costliest and most frequent natural disasters that influences human suffering and economic impact in the United States. Flooding will likely result in significant damage to structures, infrastructure, utilities, landscapes, and the environment. Erosion of stream banks, roadways, other feature may result from the movement of flood waters. The saturated ground resulting from standing flood waters may cause ground instability, collapse, erosion, or other damages. Further, floods will often generate substantial debris that will accumulate and be deposited throughout the flooded areas.

Floods can be either slow-rise or rapid onset floods. With slow rise floods, there is often warning preceding water rise by hours or days before dangerous conditions present themselves. Slow rise floods that are expected to enter into populated areas generally allow for some time to initiate evacuation and sand bagging efforts. Flooding that occurs rapidly conversely are water events that present with extremely limited warning times and a limited ability to take response actions until flooding has already begun to occur.

Flooding may take on different forms:

- **Flash Flooding** – Flash flooding is typically characterized by a rapid rise, short duration, and large volume of water in a localized area. Heavy rainfall in areas that have limited drainage capacities often contribute to flash flooding conditions. These flooding events frequently occur with limited notice requiring immediate evacuation or rapid response efforts such as sand bagging. Flash flooding may arrive with fast moving water creating added hazardous conditions.

- **Riverine Flooding** – Riverine flooding is usually caused by prolonged rainfall or rainfall combined with heavy snowmelt. When soils are already saturated, the ability for the ground to absorb water is minimized. In a riverine flood, the water way exceeds channel capacity and extends into areas outside of the channel, often in developed communities. In California, riverine flooding is most likely to occur from November through April. The duration of riverine floods may vary from a period of hours to weeks.

- **Localized Flooding** – Localized flooding is commonly the result of stormwater drainage systems being overwhelmed by unusually heavy rainfall. These flooding events frequently occur in areas that are urbanized or developed with greater amounts of impervious surfaces not allowing ground absorption. This generates added runoff into the drainage systems and onto roadways creating backups.
- **Infrastructure Failure** – Failures of dams or levees presents a serious flooding concern for areas downstream from the compromised structure. This situation may result in a catastrophic flood with limited warning time and widespread areas affected.

- **Coastal Flooding** – Coastal flooding can occur in multiple areas along the California coastline. Flooding may result from intense storms coming from the Pacific Ocean that generate elevated water levels or storm surge. The size, duration, winds generated, and intensity of the storm will influence the effect the waves will have on the shoreline. Periods of high tide can aggravate the conditions allowing greater wave impingement into coastal areas.

**Atmospheric River**

California, including the location of this campus, is subject to the effects of a phenomenon referred to as atmospheric rivers. These weather events consist of long, narrow regions in the atmosphere transporting tremendous amounts of water vapor from the tropics. These weather regions behave like rivers in the sky. They can carry heavy volumes of water vapor compared to the amount of water flow at the mouth of the Mississippi River. As these atmospheric rivers arrive into California they tend to generate significant rain and snow.

Atmospheric rivers can arrive in many different shapes and sizes. The larger events are able to generate extreme rainfall amounts resulting in flooding. They can stall over watersheds vulnerable to flooding, often saturated with heavy snow amounts. The atmospheric rivers known as a “Pineapple Express” coming from the tropics and arriving with warmer air may produce heavy rains that will melt ground snow adding to the water volume that will be added in the flood runoff.

These events can produce heavy amounts of precipitation creating extensive damages. However, these events may present as weaker systems that produce precipitation that is enough to be beneficial for the local water supply. At the higher elevations in the California mountains, these events have the potential to generate a tremendous snowpack providing a source of water during the dry summer months.

Figure 11-12: Science behind Atmospheric Rivers

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76 National Oceanic and Atmospheric Administration, “What are atmospheric rivers?”, https://www.noaa.gov/stories/what-are-atmospheric-rivers
Humboldt County is home to a variety of waterways, flood control facilities, and levee systems along the Mad River and the Eureka Plain surrounding Arcata Bay. The Mad River is one of the rivers that drains the mountains of Humboldt County and Ruth Lake in Trinity County. The Mad River drains into the Pacific Ocean 2 ½ miles north of the Humboldt State campus. The Eel River drains the Northern Coast Ranges and the southern portions of Humboldt County and northern Mendocino County. The Eel River drains into the Pacific Ocean 12 miles south of Eureka.
The Mad River is a year-round flowing river draining a 497 square mile watershed of the North Coast Range. The river feeds into the Pacific Ocean after flowing for 113 miles. The Ruth Lake reservoir in Trinity County is 70 miles upstream providing the only regulated section of river between the campus and the lake. The Jollie Giant Creek is a small creek flowing along the north side of the campus from the hills immediately to the east. The Humboldt State University campus is situated slightly higher in elevation on a hillside from the coastal plain.

Levees have been constructed to protect populated and agricultural areas of Arcata near the Humboldt State University campus. Levees are used in containment of river rise, tidal influence, and barriers from sloughs in areas of the coastal Eureka Plain floor. The Humboldt State University campus is located outside of any designated levee protected zone identified in the National Levee Database77 affecting no facilities.

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on the campus. The Humboldt State University campus lies mostly in Zone X and outside of Special Flood Hazard Areas and levee flood protected areas.

Extent of the Hazard

The Humboldt State University campus is located mostly in a designated Zone X: Area of Minimal Flood Risk. There are large portions of the community surrounding the campus on the south, west, and north sides located within a Zone AE: 1% Annual Chance Flood Hazard. The access routes into and out of the campus servicing locations in Oregon, south to Eureka and beyond, and east to Redding are found in areas designated as Zone AE: 1% Annual Chance Flood Hazard placing these transportations routes in threatened areas. Because the Humboldt State University campus lies outside of Special Flood Hazard Areas and levee flood protected areas, flooding does not substantially alter the ability of the campus to maintain operations as the distance to levee protected channels exceeds the protection zones.

Based on the above conditions, the planning committee ranks the extent of the hazard on campus as \textbf{Low}.

In support of the NFIP, FEMA identifies those areas that are more vulnerable to flooding by producing Flood Hazard Boundary Maps (FHBM), Flood Insurance Rate Maps (FIRM), and Flood Boundary and Floodway Maps (FBFM). Several areas of flood hazards are commonly identified on these maps, including the 1% annual chance flood zone. Flood zones are further delineated by risk and are assigned a letter signifier. The flood zone designations are defined and described in the following table.

Table 11-21: Flood Zone Designations and Descriptions

<table>
<thead>
<tr>
<th>Zone Designation</th>
<th>Percent Annual Chance of Flood</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Zone V</td>
<td>1%</td>
<td>Areas along coasts subject to inundation by the 1% annual chance of flooding with additional hazards associated with storm-induced waves. Because hydraulic analyses have not been performed, no BFEs or flood depths are shown.</td>
</tr>
<tr>
<td>Zones VE and V1-30</td>
<td>1%</td>
<td>Areas along coasts subject to inundation by the 1% annual chance of flooding with additional hazards associated with storm-induced waves. BFEs derived from detailed hydraulic analyses are shown within these zones. (Zone VE is used on new and revised map in place of Zones V1-30.)</td>
</tr>
</tbody>
</table>
### History of the Hazard

Flooding in Arcata and Eureka and the broader California North Coast region have typically occurred during the winter months when Pacific storms are more common. The occurrences of significant flooding typically have been the result of successive intense storms with heavy precipitation. The region has experienced flood events that have caused millions of dollars in damages and casualties. The following provides insight into information of past flooding events that are significant to the Humboldt State University campus. No record of flood events are reported for the campus, and

#### Zone A
- **1%**
- Areas with a 1% annual chance of flooding and a 26% chance of flooding over the life of a 30-year mortgage. Because detailed analyses are not performed for such areas, no depths or base flood elevations are shown within these areas.

#### Zone AE
- **1%**
- Areas with a 1% annual chance of flooding and a 26% chance of flooding over the life of a 30-year mortgage. In most instances, BFEs derived from detailed analyses are shown at selected intervals within these zones.

#### Zone AH
- **1%**
- Areas with a 1% annual chance of flooding where shallow flooding (usually areas of ponding) can occur with average depths between 1 – 3 feet.

#### Zone AO
- **1%**
- Areas with a 1% annual chance of flooding, where shallow flooding average depths are between 1 – 3 feet.

#### Zone X (shaded)
- **0.2%**
- Represents areas between the limits of the 1% annual chance flooding and 0.2% chance flooding.

#### Zone X (unshaded)
- **Undetermined**
- Areas outside of the 1% annual chance floodplain and 0.2% annual chance floodplain, areas of 1% annual chance sheet flow flooding where average depths are less than one (1) foot, areas of 1% annual chance stream flooding where the contributing drainage area is less than one (1) square mile, or areas protected from the 1% annual chance flood by levees. No BFEs or depths are shown within this zone.
only isolated flooding and small-scale ponding occasionally occurs during heavy rainfall events.

Table 11-22: Historic Flooding Events in Humboldt County

<table>
<thead>
<tr>
<th>Date</th>
<th>Event</th>
<th>Declaration</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>May 2019</td>
<td>Flood; Winter Storms</td>
<td>DR-4434-CA</td>
<td>Countywide</td>
</tr>
<tr>
<td>May 2017</td>
<td>Flood; Heavy Rains</td>
<td>DR-4308-CA</td>
<td>Countywide</td>
</tr>
<tr>
<td>February 2017</td>
<td>Flood; Winter Storms</td>
<td>DR-4301-CA</td>
<td>Countywide</td>
</tr>
<tr>
<td>February 2017</td>
<td>Flood; Winter Storms</td>
<td>DR-4302-CA</td>
<td>Countywide</td>
</tr>
<tr>
<td>February 2006</td>
<td>Flood; Winter Storms</td>
<td>DR-1628-CA</td>
<td>Countywide</td>
</tr>
<tr>
<td>February 1998</td>
<td>Flood; Winter Storms</td>
<td>DR-1203-CA</td>
<td>Countywide</td>
</tr>
<tr>
<td>January 1997</td>
<td>Flood; Winter Storms</td>
<td>DR-1155-CA</td>
<td>Countywide</td>
</tr>
<tr>
<td>March 1995</td>
<td>Flood; Winter Storms</td>
<td>DR-1046-CA</td>
<td>Eel River</td>
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<tr>
<td>January 1995</td>
<td>Flood; Winter Storms</td>
<td>DR-1044-CA</td>
<td>Countywide</td>
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<td>DR-935-CA</td>
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<td>Flood</td>
<td>DR-758-CA</td>
<td>Countywide</td>
</tr>
<tr>
<td>January 1983</td>
<td>Flood; Winter Storms</td>
<td>DR-677-CA</td>
<td>Countywide</td>
</tr>
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<td>February 1973</td>
<td>Flood; Winter Storms; Tide</td>
<td>DR-364-CA</td>
<td>Countywide</td>
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<tr>
<td>December 1964</td>
<td>Flood; Winter Storms</td>
<td>NA</td>
<td>Mad and Eel Rivers</td>
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Humboldt County Operational Area Hazard Mitigation Plan 2019, January 2020
The following flood summaries are provided by the Humboldt County Operational Area Hazard Mitigation Plan.

The December 1955 flood occurred following weeks of above-normal precipitation in the county, with rainfall measurements reaching as high as 24 inches over three days in Cummings. Damage in the Eel River Basin exceeded $22 million, with one reported fatality and 43,000 acres flooded. Heavy debris carried by high velocity river flows caused the majority of the damage.

Heavy rains accompanied by runoff from an unusually large snowpack led to flooding of the Mad and Eel Rivers in December 1964. Total damage reached $100 million, with entire communities being destroyed (including Pepperwood, the site of the 1955 fatality) and 19 fatalities reported. Millions of board feet of lumber, thousands of acres of farmland, and 4,000 head of livestock were lost, causing a tremendous economic impact on the county.

Flooding in January of 1995 caused one death and over $15 million in damage. Flood damage was reported throughout much of the county, but the most severely impacted area was the Eel River Valley. The county received both a governor’s proclamation and a presidential disaster declaration.

The March 1995 Flood event saw continued winter storms and flooding in the months following the January 1995 event caused an additional $2 million in damage throughout the county. The county received a second presidential declaration in March 1995.

The January 1997 flood was the fifth largest flood on record in Humboldt County. The U.S. Forest Service reported that the storms of December and January produced two to three times the monthly average precipitation on the Klamath National Forest. Most the reported damage was from landslides and road failures. The estimated damage to road facilities exceeded $35 million within the Klamath National Forest.

Potential Impacts of the Hazard

A flood will potentially result in extensive amounts of water entering onto developed areas. The force and volume of water that is generated by a flood may cause extensive structural damage in areas subject to standing or moving water. The effects of flooding may spread over significant distances covering large areas of land. The extent of the impacts would vary based on a number of factors such as the volume of water flooding, the time of the flood event, the amount of warning provided, the location and extent of the flood boundary, facility elevation, and distance from the flood source. Potential impacts resulting from flooding include:

- Injuries or loss of life
- Property destruction or damage
- Loss of property contents
- Infrastructure damage including roadways, bridges, other transportation means
- Public health hazards resulting from mold, mildew, and disease due to flood water
- Flooded or destroyed lifelines/supply routes
- Damaged or destroyed utilities, including on campus power generation
- Loss of community economic base
- Employment losses
- Agricultural (crops and livestock) damages or destruction
- Environmental damage
- Prolonged periods of necessary dewatering
- Flooding erosion may alter natural drainage channels
- Threat, inundation, or damage to on campus childcare facilities and occupants
- Societal and community impacts
- Psychological impacts of impacted populations
- Disruptions to education delivery to community

Additionally, individuals unable to evacuate in time or refused to leave will likely need assistance or rescue from the flooded area. Remaining in or being trapped by flood waters places individuals in significant risk of injury or death. The impacts extend beyond the danger placed upon the affected individual and places greater resource demands on agencies and organizations making efforts to rescue trapped individuals.

Probability of Future Occurrence of the Hazard

Humboldt County is determined have considerable portions of the county to be at high risk from flooding. The repeated historic occurrences have shown that the region is subject to flooding in any given year. Floods can occur at any time but are most common in the Eureka area with winter storms off the Pacific Ocean. The area surrounding the Humboldt State University campus does not generally promote conditions for flood waters to accumulate. The campus is located on a hillside allowing drainage to occur. There are specific buildings and areas of the campus that have a greater risk for isolated flooding. The Humboldt State University campus is located within a Zone X Special Flood Hazard Area (Area of Minimal Flood Hazard) but is surrounded on the south, west, and north by areas classified as Zone A (Area Inundated by 1% Annual Chance for Flooding). Access into and out of the campus will
likely be compromised in flooding events in these areas. The Zone A areas are as close as ¾ of a mile from the campus. The Zone A areas are a result of the influences of the Arcata Bay and the Mad River. However, there is also a historic record of isolated urban or street flood events provides a demonstration of potential flood activity occurring on the campus.

Based on these conditions, the planning committee ranks the probability of future occurrence for flooding as Unlikely annually, but Possible over the long term.

**Vulnerability to the Hazard**

The Humboldt State University campus is most likely subject to minor effects of flooding resulting primarily from localized flooding and ponding from excessive precipitation and isolated strong storms. There is a more remote potential for flooding and damage on campus and surrounding residential and commercial areas of Arcata due to overflow or damage to flood control systems such as the barriers surrounding the edge of Arcata Bay of levees protecting the community from Mad River rises. The flood control channels and drainage systems that surround the campus have limited storage or volume capacities. The campus and the campus community are vulnerable to the effects generated by flooding from these systems.

Vulnerability to flooding on the Humboldt State University campus will vary depending on when the flood were to occur, and the location of people and assets within any low lying areas. The risk to the campus population will be lessened during periods when classes are not in session or during periods of breaks. Conversely, during the days and hours that classes are in session and staff are at their workplaces, the human vulnerability increases. Members of the campus community located in low lying buildings may become trapped on campus depending on the level of flooding occurring on surface streets. However, in rare, region-wide events this vulnerability may be extended to the homes and workplaces of members of the campus community and their families.

Humboldt State University is in proximity to residential neighborhoods and commercial areas. In the unlikely event that these areas are inundated with flood water, the potential for release of contaminants, hazardous materials, biological contaminants, and other chemicals presents possible exposures to individuals from the campus community. Any flood waters left standing in the area would pose a significant vulnerability to the campus community remaining on campus in potential health and safety effects.

Some campus buildings and infrastructure in low lying areas might be vulnerable if low probability, large-scale flooding were to reach the university. Campus utilities, including the on-campus power plant, and communication capabilities would be impacted by flood waters rendering them disabled. A flood covering a large portion of the city would likely affect communication capabilities well beyond the boundaries of the campus. Remaining flood waters will leave behind molds and other health concerns in affected campus buildings and facilities likely requiring extensive
restoration or demolishing. The residents of the on-campus residence halls in low lying areas may have transportation limitations requiring evacuation and alternative housing procedures to be implemented if populated. In such areas, flood waters may result in damage to campus equipment, communication systems, protected documents, artwork, academic materials, computer systems, research, and other critical activities on lower levels of buildings.

The campus community and its resource needs are vulnerable to geographic isolation during a low probability/extreme flood scenario. The Eureka and Arcata region are served by three routes into and out of Humboldt County. Extensive flooding may result in inundated transportation routes or routes that have damaged by flood erosion. Resources and services needed to support the community could be unable to use ground transportation into the area. Likewise, members of the campus community, specifically students from out of the area, might be isolated from home until repairs are made or alternative transportation methods are provided.

Certain campus populations will experience greater challenges to a post-flood / failure environment. Vulnerable populations might need to navigate through flood generated debris, face extreme health safety issues from flood waters, experience extreme stresses of a disaster, an inability to communicate to or gain access to support networks, and find difficulty in accessing equipment or supplies to aid in a specific need.

Estimate of Potential Losses

Estimates of potential losses will be influenced by a variety of factors. The volume and force of the water will determine the scale of damages affecting campus infrastructure, equipment, and other impacted features. The location and elevation above flood waters will affect the level of damage and individuals exposed. The time of the academic year, the day of week, and hour in which the flooding was to occur will influence the number of people on campus and potential casualties. The severity of the storms producing precipitation, the speed of the storms moving across the area, the level of snowpack in the higher elevations, and amount of resulting snowmelt will produce varying effects on damages produced and costs incurred. Losses will be generated by the physical damages, the loss of revenue, loss of academic research, loss of building contents, and community wide economic reductions.

Based on estimate replacement costs of facilities and structures on campus, the maximum total replacement costs due to flood are $117,600,736. However, it is unlikely for flood to cause destructive losses to the entire campus.

Special Flood Hazard Area (SFHA) Estimated Losses

<table>
<thead>
<tr>
<th>Zone Designation</th>
<th>No of Buildings</th>
<th>Maximum Replacement Cost</th>
</tr>
</thead>
</table>

11-90
### Vulnerability Assessment Conclusions

The primary vulnerabilities to flood are exposed mostly by localized flooding from isolated or large-scale storms that produce heavy amounts of precipitation directly over the campus and surrounding neighborhoods. The consequences of widespread flood could generate disaster effects to communities including Arcata. While the Humboldt campus is removed from designated flood zones, the campus remains vulnerable to localized floods due to heavy rains or overflow of campus creeks.

The potential for flooding on campus and the surrounding area generates the potential for a number of cascading effects such as disruptions to the local economy, utility failures, disruptions to providing for the needs of the community, and development of public health hazards. These effects would be exacerbated by effects of seasonal flooding, ongoing heavy precipitation, or excessive run-off from the watershed contributing to the river system. The potential for widespread flooding and damage of structures due to the force of water, while unlikely, has exponentially powerful impacts on particular segments of the campus community including those with access or functional needs, international students, the homeless, and students residing in the residence halls.

### Identified Data Limitations

Lack of comprehensive historic flooding occurrences, missing campus structural replacement costs, and complete inventory of building construction features or mitigation efforts to lessen the impact due to flood inundation.
Hazardous Materials

Description of the Hazard

A hazardous material is defined in California’s State Hazardous Materials Incident Contingency Plan (1991) as “a substance or combination of substances which, because of quantity, concentration, physical, chemical, or infectious characteristics may: cause, or significantly contribute to an increase in deaths or serious illnesses; and/or pose a substantial present or potential hazard to humans or the environment.” 79 Hazardous materials are one or more of the following: flammable, corrosive or an irritant, oxidizing, explosive, toxic (poisonous or infectious), thermally unstable or reactive, or radioactive. Hazardous materials are ubiquitous in modern society and may be found at all stages of production, consumption, and disposal.

Federal and state laws permit the intentional release of some hazardous materials into the environment such that the risk to human health and the environment is thought to be acceptable. However, sometimes releases are unintentional, resulting from leaks, accidents, or natural hazards. This section focuses on such accidental releases and fall into the following key categories:

Fixed Hazardous Materials Incident: A fixed hazardous materials incident is the accidental release of chemical substances or mixtures during production or handling at a fixed facility.

Transportation Hazardous Materials Incident: A transportation hazardous materials incident is the accidental release of chemical substances or mixtures during highway, waterway or air transport. Populations, built and natural environments are potentially impacted.

Pipeline Incident: A pipeline transportation incident occurs when a break in a pipeline creates the potential for an explosion or leak of a dangerous substance (oil, gas, etc.) possibly requiring evacuation. An underground pipeline incident can be caused by environmental disruption, accidental damage, or sabotage. Incidents can range from a small, slow leak to a large rupture where an explosion is possible. Inspection and maintenance of the pipeline system along with marked gas line locations and an early warning and response procedure can lessen the risk to those near the pipelines.

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Hazardous materials can also be classified according to worker safety and health. Information provided by California Division of Safety and Health includes guidelines related to:

- **Safety hazards**: fire and fire byproducts, electricity, flammable gases, unstable structures, demolition, sharp or flying objects, excavations)
- **Health hazards**: carbon monoxide ash, soot and dust; asbestos; hazardous liquids; other hazardous substances; heat illness)

**Natural-Technological Incidents (Natechs):** During the past two decades, increasing attention has been given to hazardous materials releases resulting from *Natechs* or a natural disaster event that triggers a technological hazard event. Natechs are of particular concern for the following reasons:

- They can produce a simultaneous effect on many industrial facilities
- Can overwhelm response capacity
- Containment systems may fail
- May produce cascading disasters
- Response may be hindered by a disaster’s impact on the physical environment

**Location of the Hazard**

Hazardous materials and infrastructure such as fuel tanks, rail lines, chemicals, hazardous waste sites and gas pipelines to varying degrees are located within the CSU system and/or within its surrounding communities. The planning committee indicates that chemicals are located in the science lab, but otherwise no known hazardous materials are present on campus. At larger scales (beyond the campus planning area) hazardous materials and infrastructure are located throughout the city and county of Humboldt and reflect different types, configurations and scales dispersed across these geographic areas.

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Extent of the Hazard

There is no comprehensive statewide vulnerability assessment available at this time. As such, the true extent of the hazardous materials risk in California and its communities is not known, meaning no overarching conclusions have been reached which have been able to integrate all qualitative and quantitative risk factors to produce a comprehensive measure of the extent of the hazard.

However, for the CSU – Humboldt planning committee, although only small chemical spills have taken place on campus, and hazardous materials are limited to chemicals in the science building, a gas pipeline, a rail line, chemical industry and hazardous waste sites are located close to the campus. Based on these factors, along with the types and levels of hazardous materials in the larger community, it is prudent to rank the extent of the hazard for the CSU – Humboldt campus as Moderate, and to consider worst case scenarios as the main driver of policy in order to fully mitigate all possible hazardous materials event outcomes.

For example, according to the 2018 CA State Hazard Mitigation Plan, 400 hazardous materials problems are tied to 32 past earthquakes, including over 150 problems from the Loma Prieta Earthquake alone. That said, the plan indicates that it is likely that many such hazardous materials releases have received little attention in the past because public authorities, the media, and the public have overlooked them in the rush to address and recover from immediate disaster threats, and that responsible parties may have an incentive to understate the extent of releases or not to report them at all.

History of the Hazard

According to the CA Governor’s Office of Emergency Services’ Hazardous Materials Spill Report, the state experiences from 10 to 30 spill events daily. As of April 20th, 2021 already 2096 spill events had occurred. Such events have occurred in all the cities and/or counties where CSU campuses are located.

According to the 2018 CA State Hazard Mitigation Plan, with regard to natural-technological hazard events (Natechs), 400 hazardous materials events are tied to 32 past earthquakes, including over 150 Natech events from the Loma Prieta Earthquake alone.

For more details on specific hazmat events, please refer to the local, county and/or multi-jurisdictional hazard mitigation plans where CSU campuses are located at:


According to the campus planning committee, a few small chemical spills have taken place in the science building on the CSU – Humboldt campus, though none recently and none required evacuation.

Potential Impacts of the Hazard

A large hazardous materials release could affect an entire community or city under certain conditions related to direction of air flow (air-based chemical release) and population density or the contamination of a community’s main water supply. Either type of release could necessitate large scale evacuation. By contrast, in the rural unincorporated areas where population densities are low, even in the event of a large release, the number of homes that may need to be evacuated would be significantly lower than in an urban environment. The occurrence of a hazmat incident can also result in the shut-down of transportation corridors which can last for hours at a time while the impacted area is stabilized.

The release of some toxic gases may cause immediate death, disablement, or sickness if absorbed through the skin, injected, ingested, or inhaled. Contaminated water resources become unsafe and unusable, depending on the amount of contaminant. Some chemicals cause painful and damaging burns if they come in direct contact with skin. Prolonged and concentrated exposure to such chemicals can produce severe long-term impacts to respiratory, endocrine and nervous systems, heart and brain health.

The potential impacts of chemicals and toxic gases discussed here also apply to the students, staff and environment on the CSU – Humboldt campus.

With regard to the natural environment overall, contamination of air, ground, or water may result in harm to fish, wildlife, livestock, and crops. The release of hazardous materials into the environment may cause debilitation, disease, or birth defects over a long period of time. Loss of livestock and crops may lead to economic hardships within the community.

Recent California examples include the 2016 Aliso Canyon methane gas leak, which caused evacuation of nearby residents, many of whom experienced temporary health problems such as difficulty breathing and eye irritation; and the 2016 Fruitland metal recycle plant fire in Maywood, which released heavy metals such as lead, magnesium, copper, aluminum, antimony, calcium, iron, sulfur, tin, potassium, and zinc which pose severe risks to public health. 86 Health effects from exposure to these metals included short-term symptoms such as irritation to the eyes, nose, throat, and lungs.

Potential Impact of the Hazard (Natechs)

Natural disasters, including earthquake, flood, and fire also pose risks to public health and the environment. For example, following the Northridge Earthquake, California State University (CSU) Northridge laboratories and chemical storage rooms experienced multiple chemical spills. Such incidents, triggered by a natural disaster, pose a significant risk to students, faculty, staff, and first responders. At a minimum, all CSU campuses with a science lab (including CSU – Humboldt) is at risk of potential impact from a natural-technological (combined impact) event, especially one triggered by tsunami or earthquake.

In a severe flood event, floodwaters are often contaminated with hazardous materials posing a threat to public and animal health, groundwater, and other parts of the environment. These hazardous materials may be released from damaged or flooded underground tank sites (e.g., gas stations or chemical storage facilities), propane tanks, manure or human waste handling facilities, fertilizer and pesticide storage, agricultural sites, and household hazardous waste.

In a fire event, (such as the October 2017 Northern California firestorms which destroyed approximately 6,000 residences) entire neighborhoods can be burned to the ground. Hazardous material release creates public health concerns which can delay the initial steps of fire recovery, including reopening burned areas to residents and initiating debris removal activities. The post-fire “toxic sweep” poses a risk of coming into contact with toxic substances due to the presence of synthetic and hazardous materials.

Probability of Future Occurrence of the Hazard

The probability of occurrence for a hazmat event on the CSU – Humboldt campus can be viewed in two different ways: the history of occurrence serves as a sound predictor of future probability assuming current risk and vulnerability factors remain somewhat constant. For the purposes of the current estimate, no current data clearly indicates otherwise. As such, the probability of occurrence is Low to Moderate - the campus has experienced small-scale chemical spills, however, hazardous waste and chemical sites, a rail line and a gas pipeline are close to the campus. That said, hazmat occurrences are largely based on human error, and any changes in risk and vulnerability factors such as a decreased vigilance in materials oversight and handling practices or changes in the amount of chemicals or exposure will likely increase the probability on campus.

Vulnerability to the Hazard

Hazardous materials pose a risk to the CSU – Humboldt campus. As identified by the campus planning committee and on the hazmat map, the following vulnerabilities are present on campus: chemicals are present in the science lab, and hazardous waste and chemical sites, a rail line and a gas pipeline are close to the campus.
chemicals or hazardous waste, if spilled or released, could severely impact human health and campus operations.

Although it is quite difficult to produce a quantitative measure of vulnerability because (unlike natural hazards) the probability of occurrence is dependent on human error, which itself is variable based upon a fluctuating set of interrelated factors, some of which lack prediction or control, given the complexity of how all natural and built environments and hazmat risks factors interrelate at the local or campus level, it is prudent to assume for planning purposes that the campus’ vulnerability is a sub-set of the larger community’s vulnerability. As such, the CSU – Humboldt leadership maintains vigilance to mitigate the campus’ vulnerabilities identified above at a minimum.
Estimate of Potential Losses

As discussed previously, it is difficult if not impossible to produce an accurate quantitative measure of vulnerability because of the variable nature of a hazardous materials spill. For example, the release of a toxic airborne chemical in a populated area has severe impact potential, whereas the impact potential of a small chemical spill in a remote or rural area is most likely limited to remediation of soil. And, in both cases, the probability of occurrence is dependent on human error, which itself is variable based upon a fluctuating set of interrelated factors, some of which lack prediction or control. In all cases, different types and amounts of hazardous materials interact with fluctuating combinations of human error to produce different event outcomes with variable impact costs.

Vulnerability Assessment Conclusions

It is well understood that with regards to hazmat vulnerability, each campus and its surrounding community (including CSU – Humboldt) operates through a complex and dynamic interaction between industrial and commercial inputs and outputs and the natural and built environment. Such activity produces hazardous materials that move through the environment along both convergent and divergent routes and across all levels of land-use from site to campus to city and county and beyond. It is also clear from a review of the Humboldt County hazard mitigation plan and Cal OES’ records of hazardous material spills, that such events occur with great frequency and varying degrees of severity across jurisdictions statewide. As such, in assessing the vulnerability of the CSU – Humboldt campus, campus-level risks and vulnerabilities are not discreet or isolated but can become exacerbated or augmented through connections to broader community-level hazmat risks and vulnerabilities.

Finally, in order to draw conclusions on vulnerability, it should be noted that any identified vulnerabilities at the campus level and/or community level are circumscribed and potentially reduced by targeted policy and program interventions. Numerous policies and programs have been established in recent years in response to California’s widespread and complex and integrated hazardous materials risks - California established the Unified Program which consolidates and integrates the administrative requirements, permits, inspections, and enforcement activities of the following environmental and emergency response programs: the Aboveground Petroleum Storage Act (APSA) Program, Area Plans for Hazardous Materials Emergencies, the California Accidental Release Prevention (CalARP) Program, the Hazardous Materials Release Response Plans and Inventories (Business Plans), Hazardous Material Management Plan (HMMP) and Hazardous Material Inventory Statement (HMIS) requirements (California Fire Code), the Hazardous Waste Generator and Onsite Hazardous Waste Treatment (tiered permitting) Programs, and the Underground Storage Tank Program.
Identified Data Limitations

The CSU – Humboldt planning committee has provided information on campus-level hazmat materials and risks. Data limitations pertain to a comprehensive understanding of human activity and error related to materials control over the long term.

Landslide

Description of the Hazard

A landslide is a down-slope movement of soil, rock, or other debris, and can also be referred to as a mass movement or slope failure. These geological hazards can range in size from a few feet to over a mile in length and width and, when heavy and rapidly moving, can cause serious damage and loss of life.

Landslides are classified based on the type of material and type of movement involved. They can range from slow-moving earth flows to fast-moving debris flows, though many large slope failures involve more than one type of movement. The primary natural triggers of slope failures are water, seismic activity, and volcanic activity. Slope saturation by water can occur from intense rainfall, snowmelt, changes in ground-water levels, and surface-water level changes along coastlines. In winter months, El Nino storms or other high rainfall events may saturate soils and trigger slope failure.

Deep-Seated Landslides

Deep-seated landslides, ranging in depth from ten to several hundred feet, occur as a result of geologic and hydraulic changes, such as earthquakes or increased levels of groundwater. These landslides can move slowly or quickly and can cause extensive property damage, but rarely result in loss of life.

Debris Flows Related to Shallow Landslides

Shallow landslides may mobilize into rapidly moving debris flows and typically occur after sudden saturation of the ground. These types of debris flows are typically more dangerous because they move rapidly, causing both property damage and loss of life.

Debris flows may also occur as a result of post-fire conditions, where wildfires have left barren ground exposed to heavy rainfall. Intense rainfall, generally greater than .5 inch per hour, has the potential to trigger a post-fire debris flow.88 These landslides


may impact lives and properties within its deposition zone, and can result in downstream flooding. These post-fire debris flows often occur during the fall and winter following major summer fires.

Location of the Hazard

The susceptibility of an area to landslides depends on several variables, including magnitude of slope gradients, water content, ground cover, presence of erosion, and slope material and structure. However, landslides are most prevalent in terrain with weak material and steep slopes, and the highest risk is found in areas with high rainfall or high earthquake potential. Slope failures are also most likely to occur in areas where they have occurred in the past. In California, the most landslide-prone areas are found along the coast and in the northern Franciscan Formation.

General landslide vulnerability can be estimated from the distribution of weak rocks and steep slopes as seen below. Based on the Figure below, the Humboldt State campus is connected to areas with moderate to high susceptibility to landslide.
Humboldt County is mountainous and in a high seismic risk zone, which leads to significant landslide risk county-wide. In Arcata, landslides are more likely to occur in the steep slopes to the east and along the coastline. However, the indirect impacts of landslides may cover a larger geographical extent. Based on the campus’ close proximity to landslide hazard zones, and the history of Federally Declared landslide related events in the county, the planning committee ranks the extent of the landslide hazard for the campus as Moderate.

History of the Hazard

NOAA has recorded three occurrences of debris flow in Humboldt County, all occurring in 2005. FEMA has declared nine major disasters involving landslides, mudslides, or mud flows since 1982. During the winter storm of 2005-2006,
widespread landslide damage occurred in Humboldt County, impacting every major transportation corridor and cutting much of the county off from its neighbors. A goods shortage resulted in Arcata, as well as service and utility disruptions. That said, no landslides have occurred on or immediately adjacent to the campus.

Potential Impacts of the Hazard

CSU Humboldt may be impacted by the disruption of services as a result of landslides in the region. Landslides can result in physical damage to buildings and property and have the potential to significantly effect infrastructure. As a landslide moves, it distresses structural foundations by settlement, cracking, and tilting. Fast-moving flows can remove entire structures in one instance, while other types of flows can cause damage gradually.

Transportation and utility infrastructure are particularly vulnerable to landslides, since the failure of any component can disrupt service over a large area. The loss of power and communication and disruption of transportation can have cascading effects throughout an area, including impaired disposal of sewage, contamination of water supplies, and the release of flammable fuels. Transportation routes are also often expensive to clean up, and prolonged obstruction can disrupt the movement of people and goods for long periods of time.

Probability of Future Occurrence of the Hazard

Slope failures are also often triggered by other natural hazards, so landslide frequency is often related to the frequency of these other hazards. As climate change impacts the frequency and intensity of triggers such as rain events, fires, and coastal erosion, landslides may generally occur more often. Historically, landslides have occurred frequently in Humboldt County and therefore are highly likely to occur in the future. Given the location of the campus directly adjacent to the landslide zone, and the historical occurrence of landslides in the county, the planning committee ranks the annual probability of the landslide hazard on the campus as Possible.

Vulnerability to the Hazard

The vulnerability of the built environment to landslides depends on exposure and is more likely to incur damage as a result of proximity, rather than inferior structural design. The structures most vulnerable to landslides are buildings and utility/transportation lifelines, which can be impacted by either impact or ground deformation. Utilities and transportation infrastructure are particularly vulnerable, due to their geographic extent and susceptibility to physical distress. The Humboldt State campus may contain building and infrastructure vulnerabilities to some degree, and exhibits access route vulnerabilities due to its close proximity to moderate and high hazard zones. See the landslide location map in relation to the campus along with landslide severity zones identified.

Any population proximal to a landslide when it occurs is vulnerable to its impacts.
Estimate of Potential Losses

There are no current models for estimating potential losses from a landslide directly impacting the campus.

Although the economic impact of landslide damage can exceed that of the direct repair costs, there are currently no applicable methods for estimating indirect costs related to CSU Humboldt.

Vulnerability Assessment Conclusions

Landslides could impact the campus in a variety of ways, related to both direct and indirect impacts to buildings, infrastructure, transportation and utilities. In turn, utility outages can impact health, particularly for vulnerable populations, and can cause interruptions in operations. Interruptions may impact student and employee’s ability to travel to campus and the delivery of classes and events.

Identified Data Limitations

The ability to predict future landslides at the CSU Humboldt campus is limited. However, the USGS estimates that climate change-induced shifts in weather will increase the frequency of post-wildfire landslides, which are expected to occur almost every year in California.13
Power Outage

Description of the Hazard

Humboldt, California is a county in Northern California. Humboldt County is made up by the Arcata, Eureka, and Fortuna areas. Humboldt State, specifically, is located in Arcata, adjacent to Humboldt Bay. Humboldt is categorized as a rural area of California with about 110 miles of coastline along the Pacific Ocean.

Humboldt State University would experience disruptions in most aspects of modern life, and almost all aspects of rural life, rely on the availability of reliable utilities, such as electricity, water, and natural gas. An interruption in the supply or distribution of these commodities can leave highly populated areas, like Humboldt, with basic services, such as electricity or sanitation with an inability to manage. These interruptions can be cascading effects from other hazards, such as the result of major windstorm, floods, wildfires or caused by intentional disruption of transmission lines.

In the event of a power outage at Humboldt State University, some possibilities from a power outage event can disrupt day-to-day operations to the campus, like in-person classes, potentially impede, or limit digital communications, interrupt telephonic or radio communications, make elevators, entry ways and other devices malfunction or inoperable. Additionally, impacts can occur to the surrounding campus community by forcing temporary closures of local restaurants and other types of vendors. Additionally, thousands of Humboldt State student residents in on-campus housing would also be affected by a power outage on campus and students residing in off campus housing close to the university, as well.

Additionally, a severe outage to Humboldt County or the City of Arcata would also directly affect the campus and the community creating social, economic, and potential health and safety impacts.

An electric power disruptions and outages fall into two categories: intentional and unintentional.

The four types of intentional disruptions:

- Planned: Some disruptions are intentional and can be scheduled based maintenance or upgrading needs.
- Unscheduled: Some intentional disruptions must be done "on the spot" in response to an emergency.
- Demand-Side Management: Some customers (i.e., on the demand side) have entered into an agreement with their utility provider to curtail their demand for electricity during periods of peak system loads.
- Load Shedding: When the power system is under extreme stress due to heavy demand and/or failure of critical components, it is sometimes necessary to intentionally interrupt the service to selected customers to prevent the entire
system from collapsing. These intentional interruptions result in rolling blackouts.

Unintentional or unplanned disruptions are outages that come with essentially no advance notice or warning. This type of disruption is the most problematic. The following are categories of unplanned disruptions:

- Accident by the utility, utility contractor, or others.
- Malfunction or equipment failure.
- Equipment overload (utility company or customer).
- Reduced capability (equipment that cannot operate within its design criteria).
- Tree contact other than from storms.
- Vandalism or intentional damage.
- Weather, including lightning, wind, earthquake, flood, and broken tree limbs taking down power lines.
- Wildfire that damages transmission lines.

Location of the Hazard

Although power outages can take place within a certain area, as a hazard, it has the potential to affect the entire planning area equally. Extent of the Hazard

In order to anticipate outage conditions and reduce impacts, campus facility managers and others keep track of conditions and data provided by the media, municipal utilities and the California Independent System Operator (CAISO) is tasked with managing the power distribution grid that supplies most of California, except in areas served by municipal utilities. CAISO is thus the entity that coordinates statewide flow of electrical supply. CAISO uses a series of stage alerts to the media based on system conditions. The alerts are:

- Stage 1 - reserve margin falls below 7 percent.
- Stage 2 - reserve margin falls below 5 percent.
- Stage 3 - reserve margin falls below 1.5 percent.

Rotating blackouts become a possibility when Stage 3 is reached. Utility agencies aim to advise affected areas approximately 48 hours in advance of a potential PSPS event and will attempt notification again approximately 24 hours before power is shut off. Campus staff respond accordingly.

Given the prevalence of rolling blackouts and other power outages in California, and history of occurrence on campus. Campus operations maintain safety precautions, situational awareness, access to emergency power generators and other protocols for
managing power outages. Given that recorded outages have taken place on campus, the planning committee ranks the extent of the power outage hazard as Moderate.

History of the Hazard

The Humboldt State Threat Hazard Identification Risk Assessment reports that the university has experienced power outages impacting the university. The City of Arcata has experienced power outages as secondary events due to disasters, like wildfires, thunderstorms, and floods. Humboldt State has experienced intermittent power outages due to storms. The campus will lose power for approximately 6-8 hours. University resident halls and dining are relieved by the impact of the power outage through the use of power generators. Other campus items effected by a loss of power are 8 fish tanks up to a monetary value of 8 million dollars.

The following power outages occurred as a cascading event.

The Humboldt State THIRA states that when Humboldt County experiences a power outage, the university is also affected. The following are some power outage events that have affected the university in the recent years.

- October 9, 2019: Humboldt State University closed its campus and cancelled all classes and activities through Thursday of that week as an extended power outage affected 60,000 Humboldt County residents, including the campus community.
- October 29, 2019: Humboldt State University closed and cancelled classes due to a countywide power shutoff due to a wildfire.
- November 26, 2019: Strong winds impact Humboldt County and cause power outages throughout the county including Humboldt State University. PG&E, the areas electric utility provider, is addressing the issues creating the outage including stabilizing and repairing downed power lines.
- January 17, 2020: Humboldt State University closed campus due to a power outage. All HSU activities, on-and-off campus were cancelled, with the exception of an orientation for new students.

Potential Impacts of the Hazard

Instructors, campus residents, staff and administration rely on electricity for basic survival and operations. During a widespread power failure, it may take days to restore operations if a significant event occurs. Electrical power may be the only cooling source for many individuals around the campus and its community, and long-term outages can potentially put people’s health and life at risk. Disruptions in the supply of heating fuel may put people and property at risk during extremely cold weather if it relies on electric generation or heating mechanisms instead of gas. Additionally, many medical devices, communications devices, and security rely on power to maintain their functions.
Climate Change and Energy Shortage

Climate change is expected to bring more frequent and intense natural disasters. These changes have created a variability at a rate that makes historical data a poor predictor of future climate. For example, the warmest years on record in California occurred in 2014, 2015, and 2016.

Changes in temperatures, precipitation patterns, extreme events, and sea-level rise have the potential to decrease the efficiency of thermal power plants and substations, decrease the capacity of transmission lines, render hydropower less reliable, spur an increase in electricity demand, and put energy infrastructure at risk of flooding.

With climate warming, higher costs from increased demand for cooling in the summer are expected to outweigh the decreases in heating costs in the cooler seasons. Hotter temperatures in California will mean more energy (typically measured in “cooling-degree days”) needed to cool homes and businesses both during heat waves and on a daily basis, during the daytime peak of the diurnal temperature cycle. During future heat waves, historically cooler coastal cities (e.g., San Francisco and Los Angeles) are projected to experience greater relative increases in temperature, such that areas that never before relied on air conditioning will experience new cooling demands.

Secondary impacts of energy shortages are most often felt by vulnerable populations. For example, those who rely on electric power for life-saving medical equipment, such as respirators, are extremely vulnerable to power outages. Also, during periods of extreme heat emergencies, the elderly and the very young are more vulnerable to the loss of cooling systems requiring power sources.

Finally, disruptions involving floodwater can create significant and lengthy power outages with challenging issues preventing immediate remedies for repair. Additionally, power outages create caveats in emergency personnel reaching crisis events due to possible traffic build up due to streetlights and traffic lights also malfunctioning.

Probability of Future Occurrence of the Hazard

The probability of California experiencing a power outage can be difficult to quantify but is a hazard that occurs annually during the same seasonal periods of temperature variance throughout the calendar year. The campus, the City of Arcata and Humboldt County experience such outages. As such, the probability ranking for the campus is Likely.

Climate models suggest summer global temperatures are likely to increase while changes between temperature extremes would be more pronounced. As such, it is expected that power outages will occur more frequently in the future.
Vulnerability to the Hazard

Based on the data available, and in consideration of the increasing effects of climate change, the campus remains vulnerable to power outages in terms of impacts to people, power infrastructure and campus operations. Nonetheless, as discussed campus leadership works to reduce vulnerabilities through consistent use of safety and operational protocols and emergency power sources to ensure it is able to mitigate an interruption to electrical power.

To mitigate against power outages, the university has placed risk management strategies to manage future occurrences, like building a micro-grid project that provides enough power generation for minimal operations and obtaining sufficient generators for these issues.

Estimate of Potential Losses

The data provided by Humboldt State University does not report any value for potential losses due to power outage.

Vulnerability Assessment Conclusions

The primary concern for campus leadership is that a loss of power can lead to potential hazards to students, faculty, and staff at Channel Islands. Safety and operations protocols center on the following “direct impact” set of concerns:

Elevators, entry ways, air filtration systems and lighting provide the campus community with the necessary infrastructure and systems to function and navigate through the campus and to maintain a safe campus environment and visibility during nighttime hours. The vulnerable population (especially students with physical disabilities) may be the most heavily affected by loss of power as they rely on elevators, entry ways with automatic doors, and locks and lights may impede on a disabled student’s ability to travel and utilize the campus and its structures safely.

The use of communication devices, billing, records, and electrical tools may also become unusable due to a loss of electricity. Many records and billing items may have to revert to “by-hand” procedures and paper copies may be needed for continuity of operations. Additionally, classrooms may not be usable if lighting equipment is not functioning impacting a semester or quarter’s progress for the academic year.

Identified Data Limitations

Humboldt State did not report any monetary or life losses due to a power outage. Also, the campus did not report any incidents involving a power outage directly affecting the campus community and operations.
**Tsunami**

**Description of the Hazard:**

A tsunami is a wave triggered by any form of land displacement along the edge or bottom of an ocean or lake. Land displacement can be in the form of submarine landslides or submarine dip-slip faults. These types of faults cause ruptures that result in seafloor uplift or down-drop. This mass movement translates to a tsunami or gravity wave within the overlying water at the surface.

Tsunamis travel radially outward from the area of initiation. The size of a tsunami is proportional to the mass that moved to generate the tsunami. As a tsunami approaches the shore and the depth of the water column decreases, the energy in the wave pushes the wave crest above the water surface resulting in a larger wave height. Wave runup is the elevation above mean sea level on dry land that a tsunami reaches. Run-up is what causes inundation of coastal areas that are below the run-up height.

There are two types of source regions for tsunamis—resulting in local and distant source tsunamis as viewed from the affected shoreline. Local tsunamis are typically more threatening because they afford at-risk populations only a few minutes to find safety. California is vulnerable to, and must consider, both types. Identifying tsunami hazards requires 1) evaluating the potential for submarine mass movement both locally and at great ocean distances, and 2) identifying coastal regions within the direct or indirect path of a potential tsunami wave that are below the run-up height.

Tsunamis can travel at speeds of over 600 miles per hour in the open ocean and can grow to over 50 feet in height when they approach a shallow shoreline, potentially causing severe damage to coastal development. At the shoreline, tsunamis may take the form of a fast-rising tide, a cresting wave, or a bore (a large, turbulent wall-like wave). The bore phenomenon resembles a step-like change in the water level that advances rapidly (from 10 to 60 miles per hour). The first wave is usually followed by several larger and more destructive waves.

**Location of the Hazard:**

According to the 2018 CA State Hazard Mitigation Plan, tsunami locations span 94 incorporated communities and 83 unincorporated areas across 20 coastal counties.

As identified on the map (below), the Humboldt State University campus is located approximately ½ mile from the tsunami inundation zone.
Extent of the Hazard:

The factors shaping the extent or severity of the hazard are a combination of geophysical forces (the amount of vertical and horizontal motion of the sea floor, the area over which it occurs, and the efficiency with which energy is transferred from the earth’s crust to the ocean water) and the geographic range of coastal development to be impacted.

More specifically, as a tsunami approaches the shore, wave run-up is the elevation above mean sea level on dry land that a tsunami reaches. A tsunami’s potential severity can be forecasted as a function of the wave’s mass along with the difference
between the wave’s run-up height and the ground elevation of the affected coastal location.

There are two types of source regions for tsunamis—resulting in local and distant source tsunamis as viewed from the affected shoreline. Local tsunamis are typically more threatening because they afford at-risk populations only a few minutes to find safety. California is vulnerable to, and must consider, both types. Identifying tsunami hazards requires 1) evaluating the potential for submarine mass movement both locally and at great ocean distances, and 2) identifying coastal regions within the direct or indirect path of a potential tsunami wave that are below the run-up height.\(^{90}\)

Given the history of tsunami occurrences in Humboldt Bay, and the range of potential impacts to Humboldt County in the future, although the campus lies outside the inundation zone, the planning committee ranks the extent of tsunami as Moderate.

History of the Hazard:

The California Seismic Safety Commission report, the Tsunami Threat to California Findings and Recommendations on Tsunami Hazards Risks, published in December 2005, indicates that over 80 tsunamis have been observed or recorded along the coast of California in the past 150 years. That said, no tsunamis have impacted CSU campus locations.

According to the National Centers for Environmental Information (NCEI), have been eight tsunamis have caused damage to ports and harbors or coastal inundation in California since 1946. The most significant events are as follows:

- In 1964, a tsunami caused by a Magnitude 9.2 earthquake offshore from Alaska resulted in 13 deaths in California and destroyed portions of downtown Crescent City.
- A 2006 tsunami (originating in the Kuril Islands region north of Japan) caused approximately $20 million in damage to Crescent City harbor.
- A 2010 tsunami (originating offshore from Chile) caused millions of dollars in damage to ports and harbors in the state.
- A tsunami in 2011 (caused by a Magnitude 9.0 earthquake offshore of Japan) killed one person at the mouth of the Klamath River and caused up to $100 million of damage to 27 ports, harbors, and marinas throughout the State. The most damage occurred in Crescent City, Santa Cruz and Moss Landing harbors and a federal disaster was declared in Del Norte, Santa Cruz, and Monterey Counties. Both Crescent City and Santa Cruz harbors sustained damage to all docks, and oil spills and water/sediment contamination that

\(\text{90}\) NOAA. About Tsunami. Retrieved on 4.29.2021 from: http://www.prh.noaa.gov/itic/library/about_tsu/faqs.html#1
resulted from sunk or damaged boats. Because recovery efforts in these two harbors took several years to complete, both harbors incurred business/economic losses that have been difficult to recapture.

Table 11-23: Tsunamis That Have Affected North Coast California 91

<table>
<thead>
<tr>
<th>Date</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>03/20/1855</td>
<td>- M 6.0 Earthquake; <strong>Humboldt Bay</strong>; wave height/feet (0.0)</td>
</tr>
<tr>
<td>11/24/1885</td>
<td>- Meteorological Event <strong>Eureka</strong>; wave height/feet (0.0)</td>
</tr>
<tr>
<td>04/01/1946</td>
<td>- M 8.6 Earthquake, Unimak Island, AK <strong>Humboldt Bay</strong>; wave height/feet (0.0)</td>
</tr>
<tr>
<td>03/28/1964</td>
<td>- M 9.2 Earthquake, Prince William Sound, AK Trinidad; wave height/feet (8.9)</td>
</tr>
<tr>
<td></td>
<td>- King Salmon Slough, <strong>Humboldt Bay</strong>; wave height/feet (4.5)</td>
</tr>
<tr>
<td></td>
<td>- Humboldt Bay; wave height/feet (6.2)</td>
</tr>
<tr>
<td></td>
<td>- North Spit, <strong>Humboldt Bay</strong>; wave height/feet (3.1)</td>
</tr>
<tr>
<td></td>
<td>- Municipal Marina, <strong>Eureka</strong>; wave height/feet (5.1)</td>
</tr>
<tr>
<td></td>
<td>- Pacific Gas &amp; Elec., <strong>Humboldt Bay</strong>; wave height/feet (3.8)</td>
</tr>
<tr>
<td>03/25/1992</td>
<td>- M 7.2 Earthquake, Cape Mendocino, N. CA Trinidad; wave height/feet (3.0)</td>
</tr>
<tr>
<td></td>
<td>- North Spit, <strong>Humboldt Bay</strong>; wave height/feet (0.7)</td>
</tr>
<tr>
<td></td>
<td>- Clam Beach; wave height/feet (0.0)</td>
</tr>
<tr>
<td>11/17/2003</td>
<td>- M 7.8 Earthquake, Rat Islands, AK North Spit, <strong>Humboldt Bay</strong>; wave height/feet (0.2)</td>
</tr>
<tr>
<td>06/15/2005</td>
<td>- M 7.2 Earthquake, N. California North Spit, <strong>Humboldt Bay</strong>; wave height/feet (0.1)</td>
</tr>
</tbody>
</table>

91 Global Historical Tsunami Database, National Center for Environmental Information, 2019
Potential Impacts of the Hazard:

Tsunamis can travel at speeds of over 600 miles per hour in the open ocean and can grow to over 50 feet in height when they approach a shallow shoreline, potentially causing total devastation to coastal development.

The configuration of the coastline, the shape of the ocean floor, and the characteristics of advancing waves play important roles in the destructiveness of the waves. Bays, sounds, inlets, rivers, streams, offshore canyons, islands, and flood control channels may cause various effects that alter the level of damage. Offshore canyons can focus tsunami wave energy, and islands can filter the energy. It has been estimated that a tsunami wave entering a flood control channel could reach a mile or more inland, especially if it enters at high tide. The orientation of the coastline determines whether the waves strike head-on or are refracted from other parts of the coastline.

Although tsunami inundation mapping indicates that potential physical impacts from a tsunami wave do not exist at Humboldt State University, the campus planning committee indicates that the Aquatic Center and the campus research vessel/classroom are at risk of impact.

For Humboldt County, potential impacts include destruction of the natural environment, destruction of boats as well as other coastal development, and loss of life. Tsunamis that impact both harbors and communities also can produce free-floating debris hazards and environmental contamination from chemical spills.

Probability of Future Occurrence of the Hazard

The California Seismic Safety Commission report, the Tsunami Threat to California Findings and Recommendations on Tsunami Hazards Risks, published in December 2005, indicates that over 80 tsunamis have been observed or recorded along the coast of California in the past 150 years. If we consider historical occurrence as one data set for estimating future events, the average rate of occurrence over the past 150 years is 1 tsunami every 1.9 years. Currently, no analysis is available which differentiates this statewide probability specifically for Humboldt County, CA. Although 7 events have been recorded for the Northern California region, it is prudent to utilize the 1.9-year statewide recurrence internal for planning purposes given extreme difficulties predicting tsunami points of origin.

The rate of future occurrence may change, and may be able to make target estimates for specific locations in the future; the California State Tsunami Program is trying to refine the accuracy of the data. In doing so, the State Tsunami Program is completing a set of Probabilistic Tsunami Hazard Analysis (PTHA) maps representing risk levels from 100-year to 3000-year average return periods. Analysis using these
probabilistically based products will allow for a more common platform for comparison to other seismic and flood probabilistic analyses.92

Vulnerability to the Hazard:

With regard to CSU campus locations, direct vulnerability of assets and people to tsunami only applies to the CSU Chancellor’s Office in Long Beach, CA, as it is the only 2 campuses located in a mapped tsunami zone. (Note: Humboldt State University campus asset mapping does not identify assets within the inundation zone, although the campus committee identifies the Aquatic Center and the research vessel as located within the zone).

With regard to Humboldt State University’s vulnerabilities, the campus planning committee indicates that the California Geologic Survey datasets associated with Tsunami inundation zones will be utilized in the near future to analyze critical assets on campus that fall within zones of vulnerability. That said, the planning committee indicates that the Aquatic Center and the Coral Sea (research and classroom vessel) are located in the tsunami zone along with campus access and egress routes. In addition, according to the committee, a tsunami could create isolated islands of people due to the inundation, and no evacuation or access to hospital services. In fact, according to the 2018 State Hazard Mitigation Plan, Humboldt county’s population is among the most vulnerable to injury and life safety issues due to its close proximity to the Cascadia Subduction Zone.93

Population Vulnerability

The populations most vulnerable to the tsunami hazard are the elderly, disabled and very young who reside near beaches, low-lying coastal areas, tidal flats and river deltas that empty into ocean going waters. In the event of a local tsunami generated near the coast, little warning time would exist, so more of the population would be vulnerable, and this vulnerability may pertain to the Humboldt State University planning area. According to the campus planning committee, a tsunami could create isolated islands of people due to the inundation, and no evacuation or access to hospital services. In addition, for Humboldt County, HAZUS analysis of the inundation area indicates that a tsunami event could displace 1,441 people, with up to 96 people needing short-term shelter assistance.

Property Vulnerability

The impact of tsunami waves and the scouring associated with debris that may be carried in the water could be damaging to all structures along beaches, low-lying coastal areas, tidal flats and river deltas. The most vulnerable structures are those in

92 2018 State of California Hazard Mitigation Plan

93 2019 Humboldt County Operational Area Hazard Mitigation Plan
the front line of tsunami impact and those that are structurally unsound. According to the campus planning committee, the Aquatic Center and the Coral Sea (research and classroom vessel) are the campus’ most vulnerable assets.
Critical Facilities and Infrastructure Vulnerability

The following infrastructure is vulnerable to damage in Humboldt County, CA:

- **Water Proximate Infrastructure**—Breakwaters and piers collapse, sometimes because of scouring actions that sweep away their foundation material and sometimes because of the sheer impact of the tsunami waves.

- **Flood Control Systems**—Floodwaters can back up drainage systems, causing localized flooding. Culverts can be blocked by debris from tsunami events, also causing localized urban flooding.

- **Utility Systems**—Floodwaters can get into drinking water supplies, causing contamination. Sewer systems can be backed up, causing waste to spill into homes, neighborhoods, rivers and streams. Tsunami waves can knock down power lines and radio/cellular communication towers. Power generation facilities can be severely impacted by wave action and by inundation from floodwater.

- **Fuels**—Destruction of fueling infrastructure and related environmental and potable water contamination can occur. In Humboldt County, the Chevron terminal is located in the tsunami inundation zone on Humboldt Bay and receives most of the vehicle fuel for the county by barge.

Estimate of Potential Losses:

Estimates of potential losses specific to CSU campuses have not been conducted yet. However, for Humboldt County, the HAZUS analysis indicated that 49 percent of the county’s exposed structures (997 structures) would be impacted by the modeled scenario event with a damage estimate of $448M dollars (buildings, contents). The estimated damage value is associated with the tsunami wave only; it does not include additional damage as a result of debris battering structures or losses to from boats, bridges or utility lines. Moreover, HAZUS estimates of damage to critical facilities and infrastructure in the county show an estimated 141 facilities impacted with 66 facilities showing a light to moderate degree of damage (10% - 49% structural damage).

Vulnerability Assessment Conclusions:

According to the 2018 State of California Hazard Mitigation Plan, community exposure to tsunamis in California varies considerably—some communities may experience great losses that reflect only a small part of their community and others may experience relatively small losses that devastate them. Among the 94 incorporated communities and 83 unincorporated areas of the 20 coastal counties, the communities that are most vulnerable to injury and life safety issues exist within Del Norte and Humboldt counties due their close proximity to the Cascadia Subduction Zone.

To improve tsunami vulnerability assessments, FEMA has developed a new tsunami loss estimation module for HAZUS using existing numerical model results for tsunami...
inundation, flow depth, velocity, and force. This HAZUS module allows new capability for estimation of economic losses, and site-specific analysis of content losses, casualties, infrastructure damage, and evacuation time. The module calibrates losses based on safe zones and community preparedness levels. Such technological improvements in assessment capability can be utilized for tsunami hazard analysis and planning purposes for Humboldt State University.

Along with new probability-based tsunami maps, the HAZUS module will improve the ability to compare tsunami impacts to those of other hazards. Moreover, the probability mapping will be used for numerous applications including identifying potential tsunami hazard “zones of required investigation” under the Seismic Hazards Mapping Act and will assist state and local agencies in making land use planning decisions and will help regional and state planners understand the flood potential from tsunamis representing different risk levels. The improved analysis and data will be utilized by Humboldt State University through its partnerships with key stakeholder organizations.94

**Note:** To download the Community Exposure to Tsunami Hazards in California report visit the USGS website: [http://pubs.usgs.gov/sir/2012/5222/](http://pubs.usgs.gov/sir/2012/5222/).

**Identified Data Limitations:**

As identified in the Vulnerability Summary (above), with regard to the current planning effort, the primary data limitations for assessing the tsunami hazard for CSU campuses (Chancellor’s Office and Humboldt State University) are comprehensive asset valuations lying within the tsunami inundation zone, and the need to apply FEMA’s new probability mapping techniques and tsunami loss estimation module to the footprint of each campus. That said, CSU leadership and planning teams intends to pursue such data in the future.

94 2018 State of California Hazard Mitigation Plan
Volcano (Associated Air Quality)

Description of the Hazard

The US Geological Service defines volcanoes as “openings or vents where lava, tephra (small rocks), and steam erupt on to the Earth’s surface. Through a series of cracks within and beneath the volcano, the vent connects to one or more linked storage areas of molten or partially molten rock (magma). This connection to fresh magma allows the volcano to erupt over and over again in the same location.”

A volcanic eruption occurs when magma, lighter than surrounding rock, is driven upwards by its buoyancy and by pressure from the dissolved gases contained within it. Gases are released from magma as it reaches the surface and pressure decreases. Magma can be erupted in several ways and violent eruptions typically cause tiny pieces of tephra (ash) to be carried away by the wind. This ash is hard, does not dissolve in water, is extremely abrasive and mildly corrosive, and conducts electricity when wet. The gases released in an eruption include carbon dioxide, sulfur dioxide, hydrogen sulfide, and hydrogen halides. Depending on their concentration, these are potentially hazardous to people, animals, agriculture, and property.

Location of the Hazard

There are eight volcanic areas located throughout California. Seven of these - Medicine Lake Volcano, Mount Shasta, Lassen Volcanic Center, Clear Lake Volcanic Field, Long Valley Volcanic Region, Coso Volcanic Field, and Salton Buttes – are considered active volcanoes. No portion of CSU Humboldt or Humboldt County is located within a volcano hazard zone.

Extent of the Hazard

Volcanic hazards are most severe within a few miles of the volcano vent and the severity generally decreases with distance. Ash impact zones can range from tens to hundreds of miles from the vent source. The US Geological Survey has estimated zones surrounding active volcanoes wherein 2 inches or more of ashfall following an eruption is possible. While CSU Humboldt does not fall within an estimated ashfall zone, lighter dustings of ash outside of those areas may directly or indirectly impact the campus. As such, the planning committee ranks the extent of the hazard for the campus as Low.

History of the Hazard


No historical eruption events in California have affected the campus. Over the last 1,000 years, there have been at least 12 eruptions in California. The most recent volcanic eruption in California occurred at Lassen Peak about 100 years ago, when a major explosion delivered windborne ash over 275 miles away.

Potential Impacts of the Hazard

The specific impacts vary widely and depend on which type of volcano erupts, the style of explosion, the volume of lava, the eruption duration, and the local water conditions. As CSU Humboldt is not proximal to an active volcano, only the potential impacts of ashfall and gases have been detailed. While both these hazards can be widespread, their most severe impacts are generally seen closer to the volcanic source.

Although ashfall is typically a nonlethal volcanic hazard, it is the most widespread and disruptive. Falling ash can damage crops, electronics, and machinery. It can also impact human health by irritating the respiratory tract, eyes, and skin. The particles may enter drinking water and structures and may cause structure failure if it is thick and heavy enough. Even a fine layer of ash can disrupt utilities. A portion of California’s major electric transmission lines, aerial telecommunication lifelines, transportation corridors, and water storage and conveyance lie within the state’s volcano hazard zones. Impacts to any of these can impact operations at CSU Humboldt.

The potential impacts of gases released during volcanic eruptions are as follows:

- Carbon dioxide typically becomes diluted very quickly and is not life threatening. However, it can become trapped in higher concentrations in low-lying areas and has the potential to be fatal.
- Sulfur dioxide can cause acid rain and air pollution downwind of a volcano.
- Hydrogen sulfide can cause irritation of the upper respiratory tract. At high concentrations it can cause unconsciousness and death.
- Hydrogen halides can coat ash particles and, once deposited, poison drinking water, agricultural crops, and grazing land.

Probability of Future Occurrence of the Hazard

The US Geological Survey, based on the record of volcanic activity in California, estimates that the probability of another small- to moderate-sized eruption in the next thirty years is about 16 percent. As such, the annual probability of future occurrence for the campus is ranked by the committee as Unlikely.

Vulnerability to the Hazard

Populations living near volcanoes are the most vulnerable to eruptions and lava flows. However, volcanic ash can travel and affect populations miles away. The location and
thickness of ash in any given area is a function of the severity of the eruption and wind speed and direction. For CSU Humboldt, there is low vulnerability to the immediate impacts of volcanic eruptions due to the limited area affected and remote potential of an eruption. In the event of a widespread ashfall event, the elderly, infants, and populations with existing respiratory disease will be at higher risk.

**Estimate of Potential Losses**

Impacts to critical infrastructure, agriculture, and property from ashfall have the potential to cause widespread disruption, damage, and economic loss throughout the state. In the event of a widespread ashfall event, impacts will be immediate.

Current modeling is not precise enough to allow for an assessment of potential losses from ashfall to structures or infrastructure on or surrounding the campus.

**Vulnerability Assessment Conclusions**

CSU Humboldt is unlikely to experience the direct impacts of a volcanic event. While the campus may be indirectly impacted by ashfall elsewhere in the state, direct ashfall impacts are generally unlikely but possible in a widespread event. However, the likelihood of any volcanic eruption in the state impacting the campus is very low.

**Identified Data Limitations**

Not all active volcanoes in California have been zoned for hazards by the US Geological Survey. This, together with the infrequent occurrence of volcanic explosions and number of factors determining type and extent of impacts, make the quantification of potential loss difficult.

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**Wildfire**

**Description of the Hazard**

While wildfires are a natural part of California’s ecosystem, wildfires in California represent a hazard that presents one of the greatest probabilities of destruction along with a demonstrated history of catastrophic fire events in recent years. The destructive fire seasons of 2017 to 2020 illustrated the destructive forces fire presents to communities across the state. Wildfires may result in the structural loss, infrastructure loss, dangerous air quality, environmental damages, economic impacts, injuries, and loss of life. In many communities throughout California, wildfire presents greatest risk to human life and property.

Wildfires have been defined as any free burning vegetation fire that initiates from an unplanned ignition, whether natural or human caused demanding fire suppression actions to contain.97 These fires are prone to become uncontrolled, spreading through

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97 State of California Hazard Mitigation Plan, September 2018
vegetative fuels rapidly exposing people and structures to harm. Wildfires present a significant risk to communities across the state, as evidenced by increasing trends of structural losses from wildland fires. This risk is elevated in areas where development and community growth has intersected, also known as the wildland-urban interface (WUI). In the interface setting, development itself can provide additional fuel for large fires. Recent fires have also demonstrated the ability of fire to consume populated areas in extreme conditions.

California’s Mediterranean climate in combination with its geography and vast population create a combination of factors that promotes an optimal environment for large fire growth and consequences. As there is great diversity of geographic characteristics across the state, the risks and potential consequences of wildfire must be assessed locally. The physical location, weather patterns, local fuel types and volume, extent of the WUI, topography, and additional factors will factor differently from part of the state to another.

The behavior of wildfires in California is significantly influenced by three distinct geographic factors. These factors will help shape the size, direction of spread, rate of combustion, fire intensity, and ability to pre-heat fuels. The physical factors contributing to wildfire behavior include:

- **Topography** – The rate in which wildfires spread increases with greater slopes in topography. The greater the slope will result in more pre-heating of fuel above the advancing fire. The direction that a slope faces will also influence fire behavior as south facing slopes receive greater solar radiation and thus drier vegetation that is more susceptible to combustion. Ridgetops often denote the end of fire spread as fire has greater difficulty spreading downhill.

- **Weather** – Weather factors substantially in influencing the behavior of wildfires. Wind, temperature, humidity, lightning, and lack of precipitation all contribute to a fire’s ability or inability to spread and intensify. California routinely experiences conditions in which these factors are in alignment to contribute to extreme fire behavior during the summer and fall seasons. High winds, low humidity, and high temperatures provide an environment promoting extreme fire activity.

- **Fuels** – Certain types of vegetation are increasingly prone to igniting and promote more intense burning. Areas with greater “fuel loading” (amount of fuel present in terms of weight of fuel per unit of area) increases the amount of fuel to fuel a fire. Greater volumes of dead or dry vegetation compared to live plants is a critical factor. Vegetation during drought conditions will experience decrease in moisture content increasing the conditions for combustion. Fuels close proximity to one another allows for rapid spread through contact or radiant exposures.
A risk assessment for wildfires should be implemented within a geospatial context focusing on the specific location features and incorporates the three components of the wildfire risk triangle – likelihood, intensity, and susceptibility.

Location of the Hazard

Substantial portions of the State of California are exceptionally vulnerable to wildfire activity or reside in a wildland-urban interface (WUI) area due to the vast open spaces, rangelands, forests and other lands with high susceptibility to fire occurring throughout the state. The area immediately surrounding the Humboldt State University campus is not in direct proximity to fire hazard zones designated as a High Fire Hazard Severity Zones. However, the east side of the campus does back up into a dense forest with heavy vegetative fuels.

The Humboldt State University campus is located in Arcata at the edge of the Arcata Community Forest. The forest is densely saturated with redwood trees, ferns, and other dense vegetation. These hills surrounding the east side of the campus are largely covered in moderate to high fuel density areas. In general, areas considered to be within Local Fire Hazard Severity Zones defined by the Fire and Resource Assessment Program (FRAP) within the California Department of Forestry and Fire Protection (CalFire) occur immediately east of the Humboldt campus. These hills surrounding the Humboldt communities can be topographically diverse, contain heavier vegetative fuels, and often have residential development interspersed.

Figure 11-16: Wildfire Hazard Severity Zones
Extent of the Hazard

The area immediately surrounding the Humboldt State University campus is not in direct proximity to fire hazard zones designated as a High Fire Hazard Severity Zones, but the hills surrounding the east side of the campus are largely covered in moderate to high fuel density areas. Humboldt County has a long history of wildfire activity despite the fact that the campus does not have a history of wildfire activity occurring within proximity to the campus. The campus does, however, have a history of being affected by wildfire related smoke and poor air quality. Based on these conditions, the planning committee ranks the extent of the hazard on campus as **Low to Moderate**.

The National Fire Danger Rating System (NFDRS) is the current system in use for rating and classifying the potential danger of fire. The NFDRS tracks the effects of previous weather events on both dead and live fuel loads and adjusts accordingly based on future or predicted weather conditions. These complex relationships and equations are computed, and the outputs are expressed in terms that users can quickly and easily understand. The current NFDRS is used by all federal and most state agencies to assess fire danger conditions.
The following table depicts the NFDRS, from the US Forest Service’s Wildland Fire Assessment System.

Table 11-24: National Fire Danger Rating System

<table>
<thead>
<tr>
<th>Rating</th>
<th>Basic Description</th>
<th>Detailed Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>CLASS 1: Low Danger (L)</td>
<td>Fires not easily started</td>
<td>Fuels do not ignite readily from small firebrands. Fires in open or cured grassland may burn freely a few hours after rain, but wood fires spread slowly by creeping or smoldering and burn in irregular fingers. There is little danger of spotting.</td>
</tr>
<tr>
<td>COLOR CODE: Green</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CLASS 2: Moderate Danger (M)</td>
<td>Fires start easily and spread at a moderate rate</td>
<td>Fires can start from most accidental causes. Fires in open cured grassland will burn briskly and spread rapidly on windy days. Woods fires spread slowly to moderately fast. The average fire is of moderate intensity, although heavy concentrations of fuel -- especially draped fuel -- may burn hot. Short-distance spotting may occur but is not persistent. Fires are not likely to become serious and control is relatively easy.</td>
</tr>
<tr>
<td>COLOR CODE: Blue</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CLASS 3: High Danger (H)</td>
<td>Fires start easily and spread at a rapid rate</td>
<td>All fine dead fuels ignite readily, and fires start easily from most causes. Unattended brush and campfires are likely to escape. Fires spread rapidly and short-distance spotting is common. High intensity burning may develop on slopes or in concentrations of fine fuel. Fires may become serious and their control difficult, unless they are hit hard and fast while small.</td>
</tr>
<tr>
<td>COLOR CODE: Yellow</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CLASS 4: Very High Danger (VH)</td>
<td>Fires start very easily and spread at a very fast rate</td>
<td>Fires start easily from all causes and immediately after ignition, spread rapidly and increase quickly in intensity. Spot fires are a constant danger. Fires burning in light fuels may quickly develop high-intensity characteristics - such as long-distance spotting - and fire whirlwinds when they burn into heavier fuels. Direct attack at the head of such fires is rarely possible after they have been burning more than a few minutes.</td>
</tr>
<tr>
<td>COLOR CODE: Orange</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Fires under extreme conditions start quickly, spread furiously, and burn intensely. All fires are potentially serious. Development into high intensity burning will usually be faster and occur from smaller fires than in the Very High Danger class (4). Direct attack is rarely possible and may be dangerous, except immediately after ignition. Fires that develop headway in heavy slash or in conifer stands may be unmanageable while the extreme burning condition lasts. Under these conditions, the only effective and safe control action is on the flanks, until the weather changes or the fuel supply lessens.

Due to the impacts of wildfires on public health, agencies across the nation have adopted the use of the Air Quality Index (AQI) to communicate and provide a consistent approach to air quality measurements and categorization. The AQI primarily focuses on the health effects caused by pollutants in the air such as smoke.

The goal of the AQI is to provide advisories to assist the public in determining when to reduce exposures to inhalation of air pollution as pollution levels rise.
History of the Hazard

The State of California has a long history of chronic and destructive wildfires throughout the state. On average, 8,300 wildfires have caused burnt 928,245 acres across the state over the 20-year period between 2000 and 2020. Humboldt County also has a long history of wildfire activity despite the generally wet climate. Several of the historic large fires have occurred in the area of Trinidad north of the campus. Wildfires occurring in Humboldt County have resulted in hundreds of thousands of acres burned and millions of dollars in damages.

The campus does not have a history of wildfire activity occurring within proximity to the campus. However, the County is surrounded by areas that are considered to be of high fire threat that would produce vast quantities of smoke and particulates into the air. The Humboldt State University campus has experienced multiple days of poor air quality due to fires burning in southern California mountains. The 2020 fire season in particular illustrated the increase in wildfire generated smoke saturating the air of communities throughout the state including Humboldt County. CSU Humboldt personnel reported the ongoing development of policies and procedures to address the response to poor air quality days.

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100 California Department of Forestry and Fire Protection, Stats and Events, https://www.fire.ca.gov/stats-events/
Table 11-25: Historic Large-Scale Fires in Humboldt County101

<table>
<thead>
<tr>
<th>Date</th>
<th>Fire</th>
<th>Location</th>
<th>Declaration</th>
<th>Damages</th>
</tr>
</thead>
<tbody>
<tr>
<td>1908</td>
<td>Luffenholz</td>
<td>Trinidad</td>
<td>NA</td>
<td>7,432 acres</td>
</tr>
<tr>
<td>1936</td>
<td>A-Line</td>
<td>Trinidad</td>
<td>NA</td>
<td>17,527 acres</td>
</tr>
<tr>
<td>1945</td>
<td>Unnamed</td>
<td>Patricks Point</td>
<td>NA</td>
<td>15,000 acres</td>
</tr>
<tr>
<td>1998</td>
<td>Unnamed</td>
<td>Orleans</td>
<td>NA</td>
<td>19,880 acres</td>
</tr>
<tr>
<td>1999</td>
<td>Megram</td>
<td>Willow Creek</td>
<td>NA</td>
<td>59,272 acres</td>
</tr>
<tr>
<td>2003</td>
<td>Canoe</td>
<td>Humboldt Redwoods</td>
<td>NA</td>
<td>11,044 acres</td>
</tr>
<tr>
<td>2003</td>
<td>Honeydew</td>
<td>King Range</td>
<td>NA</td>
<td>11,770 acres</td>
</tr>
<tr>
<td>2013</td>
<td>Corral</td>
<td>Six Rivers NF</td>
<td>NA</td>
<td>11,719 acres</td>
</tr>
<tr>
<td>2015</td>
<td>Blake</td>
<td>Six Rivers NF</td>
<td>NA</td>
<td>11,425 acres</td>
</tr>
<tr>
<td>9/27/2020</td>
<td>Red Salmon</td>
<td>NE Humboldt County</td>
<td>DR-4569</td>
<td>144,698 acres (multi-county)</td>
</tr>
</tbody>
</table>

Potential Impacts of the Hazard

The location of the Humboldt State University campus lies West of areas designated as High Fire Hazard Severity Zones places a potential direct threat that flame, ember, and smoke exposure from wildfire to the campus. The wet climate that normally persists in this region moderates wildfire activity, however weather conditions can shift to promote wildfire development. The potential impacts to wildfire further exist with members of the campus community who reside or work in these fire hazard zones.

Potential impacts to the campus community resulting from wildfires include:

- Injuries or loss of life
- Campus property destruction or damage
- Residential property destruction or damage

101 Humboldt County Operational Area Hazard Mitigation Plan 2019, January 2020
• Commercial property destruction or damage
• Loss of property contents
• Infrastructure damage
• Damaged or destroyed lifelines/supply routes
• Damaged or destroyed utilities
• Damaged or destroyed critical facilities supporting campus emergency support needs
• Loss of community economic base
• Employment losses
• Loss to ground supporting vegetation on hillsides resulting in erosion or landslides in future precipitation events
• Agricultural (crops and livestock) damages or destruction
• Environmental damage
• Societal and community impacts
• Damage to organizations and facilities providing support services to vulnerable populations
• Greater evacuation challenges for those most vulnerable
• Psychological impacts of impacted populations
• Disruptions to education delivery to community

Potential impacts resulting from wildfire generated smoke include:

• Dangerous levels of air pollution
• Human Health Effects
  • Similar health impacts to pets
• Air conditioning systems overwhelmed
• Greater demands on air filtration systems
• Greater demands on healthcare systems
• Reduced outdoor work productivity
• Closures of academic sessions

Additionally, there remains a number of secondary impacts from wildfires that could affect the campus community. Utilities feeding areas of Humboldt County including the campus may be damaged resulting in power outages. Fire related damage in the watersheds will likely cause future landslides, degradation to plants supporting hillsides, and impact the hydroelectric power capabilities. Fires may present threats to
areas of recreation, scenic value, and wildlife that are a part of the culture of the campus community.

**Probability of Future Occurrence of the Hazard**

Based on the wildfire threat potential in the area on and surrounding the Humboldt State University campus, including the immediate proximity to Fire Hazard Severity Zones categorized as “Moderate”, dense vegetation/timber on hillsides east of campus, the proximity to, the historic occurrences of fires, and the typical weather conditions, the probability of wildfire related damage is considered **Unlikely**.

Based on the wildfire threat potential in the area surrounding the campus and the San Francisco East Bay region, including the volume of areas in elevated Fire Hazard Severity Zones throughout the Alameda and Contra Costa Counties, the past occurrences of wildfire generated smoke from areas beyond Alameda County, the probability of wildfire generated smoke impacts to air quality is considered **Possible**.

**Vulnerability to the Hazard**

The Humboldt State University campus is subject to a low probability direct impact from wildfire due to the campus location within a wildland-urban interface zone, in the event that offshore winds carry a hillside fire into the coastal zone. That said, the campus is not identified to reside near a designated local High Fire Hazard Severity Zone. The campus is bordered to the east and the north by hillsides and open lands containing dense vegetation. Additionally, vulnerabilities to the effects of wildfire would lie within the campus community who may reside or work in locations that are exposed to the Fire Hazard Severity Zones in other parts of the surrounding region. Wildfires occurring in other areas of the region may result in the displacement of large numbers of people. These effects may spill onto the campus in the form of evacuees or facility support to emergency resources.

Fire directly threatening the campus would likely take the form of vegetation fires along the hillsides and extending onto the campus or localized fires involving single structures or small areas. Smaller vegetation fires are possible surrounding the campus in the urban forest or fields surrounding the city. These incidents would likely have significant impact to the campus. However, the typical wet weather conditions lessen the threat of fire adversely impacting the campus.

The primary basis of vulnerability is based on the population affected and the built environment exposed. In general, newer construction will be more fire resistant than older buildings as building and fire codes and construction technology have improved. Density of buildings and proximity of fuels to buildings or equipment at risk of combustion would additionally influence the fire’s ability to spread to structures. Structures with vegetation and other combustibles near the structure increases the ability of fire to spread to buildings.

Some areas of particular vulnerability on the campus includes:
- Students and staff engaging in outdoor activities when the air is determined to be unhealthy are vulnerable to adverse health effects.
- Buildings with ineffective HVAC or do not have HVAC will cause limitations in filtering of air during smoke filled days.
- Power outages or brownouts during days with high levels of smoke will limit the ability to filter the air during days with unhealthy air.
- Offshore wind events may push large fire and volumes of smoke into coastal portions of Humboldt County from interior forests.
- Students originating from outside of the Eureka area may become isolated from family if transportation routes are closed.

Access to the east using State Route 299 servicing access to Redding and interior California could become cutoff during fire incidents. Additionally, US Highway 101 both north and south of Arcata transits areas of dense forests and other vegetation that could be vulnerable to fire conditions. The university is limited by these routes for access to and from the campus. Access for supplies, equipment, and emergency services in addition to evacuation away from the campus would likely be forced to use alternative transportation methods into and out of Eureka and Arcata.

Additional concerns regarding vulnerabilities to wildfire are related to the smoke that fires in the area would produce. The recent summer seasons have clearly demonstrated the reality of large wildfires producing enough smoke to fill North Coast valleys even from substantial distances away. These recent fires have displayed how the effects of this smoke impact the general population and especially vulnerable populations. Humboldt State University students, faculty, and staff both on campus and off campus face these same vulnerabilities related to smoke filled air.

Smoke generated from large wildfires pose a threat in terms of diminished air quality that would be exposed to the population within the area of smoke distribution. Individuals with existing health problems such as respiratory or cardiac illnesses are increasingly vulnerable to wildfire generated smoke. Staff who work in roles requiring outdoor activity will be increasingly exposed during days where the air quality index is considered unhealthy or worse. Student athletes participating in outdoor sports and engaging in aerobic activities are increasingly vulnerable to the effects of wildfire.

The vulnerability to members of the campus community in which wildfire generated smoke on the Humboldt State University campus will vary depending on when the air quality was to reach unhealthy levels. The risk to the campus population will be lessened during periods when classes are not in session or during periods of breaks. Conversely, during the days and hours that classes are in session and staff are at their workplaces, the human vulnerability increases. However, in region-wide events this vulnerability may be shared with the homes and workplaces of members of the campus community and their families.
Certain campus populations will experience greater challenges to a post-flood / failure environment. Vulnerable populations will likely face disproportionate health safety issues from smoke filled air, experience increased stresses, may require the need to remain away from the campus enclosed at home, and may find difficulty in accessing equipment or supplies to aid in a specific need.

Estimate of Potential Losses

Estimates of potential losses will be influenced by a variety of factors. Costs would also be likely to include mitigation or repairs of HVAC systems, sealing of doors and windows, and other methods of keeping smoke from entering buildings. Secondary costs would include lost academic days during campus closures, lost staff on campus productivity, and health and medical interventions for affected members of the campus community.

Based on estimate replacement costs of facilities and structures on campus, the maximum total replacement costs due to wildfire are $117,600,736. However due to the lack of a complete inventory of building and facility costs, the total replacement estimate is likely much higher.

Table 11-26: Wildfire Hazard Potential (WHP) Zone Estimated Losses

<table>
<thead>
<tr>
<th>WHP Zone</th>
<th>No. of Buildings</th>
<th>Maximum Replacement Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Extreme</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Very High</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>High</td>
<td>1</td>
<td>$1,496,341</td>
</tr>
<tr>
<td>Moderate</td>
<td>18</td>
<td>$8,051,120</td>
</tr>
<tr>
<td>Low</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Very Low</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Non-Burnable</td>
<td>72</td>
<td>$108,053,275</td>
</tr>
<tr>
<td>No Building Value Data Provided*</td>
<td>27</td>
<td>Unknown</td>
</tr>
</tbody>
</table>

*Buildings with no value defined are also included in the respective Zones they are found in.

Vulnerability Assessment Conclusions

The occurrence of wildfires has been a frequent event in Humboldt County, including wildfire incidents that have threatened the Humboldt State University campus and the Concord campus. The location of the Humboldt State University campus exposed to dense forests with moderate to heavy vegetative fuels along the eastern edges presents a threat of fire to the campus community and campus assets. These environments are ideal for the development of wildfire activity in the right conditions. However, the typical weather patterns for California’s North Coast provides moist air off of the ocean, regular precipitation, and fog allowing for fuel moistures to remain high. The consequences of fires in these areas would present primary and secondary.
consequences to the Humboldt State University campuses and expose vulnerabilities on the campus and to the campus community.

The topography and weather conditions of the region also allows for smoke filled air to linger in the valleys of Humboldt County with the potential for unhealthy air quality depending on wind conditions. Large fires burning from even far away locations in northern California have demonstrated to fill expansive areas with smoke filled air and travel over great distances.

Communities located within or near the Wildland Urban Interface throughout populated areas across northern California may be subject to damaging fires. These same communities may be home to members of the campus community. The potential for large-scale wildfires in the region further generates the added potential for a number of cascading effects such as disruptions to the local economy, utility failures, disruptions to providing for the needs of the community, and development of public health hazards. The potential for large-scale wildfires and resulting damage of homes and businesses has exponentially powerful impacts on particular populations among the campus community including those with access or functional needs, international students, and homeless students.

**Identified Data Limitations**

Missing campus structural replacement costs and an inventory of building construction types to include status of earthquake retrofitting. HAZUS generated analysis is focused on the broader community level versus finetuning the analysis to the micro-level for facilities such as a university campus.

**Severe Weather (Wind, Tornado, Hail and Lightning)**

**Description of the Hazard**

Severe weather can be described as a variety of weather or climate events that are beyond or near the ends of the range of observed weather patterns and behavior. These events can include high or extreme winds, storms, lightning, hail, tornadoes, heat waves, unusually cold temperatures, extreme rainfall, and flooding. According to the Intergovernmental Panel on Climate Change (IPCC), to be classified as severe (or extreme), the occurrence of each value of a climate or weather variable (e.g., wind,

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hail, lightning, tornado, etc.) must be “above (or below) a threshold value near the upper (or lower) ends of the range of observed values of the variable.”

Severe weather in California can be generated by local, regional, and/or global weather and climate influences. From the individual thunderstorm to the strong El Niño, damaging weather elements that are produced by and accompany severe weather and climate phenomena (e.g., damaging winds, hail, lightning, and tornadoes) occur throughout California and the California State University (CSU) system.

**Global Scale Influences on Severe Weather in California: El Niño, La Niña, and ENSO**

The El Niño-Southern Oscillation (ENSO) is a recurring climate pattern involving changes in the temperature of waters in the central and eastern tropical Pacific Ocean. On periods ranging from about three (3) to seven (7) years, the surface waters across a large swath of the tropical Pacific Ocean warm or cool by anywhere from 1°C to 3°C, compared to normal. This oscillating warming and cooling pattern, referred to as the ENSO cycle, directly affects rainfall distribution in the tropics and can have a strong influence on weather across the United States and other parts of the world.

El Niño and La Niña are extreme phases of the ENSO cycle, with a third phase occurring between them called the Neutral phase. The El Niño phase is characterized by unusually warm ocean temperatures and weaker-than-normal east winds in the Equatorial Pacific, while the La Niña phase is characterized by unusually cold ocean temperatures and stronger-than-normal east winds in the Equatorial Pacific. Both extreme ENSO phases lead to significant differences from the average ocean temperatures, winds, surface pressure, and rainfall across parts of the tropical Pacific. The Neutral phase indicates that conditions are near their long-term average.

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104 Retrieved on 07.18.2021 from https://www.weather.gov/mhx/ensowhat


106 Retrieved on 07.17.2021 from https://www.climate.gov/news-features/understanding-climate/el-ni%C3%B1o-and-la-ni%C3%B1a-frequently-asked-questions
The extreme ENSO phases affect the frequency and intensity of weather events across the world, including in California.107 On average, areas across California experience exceptionally stormy winters with increased precipitation under El Niño conditions, but experience less stormy and drier winters under La Niña conditions.108 This variability in storminess and precipitation brought on by El Niño and La Niña events affects the both the frequency and intensity of severe weather conditions experienced by all CSU campuses, including Humboldt State University.

Regional Climate Influences on Severe Weather across California

Most of the weather in California is influenced by the wet-winter/ dry-summer Mediterranean climate pattern. In the summer months, Pacific storm tracks are deflected north due to the position of the Pacific High (i.e., a large-scale atmospheric circulation over the Northeast Pacific Ocean), preventing Pacific storms from reaching California. As a result, most summer storms are generated due to the incursion of moist air from the Gulf of Mexico or the Gulf of California, and occur as scattered, locally heavy showers in the desert and mountain regions of the state. In the winter months, the Pacific High decreases in intensity and moves south, permitting powerful Pacific storms to move into and across the state; these storms can produce extreme winds, heavy rains (including “atmospheric river” events), and widespread coastal and inland flooding. (Please see the Flood Hazard profile in this document for information on Floods.) As a result, storm events accompanied by precipitation in California are far more frequent in the winter months than they are in the summer months.109

While the Mediterranean climate pattern influences the seasonal frequency, intensity, geographic spread, and type of some severe weather events CSU campuses experience (including Humboldt State) other severe weather phenomena may occur in California at any time of the year. For example, near the coast and over the Central Valley, there appears to be no defined seasonality to thunderstorms, and these storms are usually light and infrequent. Thunderstorms are more intense and more frequent in the intermediate and higher elevations of the Sierra Nevada, and occur with greater frequency during the summer months.110

Types of Storms in California

107 Retrieved on 07.16.2021 from https://www.pmel.noaa.gov/elnino/what-is-el-nino
110 Retrieved on 07.17.2021 from https://wrcc.dri.edu/Climate/narrative_ca.php
The 2018 California State Hazard Mitigation Plan (SHMP) defines a storm as a violent atmospheric disturbance occurring over land and/or water that is distinguished by its strength, characteristics, and the scale of the resulting damage.\textsuperscript{111} The SHMP also lists the following types of storms that produce hazardous conditions and potential damage throughout the state of California.\textsuperscript{112} These storms affect (in varying degrees) all CSU campuses, including Humboldt State.

- **Thunderstorm**: A rain-bearing cloud that also produces lightning. Thunderstorms can produce some of nature’s most destructive and deadly weather including tornadoes, hail, strong winds, lightning and flooding.\textsuperscript{113} Thunderstorms are caused by an atmospheric imbalance from warm unstable air rising rapidly into the atmosphere. Lightning, which occurs during all thunderstorms, can strike anywhere.\textsuperscript{114} Thunderstorms can produce some of nature’s most destructive and deadly weather including tornadoes, hail, strong winds, lightning and flooding.\textsuperscript{115} *Severe thunderstorms* are more intense, violent, and dangerous thunderstorms. The National Oceanic and Atmospheric Administration (NOAA) defines a severe thunderstorm as any storm that produces one or more of the following elements: Damaging winds or speeds of 58 mph (50 knots) or greater, hail 1 inch in diameter or larger, and/or a tornado.\textsuperscript{116 117}

- **Hailstorm**: a type of storm that precipitates round chunks of ice. Hailstorms usually occur during regular thunderstorms.

- **Wind storm**: marked by high wind with little or no precipitation.

- **Winter storm**: A storm that can produce a combination of freezing rain, sleet, heavy snow, and/or strong winds.

- **Coastal storm**: large wind-driven waves and/or storm surge that strike the coastal zone.


\textsuperscript{113} Retrieved on 07.14.2021 from https://www.weather.gov/phi/ThunderstormDefinition


\textsuperscript{115} Retrieved on 07.14.2021 from https://www.noaa.gov/explainers/severe-storms

\textsuperscript{116} Retrieved on 07.15.2021 from https://www.noaa.gov/explainers/severe-storms

\textsuperscript{117} Retrieved on 07.15.2021 from https://www.weather.gov/safety/thunderstorm
• **Ice storm**: Ice storms are one of the most dangerous forms of winter storms. When surface temperatures are below freezing, but a thick layer of above-freezing air remains aloft, rain can fall into the freezing layer and freeze upon impact into a glaze of ice. In general, 8 millimeters (0.31 inch) of accumulation is all that is required, especially in combination with breezy conditions, to start downing power lines as well as tree limbs. Ice storms also make unheated road surfaces too slick to drive on. Ice storms can vary in time range from hours to days and can cripple small towns and large urban centers alike.

• **Snowstorm**: A heavy fall of snow accumulating at a rate of more than 5 centimeters (2 inches) per hour that lasts several hours. Snowstorms, especially ones with a high liquid equivalent and breezy conditions, can down tree limbs, cut off power, and paralyze travel over a large region.118

**Severe Weather Hazard Elements: Wind Hazards, Hail, and Lightning**

This hazard profile concentrates on the following types of severe weather hazards: wind hazards (including tornadoes), hail, and lightning. These hazards are produced by a variety of weather phenomena, including thunderstorms, coastal storms, winter storms, and topographically-enhanced downslope winds. While storm and downslope wind hazards are responsible for severe weather events across the CSU system, only the wind, tornado, hail, and lightning elements generated by these hazards are covered in this profile. (Storm-related hazards such as flooding and extreme temperatures are covered in other sections of this document.)

**Wind Hazards**

**Wind** is the horizontal movement of air past any given point. Wind begins with differences in air pressures; pressure that is higher at one point than another sets up a force, pushing the high towards the low pressure.119 Wind gusts are defined as “rapid fluctuations in the wind speed with a variation of 10 knots or more between peaks and lulls.” 120

Wind hazards in California take several forms: High Wind, Strong Winds, Thunderstorm Winds, Mountain-Valley (Downslope) Winds, and Tornadoes. These hazards are encountered across California, and have the potential to cause harm to or loss of life and/or property throughout California and the CSU system (including Humboldt State).

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High Winds, Strong Winds, and Thunderstorm Winds

The National Weather Service reports three (3) types of wind events that occur areas over land: High Winds, Strong Winds, and Thunderstorm Winds. Collectively, these reports are used to determine the frequency with which wind hazard events have affected areas across the U.S., including California.

High Winds

High winds are defined as sustained non-convective winds of 35 knots (40 mph) or greater lasting for 1 hour or longer, or gusts of 50 knots (58 mph) or greater for any duration (or otherwise locally/regionally defined). In some mountainous areas, the above numerical values are 43 knots (50 mph) and 65 knots (75 mph), respectively.\(^{121}\)

Strong Winds

Strong winds are defined as non-convective winds gusting less than 50 knots (58 mph), or sustained winds less than 35 knots (40 mph), resulting in a fatality, injury, or damage.\(^{122}\)

Thunderstorm Winds

Thunderstorm winds are winds that arise from thunderstorm convection (occurring within 30 minutes of lightning being observed or detected), with speeds of at least 50 knots (58 mph). They can also be winds of any speed (non-severe thunderstorm winds below 50 knots (58 mph)) producing a fatality, injury, or damage.\(^{123}\)

Please note: **Straight-line wind** is a term used to define any thunderstorm wind that is not associated with rotation. It is used mainly to differentiate from the rotational winds found in tornado-producing storms.\(^{124}\) However, it is not a term used in the NCEI Storm Events Database, and therefore cannot be used to determine severe weather history of or potential impacts to CSU campuses.

Tornadoes

A tornado is an extreme severe weather wind hazard. A tornado is a rapidly rotating column of air extending from a thunderstorm to the surface of the Earth.\(^{125}\) This column extends between cloud and the Earth’s surface. The damage from tornadoes comes from the strong winds they contain and the flying debris they create. It is generally believed that rotational wind speeds can be as high as 300 mph in the most


\(^{124}\) Retrieved on 07.15.2021 from https://www.nssl.noaa.gov/education/svrwx101/wind/types/

\(^{125}\) Retrieved on 07.15.2021 from https://www.earthnetworks.com/tornado/
violent tornadoes.\textsuperscript{126} On a local scale, tornadoes are the most violent and most destructive of all atmospheric phenomena.\textsuperscript{127}

**Mountain-Valley (Downslope) Wind Systems: Santa Ana, Diablo, and Sundowner Winds.**

**Santa Ana Winds.** A type of wind hazard that is peculiar to Southern California is called a *Santa Ana Wind*. Santa Ana winds are strong, topographically-enhanced, extremely dry downslope winds that originate inland and affect coastal southern California and northern Baja California (Mexico).\textsuperscript{128} They occur when air from a region of high pressure over the dry, desert region of the southwestern U.S. flows westward towards low pressure located off the California coast. This creates dry winds that flow east to west through the mountain passages in Southern California. These winds have a strong seasonal component; they are most common during the cooler months of the year, occurring from September through May. Santa Ana winds typically feel warm (or even hot) because as the cool desert air moves down the side of the mountain, it is compressed, which causes the temperature of the air to rise. If strong enough, Santa Ana winds can cause major property damage, and may present difficulties for airborne and seagoing transportation. They also may increase wildfire risk because of the dryness of the winds and the speed at which they can spread a flame across the landscape.\textsuperscript{129} (Note: The Wildfire hazard is profiled elsewhere in this document.)

Figure below illustrates the mechanisms involved in the generation of Santa Ana winds across Southern California.

\textsuperscript{126} Retrieved on 07.15.2021 from https://www.nssl.noaa.gov/education/svrwx101/tornadoes/faq/

\textsuperscript{127} Retrieved on 07.15.2021 from https://www.weather.gov/bgm/severedefinitions


**Diablo Winds.** The Diablo wind is another type of topographically-enhanced downslope wind phenomenon that occurs in the North-Central areas of California. Diablo winds are offshore wind events that flow northeasterly over Northern California’s Coast Ranges, often creating high wind speeds downwind of major canyons and over ridges, and extreme fire danger for the San Francisco Bay Area. Diablo winds are driven by a surface pressure gradient that forms in response to an inverted pressure trough that develops over California.¹³¹

**Sundowner Winds.** Sundowner winds are significant and potentially damaging downslope wind and warming events that periodically occur along a short segment of the southern California coast in the vicinity of Santa Barbara, CA. The unique topography of this coastal region promotes the development of Sundowner wind events: over a length of about 100 km, the coastline is oriented approximately west–

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east, with the adjoining narrow coastal plain bounded by a steeply rising (to
elevations greater than 1200 m) and coast-parallel mountain range. Called Sundowner
winds because they often begin in the late afternoon or early evening, their onset is
typically associated with a rapid rise in temperature and decrease in relative humidity,
and the winds tend to blow from the north from the Santa Ynez Mountains to the
coast of Santa Barbara County, California. During the more intense Sundowner wind
events, wind speeds can be of gale force 39-54 miles per hour) or higher, and can
even reach hurricane force (≥ 74 miles per hour) in the most extreme cases.
Temperatures over the coastal plain, and even at the coast itself, can rise significantly
above 37.8°C (100°F). Seasonally, Sundowner winds peak in March, April, and May,
with a minimum during summer and a secondary peak in winter that often
corresponds with Santa Ana winds. In addition to causing a dramatic change from the
more typical marine-influenced local weather conditions, Sundowner wind episodes
have produced significant wind-related property and agricultural damage, as well as
conditions of extreme fire danger.132 133 134

**Hail**

Hail is a form of precipitation consisting of solid ice that forms inside thunderstorm
updrafts.135 It is roughly round in shape and at least 0.2’ in diameter. Hail develops in
the upper atmosphere as ice crystals that are bounced about by high velocity updraft
winds; the ice crystals accumulate frozen droplets and fall after developing enough
weight. The size of hailstones varies and is a direct consequence of the severity and
size of the storm that produces them – the higher the temperatures at the Earth’s
surface, the greater the strength of the updrafts and the amount of time hailstones are
suspended, and therefore the greater the size of the hailstone.136

**Lightning**

Lightning is an electrical discharge produced by a thunderstorm. Lightning rapidly
heats the air in its immediate vicinity to about 50,000°F - about five times the
temperature of the surface of the sun. This compresses the surrounding air and

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133 Blier, W. “The Sundowner Winds of Santa Barbara, California.” *Weather and Forecasting*, Volume 13

from a dynamically downscaled climatology: Environment and effects aloft and offshore. *Journal of
https://doi.org/10.1029/2018JD029065


creates a supersonic shock wave, which decays to an acoustic wave that is heard as thunder.\textsuperscript{137}

The discharge may occur within or between clouds, between the cloud and air, between a cloud and the ground, or between the ground and a cloud.\textsuperscript{138} Lightning that is produced from thunderstorms in which precipitation evaporates before reaching the ground is called “dry lightning.”

Location of the Hazard

Severe weather is a non-spatial hazard, and can occur anywhere in the CSU system, including on the Humboldt State campus. No one area of the campus – or of the surrounding community – is subject to experiencing severe weather more than any other area.

There is geographic variability among the different types of mountain and valley wind events (as a sub-category of the severe weather hazard). Santa Ana winds occur in Southern California, Diablo winds occur in North-Central California, and Sundowner winds occur almost exclusively in Santa Barbara County, California.

Extent of the Hazard

Severe weather hazards are non-spatial hazards that potentially affect all Humboldt State campus areas equally. However, the smallest geographic unit of measurement for almost all official severe weather event data is at the county level. Because the severe weather data used do not exist at the campus level, it is assumed that the same (or similar) severe weather risks to Humboldt State reflect those of the surrounding community and County. As a result, all assets and people at Humboldt State are at risk from the effects of severe weather and can expect to experience at least some (or the complete range of) endemic severe weather hazards. In consideration of the campus’ design, layout, and operations, the severe weather history and degree of severity in the Arcata area, and the history and degree of severity of each severe weather sub-type identified by the extent scales (below), the campus planning committee ranks the overall extent of the Severe Weather hazard as \textbf{MODERATE}. See each sub-hazard below for the planning committee’s sub-type extent ranking.

\textbf{Wind Hazard: Non-Rotational}

The Beaufort Scale is an empirical measure that relates wind speed to observed conditions at sea or on land. Its full name is the Beaufort wind force scale. First developed in 1805, it is still used today to estimate wind strengths.

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139 Retrieved on 07.15.2021 from https://www.rmets.org/resource/beaufort-scale

140 Retrieved on 07.15.2021 from https://www.weather.gov/mfl/beaufort
Table 11-27: Beaufort Wind Force Scale\textsuperscript{141}

<table>
<thead>
<tr>
<th>Force</th>
<th>Speed (mph)</th>
<th>Speed (knots)</th>
<th>Description</th>
<th>Specifications for use at sea</th>
<th>Specifications for use on land</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0-1</td>
<td>0-1</td>
<td>Calm</td>
<td>Sea like a mirror.</td>
<td>Calm; smoke rises vertically.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>1-3</td>
<td>1-3</td>
<td>Light Air</td>
<td>Ripples with the appearance of scales are formed, but without foam crests.</td>
<td>Direction of wind shown by smoke drift, but not by wind vanes.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>4-7</td>
<td>4-6</td>
<td>Light Breeze</td>
<td>Small wavelets, still short, but more pronounced. Crests have a glassy appearance and do not break.</td>
<td>Wind felt on face; leaves rustle; ordinary vanes moved by wind.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>8-12</td>
<td>7-10</td>
<td>Gentle Breeze</td>
<td>Large wavelets. Crests begin to break. Foam of glassy appearance. Perhaps scattered white horses.</td>
<td>Leaves and small twigs in constant motion; wind extends light flag.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>13-18</td>
<td>11-16</td>
<td>Moderate Breeze</td>
<td>Small waves, becoming larger; fairly frequent white horses.</td>
<td>Raises dust and loose paper; small branches are moved.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>19-24</td>
<td>17-21</td>
<td>Fresh Breeze</td>
<td>Moderate waves, taking a more pronounced long form; many white horses are formed.</td>
<td>Small trees in leaf begin to sway; crested wavelets form on inland waters.</td>
</tr>
</tbody>
</table>

\textsuperscript{141} Retrieved on 07.15.2021 from https://www.weather.gov/mfl/beaufort
<table>
<thead>
<tr>
<th>Page</th>
<th>Start</th>
<th>End</th>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>6</td>
<td>25-31</td>
<td>22-27</td>
<td>Strong Breeze</td>
<td>Large waves begin to form; the white foam crests are more extensive everywhere.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Large branches in motion; whistling heard in telegraph wires; umbrellas used with difficulty.</td>
</tr>
<tr>
<td>7</td>
<td>32-38</td>
<td>28-33</td>
<td>Near Gale</td>
<td>Sea heaps up and white foam from breaking waves begins to be blown in streaks along the direction of the wind.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Whole trees in motion; inconvenience felt when walking against the wind.</td>
</tr>
<tr>
<td>8</td>
<td>39-46</td>
<td>34-40</td>
<td>Gale</td>
<td>Moderately high waves of greater length; edges of crests begin to break into spindrift. The foam is blown in well-marked streaks along the direction of the wind.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Breaks twigs off trees; generally impedes progress.</td>
</tr>
<tr>
<td>9</td>
<td>47-54</td>
<td>41-47</td>
<td>Severe Gale</td>
<td>High waves. Dense streaks of foam along the direction of the wind. Crests of waves begin to topple, tumble and roll over. Spray may affect visibility</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Slight structural damage occurs (chimney-pots and slates removed)</td>
</tr>
<tr>
<td>10</td>
<td>55-63</td>
<td>48-55</td>
<td>Storm</td>
<td>Very high waves with long overhanging crests. The resulting foam, in great patches, is blown in dense white streaks along the direction of the wind. On the whole the surface of the sea takes on a white appearance. The tumbling of the sea becomes heavy and shock-like. Visibility affected.</td>
</tr>
</tbody>
</table>
Seldom experienced inland; trees uprooted; considerable structural damage occurs.

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th><strong>Violent Storm</strong></th>
</tr>
</thead>
</table>
| 11| 64-72| 56-63| Exceptionally high waves (small and medium-size ships might be for a time lost to view behind the waves). The sea is completely covered with long white patches of foam lying along the direction of the wind. Everywhere the edges of the wave crests are blown into froth. Visibility affected.
|   |      |      | Very rarely experienced; accompanied by wide-spread damage. |

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th><strong>Hurricane</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>12</td>
<td>73+</td>
<td>64+</td>
<td>The air is filled with foam and spray. Sea completely white with driving spray; visibility very seriously affected.</td>
</tr>
</tbody>
</table>

Based on those extent ranking factors identified (above), the planning committee ranks the extent of non-rotational wind hazards as **MODERATE**.

**Extent: Tornado**

Tornadoes have their own severity/extent scale. Until 2007, tornadoes were measured and described according to the Fujita Scale.\(^{142}\)

In February 2007, use of the Fujita Scale was discontinued. In its place, the Enhanced Fujita (EF) Scale is used. The Enhanced Fujita scale considers how most structures are designed and is thought to be a much more accurate representation of the surface wind speeds in the most violent tornadoes. Like the original Fujita scale, the Enhanced Fujita scale is a set of wind estimates (not measurements) based on damage.

It is important to note the date that a tornado occurred. Tornadoes that occurred prior to February, 2007 are classified using the original Fujita scale and will not be converted to the Enhanced Fujita Scale.

Table below illustrates the Fujita Scale in use prior to February 2007.

\(^{142}\) Retrieved on 07.19.2021 from https://www.weather.gov/tae/ef_scale
<table>
<thead>
<tr>
<th>F-Scale Number</th>
<th>Intensity Phrase</th>
<th>Wind Speed</th>
<th>Type of Damage</th>
</tr>
</thead>
<tbody>
<tr>
<td>F0</td>
<td>Gale tornado</td>
<td>40-72 mph</td>
<td>Some damage to chimneys; breaks branches off trees; pushes over shallow-rooted trees; damages sign boards.</td>
</tr>
<tr>
<td>F1</td>
<td>Moderate tornado</td>
<td>73-112 mph</td>
<td>The lower limit is the beginning of hurricane wind speed; peels surface off roofs; mobile homes pushed off foundations or overturned; moving autos pushed off the roads; attached garages may be destroyed.</td>
</tr>
<tr>
<td>F2</td>
<td>Significant tornado</td>
<td>113-157 mph</td>
<td>Considerable damage. Roofs torn off frame houses; mobile homes demolished; boxcars pushed over; large trees snapped or uprooted; light object missiles generated.</td>
</tr>
<tr>
<td>F3</td>
<td>Severe tornado</td>
<td>158-206 mph</td>
<td>Roof and some walls torn off well-constructed houses; trains overturned; most trees in forest uprooted.</td>
</tr>
<tr>
<td>F4</td>
<td>Devastating tornado</td>
<td>207-260 mph</td>
<td>Well-constructed houses leveled; structures with weak foundations blown off some distance; cars thrown and large missiles generated.</td>
</tr>
<tr>
<td>F5</td>
<td>Incredible tornado</td>
<td>261-318 mph</td>
<td>Strong frame houses lifted off foundations and carried considerable distances to disintegrate; automobile sized missiles fly through the air in excess of 100 meters; trees debarked; steel reinforced</td>
</tr>
</tbody>
</table>

F6 Inconceivable tornado 319-379 mph These winds are very unlikely. The small area of damage they might produce would probably not be recognizable along with the mess produced by F4 and F5 wind that would surround the F6 winds. Missiles, such as cars and refrigerators would do serious secondary damage that could not be directly identified as F6 damage. If this level is ever achieved, evidence for it might only be found in some manner of ground swirl pattern, for it may never be identifiable through engineering studies.

Table below illustrates the Enhanced Fujita (EF) Scale, currently in use. Tornadoes that have occurred since February, 2007 are classified using the Enhanced Fujita Scale.

Table 11-29: Enhanced Fujita Scale (February 2007 and Later) 144

<table>
<thead>
<tr>
<th>Enhanced Fujita Category</th>
<th>Wind Speed</th>
<th>Potential Damage</th>
</tr>
</thead>
<tbody>
<tr>
<td>EF0</td>
<td>65-85 mph</td>
<td>Light damage. Peels surface off some roofs; some damage to gutters or siding; branches broken off trees; shallow-rooted trees pushed over.</td>
</tr>
<tr>
<td>EF1</td>
<td>86-110 mph</td>
<td>Moderate damage. Roofs severely stripped; mobile homes overturned or badly damaged; loss of exterior doors; windows and other glass broken.</td>
</tr>
<tr>
<td>EF2</td>
<td>111-135 mph</td>
<td>Considerable damage. Roofs torn off well-constructed houses; foundations of frame homes shifted; mobile homes</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Extent</th>
<th>Speed Range</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>EF3</td>
<td>136-165 mph</td>
<td>Severe damage. Entire stories of well-constructed houses destroyed; severe damage to large buildings such as shopping malls; trains overturned; trees debarked; heavy cars lifted off the ground and thrown; structures with weak foundations blown away some distance.</td>
</tr>
<tr>
<td>EF4</td>
<td>166-200 mph</td>
<td>Devastating damage. Well-constructed houses and whole frame houses completely leveled; cars thrown and small missiles generated.</td>
</tr>
<tr>
<td>EF5</td>
<td>&gt;200 mph</td>
<td>Incredible damage. Strong frame houses leveled off foundations and swept away; automobile-sized missiles fly through the air in excess of 100 m (107 yd); high-rise buildings have significant structural deformation; incredible phenomena will occur.</td>
</tr>
</tbody>
</table>

Based on the extent ranking factors identified (above), the planning committee ranks the extent of tornados as **LOW**.

**Extent: Hail**

The National Oceanic and Atmospheric Administration and the Tornado and Storm Research Organization (TORRO) have combined efforts to create the Hailstorm...
Table 11-30: Combined NOAA/TORRO Hailstorm Intensity Scale

<table>
<thead>
<tr>
<th>Size Code</th>
<th>Intensity Category</th>
<th>Typical Hail Diameter</th>
<th>Approximate Size</th>
<th>Typical Damage Impacts</th>
</tr>
</thead>
<tbody>
<tr>
<td>H0</td>
<td>Hard Hail</td>
<td>Up to 0.33”</td>
<td>Pea</td>
<td>No damage</td>
</tr>
<tr>
<td>H1</td>
<td>Potentially Damaging</td>
<td>0.33” – 0.60”</td>
<td>Marble or Mothball</td>
<td>Slight damage to plants and crops</td>
</tr>
<tr>
<td>H2</td>
<td>Potentially Damaging</td>
<td>0.60” – 0.80”</td>
<td>Dime or grape</td>
<td>Significant damage to fruit, crops, and vegetation</td>
</tr>
<tr>
<td>H3</td>
<td>Severe</td>
<td>0.80” – 1.20”</td>
<td>Nickel to Quarter</td>
<td>Severe damage to fruit and crops, damage to glass and plastic structures, paint and wood scored</td>
</tr>
<tr>
<td>H4</td>
<td>Severe</td>
<td>1.20” – 1.60”</td>
<td>Half Dollar to Ping Pong Ball</td>
<td>Widespread glass damage, vehicle body damage</td>
</tr>
</tbody>
</table>

---

<table>
<thead>
<tr>
<th>Hn</th>
<th>Extent</th>
<th>Size</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>H5</td>
<td>Destructive</td>
<td>1.60” – 2.0”</td>
<td>Silver Dollar to Golf Ball</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Wholesale destruction of glass, damage to tiled roofs, significant risk of injuries</td>
</tr>
<tr>
<td>H6</td>
<td>Destructive</td>
<td>2.0” – 2.4”</td>
<td>Lime or Egg</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Aircraft body dented; brick walls pitted</td>
</tr>
<tr>
<td>H7</td>
<td>Very Destructive</td>
<td>2.4” – 3.0”</td>
<td>Tennis Ball</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Severe roof damage, risk of serious injuries</td>
</tr>
<tr>
<td>H8</td>
<td>Very Destructive</td>
<td>3.0” – 3.5”</td>
<td>Baseball to Orange</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Severe damage to aircraft body</td>
</tr>
<tr>
<td>H9</td>
<td>Super Hailstorms</td>
<td>3.5” – 4.0”</td>
<td>Grapefruit</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Extensive structural damage, risk of severe or fatal injuries to persons caught in the open</td>
</tr>
</tbody>
</table>

Based on those extent ranking factors identified (above), the planning committee ranks the extent of the hail hazard as **LOW**.

**Extent: Lightning**

The National Weather Service (NWS) uses a Lightning Activity Level (LAL) scale to indicate the frequency and character of cloud-to-ground (C/G) lightning. The scale uses a range of 1 – 6, with 6 being the high end of the scale. Table 10-XX provides details of the LAL scale.
**Table 11-31: Lightning Activity Level (LAL) Scale**

<table>
<thead>
<tr>
<th>Rank</th>
<th>Cloud and Storm Development</th>
<th>Areal Coverage</th>
<th>Counts C/G per 5 Minutes</th>
<th>Counts C/G per 15 Minutes</th>
<th>Average C/G per Minute</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>No Thunderstorms</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>2</td>
<td>Cumulus clouds are common but only a few reaches the towering stage. A single thunderstorm must be confirmed in the rating area. The clouds mostly produce virga, but light rain will occasionally reach ground. Lightning is very infrequent.</td>
<td>&lt;15%</td>
<td>1-5</td>
<td>1-8</td>
<td>&lt;1</td>
</tr>
<tr>
<td>3</td>
<td>Cumulus clouds are common. Swelling and towering cumulus cover less than 2/10 of the sky. Thunderstorms are few, but 2 to 3 occur within the observation area. Light to moderate rain will reach the ground, and lightning is infrequent.</td>
<td>15% to 24%</td>
<td>6-10</td>
<td>9-15</td>
<td>1-2</td>
</tr>
</tbody>
</table>

---

<table>
<thead>
<tr>
<th>Rank</th>
<th>Cloud and Storm Development</th>
<th>Areal Coverage</th>
<th>Counts C/G per 5 Minutes</th>
<th>Counts C/G per 15 Minutes</th>
<th>Average C/G per Minute</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>Swelling cumulus and towering cumulus cover 2-3/10 of the sky. Thunderstorms are scattered but more than three must occur within the observation area. Moderate rain is commonly produced, and lightning is frequent.</td>
<td>25% to 50%</td>
<td>11-15</td>
<td>16-25</td>
<td>2-3</td>
</tr>
<tr>
<td>5</td>
<td>Towering cumulus and thunderstorms are numerous. They cover more than 3/10 and occasionally obscure the sky. Rain is moderate to heavy, and lightning is frequent and intense.</td>
<td>&gt;50%</td>
<td>&gt;15</td>
<td>&gt;25</td>
<td>&gt;3</td>
</tr>
<tr>
<td>6</td>
<td>Dry lightning outbreak. (LAL of 3 or greater with majority of storms producing little or no rainfall.)</td>
<td>&gt;15%</td>
<td>None</td>
<td>None</td>
<td>None</td>
</tr>
</tbody>
</table>
Based on those extent ranking factors identified (above), the planning committee ranks the extent of the lightening hazard as **LOW**.

**Extent: Thunderstorms that Generate Wind, Tornado, Hail, and Lightning Hazard Events**

Thunderstorms are not explicitly identified as a severe weather category for this hazard profile. However, they are responsible for most tornado, lightning, and hail hazard events – as well as a significant number of wind hazard events – across California and the CSU system. While individual thunderstorms affect relatively small areas, there are many instances in which thunderstorms can cluster together and/or travel in a line over long distances, producing significant damage over large geographic areas.

A thunderstorm is classified as “severe” when certain meteorological parameters within the thunderstorm are reached (i.e., damaging winds or speeds of 58 mph (50 knots) or greater, hail 1 inch in diameter or larger, and/or a tornado). However, there is currently no established, objective severity scale for thunderstorms.\(^\text{147}\) \(^\text{148}\) That said, according to the *Glossary of Meteorology* published by the American Meteorological Society (AMS), a thunderstorm is reported as *light, medium, or heavy* according to following five (5) characteristics:

- the nature of the lightning and thunder;
- the type and intensity of the precipitation, if any;
- the speed and gustiness of the wind;
- the appearance of the clouds; and
- the effect upon surface temperature.\(^\text{149}\)

A thunderstorm may also be classified by the nature of the overall weather situation in which the thunderstorm is produced, including:

- **Airmass Thunderstorm**: A thunderstorm produced by local convection within an unstable air mass;\(^\text{150}\)

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\(^\text{147}\) Retrieved on 07.15.2021 from https://www.noaa.gov/explainers/severe-storms

\(^\text{148}\) Retrieved on 07.15.2021 from https://www.weather.gov/safety/thunderstorm


- **Frontal Thunderstorm**: An individual thunderstorm the initiation of which results from rising motion associated with a front, or a thunderstorm within a convective system generated and organized by frontal rising motion;\(^{151}\) or

- **Squall-line Thunderstorm**: An individual thunderstorm included within a squall line (i.e., a continuous or broken line of active deep moist convection frequently associated with thunder). \(^{152} \)\(^{153}\)

Based on the extent ranking factors identified (above) in relation to campus layout and operations, and past event low degree of severity, the planning committee ranks the extent of the thunderstorm hazard as **LOW**.

**History of the Hazard**

**Historical Storm Data Collection: NCEI Storm Events Database**

Historical information regarding severe weather hazards can be found using The National Centers for Environmental Information (NCEI) Storm Events Database. The Storm Events Database contains searchable, archived National Weather Service (NWS) storm data from January 1950 to April 2021, as entered by NOAA’s National Weather Service (NWS). Due to changes in the data collection and processing procedures over time, there are unique periods of record available depending on the event type.\(^{154}\) For example, from 1950 through 1954, only tornado events were recorded; from 1955 through 1995, only tornado, thunderstorm wind, and hail events were introduced into the database; from 1996 to present, 45 additional event types are recorded, including high wind, strong wind, and lightning events.\(^{155}\) To obtain the most accurate portrayal of severe weather event frequency, searches of the Storm Events Database are conducted using data collected since 01/01/1996. As a reminder, all official severe weather event data is at the county level. Severe weather data do not exist at the campus level. That said, it may be the case that the campus to some degree experiences the severe weather events reported for the surrounding community and County.

**Wind Hazards (excluding Tornadoes)**


Information obtained from the NCEI Storm Event Database website shows the number of events (or occurrences) of wind hazard events in Humboldt County since 1996. Here, wind hazard events include all “High Wind,” “Strong Wind,” and “Thunderstorm Wind” storm reports.

- **High Wind**: at least 114 events, or approximately 4.50 events per year
- **Strong Wind**: at least 14 events, or 0.55 events per year
- **Thunderstorm Wind**: at least 10 events, or approximately 0.39 events per year
- **All Wind Hazard events** (excluding Tornadoes): at least 132 events, or approximately 5.21 events per year (Note: This was determined by conducting a simultaneous search of the component wind hazards of high wind, strong wind and thunderstorm wind.)

Overall, in Humboldt County, there have been at least 132 wind hazard events since 1996, excluding tornadoes. That translates to an approximate average historical frequency of occurrence of 5.21 wind hazard events per year.

Please note: Differences between the sums of individual component severe weather hazard event Database searches (i.e., 138 events) and simultaneous Database searches of all severe weather hazard events (i.e., 132 events) may be due to the following factors: (1) multiple event types are in the same record (e.g., "Thunderstorm Wind/Hail" or "Hail/Tornado;" and/or (2) severe weather hazard events such as “Thunderstorm Wind” or “Hail” that are reported for Humboldt County have actually taken place hundreds of miles away, but are erroneously recorded as events that have

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158 National Climatic Data Center. Storm Events Database. Retrieved 07.30.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28Z%29+High+Wind&eventType=%28Z%29+Strong+Wind&eventType=%28C%29+Thunderstorm+Wind&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=HUMBOLDT%3A23&hailfilter=0.00&tornfilter=0&windfilter=0&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA

159 National Climatic Data Center. Storm Events Database. Retrieved 07.30.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28Z%29+High+Wind&eventType=%28Z%29+Strong+Wind&eventType=%28C%29+Thunderstorm+Wind&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=HUMBOLDT%3A23&hailfilter=0.00&tornfilter=0&windfilter=0&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA
occurred in the County.\textsuperscript{160} When such a discrepancy arises, the more conservative aggregate hazard wind event value (i.e., 132 events) is used to determine the historical frequency of occurrence for the severe weather hazard. The origin of this discrepancy is unknown at this time.

**Historical Wind Hazard Losses for Humboldt County since 1996**

According to the NCEI Storm Events Database, the wind hazard events that Humboldt County has experienced since 1996 have been costly. There has been 1 death, and approximately $5,736,000 in reported property damage estimates; however, there have been no reported injuries or crop damage.

**Tornado Wind Hazards**

Information from the NCEI Storm Events Database indicates that since 1996, there has been 1 reported event of a tornado in Humboldt County, which translates to approximately 0.04 tornado events per year. This tornado was rated EF0 and occurred in 2018.

**Historical Tornado Hazard Losses for Humboldt County since 1996**

According to the NCEI Storm Events Database, tornado hazard event losses that Humboldt County has experienced since 1996 have been negligible. There have been no deaths, injuries, or no crop damage, and reported property damage estimates have totaled $100.\textsuperscript{161}

**Hail**

Information from the NCEI Storm Events Database indicates that since 1996, there have been 21 reported events of hail in Humboldt County, which translates to approximately 0.83 hail events per year.\textsuperscript{162} (Note: The NCEI Storm Event Database search results for hail indicate that there has been a total of 22 reports of hail since 1996. However, one (1) entry is for a hail event in San Diego County, hundreds of miles away.)


\textsuperscript{161} National Climatic Data Center. Storm Events Database. Retrieved 07.30.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Tornado&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=HUMBOLDT%3A23&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA

\textsuperscript{162} National Climatic Data Center. Storm Events Database. Retrieved 07.30.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Hail&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=HUMBOLDT%3A23&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA
miles away from Humboldt County. The origin of this discrepancy is unknown at this time.)

**Historical Hail Hazard Losses for Humboldt County since 1996**

According to the NCEI Storm Events Database, the hail hazard events that Humboldt County has experienced since 1996 have been moderate. There have been 0 deaths and 1 injuries, and property damage estimates have totaled approximately $23,250; no crop damage estimates have been reported.\(^\text{163}\) (Note: The San Diego County hail event that was included erroneously in the search results for hail events in Humboldt County accounted for five (5) injuries and crop damage estimates (i.e., $300,000) presented in the search results.)

**Lightning**

Information from the NCEI Storm Events Database indicates that since 1996, there has been one (1) reported event of lightning in Humboldt County, which translates to approximately 0.04 lightning events per year.\(^\text{164}\)

**Historical Lightning Hazard Losses for Humboldt County since 1996**

According to the NCEI Storm Events Database, the lightning hazard events that Humboldt County has experienced since 1996 have produced no deaths, injuries, property damage, or crop damage.\(^\text{165}\)

**All Severe Weather Hazard Events Recorded by the NCEI Storm Events Database**

\(^\text{163}\) National Climatic Data Center. Storm Events Database. Retrieved 07.30.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Hail&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=HUMBOLDT%3A23&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA

\(^\text{164}\) National Climatic Data Center. Storm Events Database. Retrieved 07.30.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Lightning&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=HUMBOLDT%3A23&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA

\(^\text{165}\) National Climatic Data Center. Storm Events Database. Retrieved 07.30.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Lightning&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=HUMBOLDT%3A23&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA
Information obtained from the NCEI Storm Events Database indicates that there have been 155 occurrences of the severe weather hazard in Humboldt County. This translates to 6.12 severe weather hazard occurrences per year.¹⁶⁶

Please note: Differences between the sums of individual component severe weather hazard event Database searches (i.e., 162 events) and simultaneous Database searches of all severe weather hazard events (i.e., 155 events) may be due to the following factors: (1) multiple event types are in the same record (e.g., "Thunderstorm Wind/Hail" or "Hail/Tornado;" and/or (2) severe weather hazard events such as “Thunderstorm Wind” or “Hail” that are reported for Humboldt County have actually taken place hundreds of miles away, but are erroneously recorded as events that have occurred in the County.¹⁶⁷ When such a discrepancy arises, the more conservative aggregate hazard wind event value (i.e., 155 events) is used to determine the historical frequency of occurrence for the severe weather hazard. The origin of this discrepancy is unknown at this time.

**Historical, Aggregated Severe Hazard Losses for Humboldt County since 1996**

According to the NCEI Storm Events Database, the severe weather events that Humboldt County has experienced since 1996 have been costly. There has been 1 death and 1 injury, and no crop damage; property damage estimates have totaled approximately $5,759,000.¹⁶⁸ It is important to note that for all Humboldt County severe weather hazard events recorded on the Storm Events Database, the one (1) reported death and approximately 99.6% of all estimated property damages have been caused by wind hazard events alone.

**Wind Hazards Not Included in the NCEI Storm Events Database**

*Santa Ana Winds*

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¹⁶⁶ National Climatic Data Center. Storm Events Database. Retrieved 07.30.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType%28C%29+Hail&eventType%28Z%29+High+Wind&eventType%28C%29+Lightning&eventType%28Z%29+Strong+Wind&eventType%28C%29+Thunderstorm+Wind&eventType%28C%29+Tornado&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=HUMBOLDT%3A23&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitButton=Search&statefips=6%2CCALIFORNIA


¹⁶⁸ National Climatic Data Center. Storm Events Database. Retrieved 07.30.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType%28C%29+Hail&eventType%28Z%29+High+Wind&eventType%28C%29+Lightning&eventType%28Z%29+Strong+Wind&eventType%28C%29+Thunderstorm+Wind&eventType%28C%29+Tornado&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=HUMBOLDT%3A23&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitButton=Search&statefips=6%2CCALIFORNIA
Santa Ana wind events occur at least twice per month from October through April.\footnote{169} From 1948 to 2012, total of 2056 events on the 65-year record were recorded in the Southern California region, yielding an average of \textbf{32 occurrences per year}. Typical Santa Ana wind events last 1–2 days and represent 27\% of the occurrences, with events lasting up to 6 days accounting for 90\% of all occurrences. The remaining 10\% are made up almost entirely of events lasting between 7 and 12 days.\footnote{170} \footnote{171}

Figure below shows the mean monthly frequency per season of Santa Ana Wind events detected from 1948 to 2012. Extreme Santa Ana wind events are shown in dark red, and are defined as those events that are above the 90th percentile of all events on record.

**Diablo Winds**

Diablo wind events occur approximately **2.5 events per year**. These events are most frequent during the fall and early winter seasons, with the highest frequency of events occurring in October. As a result, the highest risk of Diablo-wind-related damage is in the fall and early winter.\(^\text{174}\)

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Figure below shows the monthly frequency of Diablo winds (along with average live fuel moisture content). The Diablo Wind data are derived from a 17-year climatology of San Francisco Bay Area regional surface weather stations.\textsuperscript{175}

Figure 11-20: Monthly Frequency of Diablo Winds and Average Live Fuel Moisture Content (Dashed Line)\textsuperscript{176}

\textbf{Sundowner Winds}

Strong sundowner wind events occur approximately \textbf{2-3 times per year}. These events can create sharp temperature rises, local gale force winds, and significant weather-related problems. Rare, “explosive” types of sundowner wind events occur about 6 times per century that present dangerous weather situations, generating extremely strong and hot winds that can reach gale force or higher speeds.\textsuperscript{177}

\textbf{Historical Frequency of All Severe Weather Hazards}

Table below shows the average historical frequency of severe weather hazard events for Humboldt County since 1996.)

\textsuperscript{175} Retrieved on 07.15.2021 from https://www.fireweather.org/diablo-winds

\textsuperscript{176} Retrieved on 07.13.2021 from https://www.fireweather.org/diablo-winds

Table 11-32: Severe Weather Hazard Event

Frequencies for Humboldt County since 1996.

<table>
<thead>
<tr>
<th>Severe Weather Hazard Category</th>
<th>Average Number of Hazard Events Per Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wind (Includes High, Strong and Thunderstorm Winds ONLY)</td>
<td>5.21</td>
</tr>
<tr>
<td>Tornado</td>
<td>0.04</td>
</tr>
<tr>
<td>Hail</td>
<td>0.83</td>
</tr>
<tr>
<td>Lightning</td>
<td>0.04</td>
</tr>
<tr>
<td>Diablo Wind*</td>
<td>2.5</td>
</tr>
<tr>
<td>Santa Ana Wind *</td>
<td>32</td>
</tr>
<tr>
<td>Sundowner Wind*</td>
<td>2 to 3</td>
</tr>
</tbody>
</table>

* Note: The Santa Ana, Diablo, and Sundowner wind hazards are not present in Humboldt County. They are included here for information purposes only.

Potential Impacts of the Hazard

The significance (or priority) of a hazard’s potential impacts is based primarily on the frequency and resulting damage caused by the hazard, including deaths/injuries and property, crop, and economic damage. All assets and people within Humboldt State University campus areas are at risk from the effects of severe weather hazards.

**Wind Hazards (Including Tornadoes)**

Wind hazard events have the potential to impact people, property, and operations on campuses across the CSU system. People caught in the open during an extreme wind event are exposed to high winds and debris, and could be injured or killed.

The habitability of buildings can be compromised (by damaging roofs, windows, or other weak points in the building envelope), leading to long-term operational issues for the campus. As with most university campuses, space is always at a premium at the Humboldt State campus, and the loss of any currently utilized space due to building or structural damage would likely disrupt operations and the University’s mission.
Extreme wind events can result in power failure, which would impact the operation of the campus. Fallen tree limbs and other potential transportation hazards may also cause disruption to the surrounding community and limit ingress/egress to the campus.

According to Humboldt County Operational Area Hazard Mitigation Plan 2019, damaging wind events are considered to be medium significance, and therefore to have a moderate potential impact on the County and (by extension) the Humboldt State campus.¹⁷⁸

**Hail**

Hail typically impacts property by damaging structures, cars, and utilities as it falls. Dents in cars, broken glass, and holes in roofs are common impacts of hail. Injuries to people from hail are less common, though they can happen, as hail is a hard object falling in an unpredictable manner at a fairly high rate of speed.

According to Humboldt County Operational Area Hazard Mitigation Plan 2019, hail hazards are considered to be of low significance, and therefore have a minimal potential impact on the County and (by extension) the Humboldt State campus.¹⁷⁹

**Lightning**

Lightning strikes the United States about 20-25 million times a year.¹⁸⁰ Although most lightning occurs in the summer months, people can be struck at any time of year. Since 1990, lightning has killed an average of 39 people each year in the United States, and hundreds more have been injured.¹⁸¹ Property losses due to lightning have been very costly across the U.S. For example, from 2005 through 2020, U.S. homeowner’s insurance claim payouts for lightning losses totaled approximately $15,334,600,000, or $958,412,500 worth of payouts per year.¹⁸² (Commercial claim payouts for lightning losses for the U.S. were not available.)


According to Humboldt County Operational Area Hazard Mitigation Plan 2019, lightning hazards are considered to be of low significance, and therefore have a minimal potential impact on the County and (by extension) the Humboldt State campus.\textsuperscript{183}

\textbf{Severe Weather Hazards Combined}

According to Humboldt County Operational Area Hazard Mitigation Plan 2019, important issues associated with severe weather in the planning area include the following:

- The most common direct impact from severe weather in Humboldt County is loss of power;
- Potential severe weather impacts (especially damaging winds) are greatest on older building stock in the planning area, as many of those structures are built to low code standards or none at all;
- Severe weather may also affect isolated population centers in Humboldt County disproportionately.\textsuperscript{184}

\textbf{Probability of Future Occurrence of the Hazard}

Areas throughout California, including all California State University (CSU) campuses, experience severe weather events every year, and future occurrences of such events are projected to increase in both their frequency and intensity. According to Humboldt County Operational Area Hazard Mitigation Plan 2019, although the probabilities of future occurrence of specific hazards (i.e., wind, tornado, hail, and lightning) vary greatly, the probability of any severe weather event impacting the planning area is \textbf{HIGH}.\textsuperscript{185} Also, according to the NCEI Storm Events Database, some of these same severe weather hazards have occurred in Humboldt County at least once per year. Furthermore, while the severe weather hazard is a non-spatial hazard that affects all areas of the Humboldt State campus equally, the smallest geographic unit of measurement for almost all official severe weather event data is at the county level. Because the severe weather data used in this assessment do not exist at the campus level, it is assumed that the severe weather probabilities for the Humboldt State


campus reflect those of the surrounding community and County identified in the Table below.

Based on the data available from both to Humboldt County Operational Area Hazard Mitigation Plan 2019 and the NCEI Storm Events Database, the severe weather hazard is expected to occur on (or otherwise impact) Humboldt County and the Humboldt State campus at least once on an annual basis. Therefore, the probability of future occurrence of the severe weather hazard for Humboldt State is HIGHLY LIKELY. See table below for probabilities of future occurrence for component severe weather hazards for the County and the campus.

Table 11-33: Severe Weather Hazard Probabilities of Future Occurrence for Humboldt County and Humboldt State University

<table>
<thead>
<tr>
<th>Severe Weather Hazard Category</th>
<th>Average Number of Hazard Events Per Year</th>
<th>Probability of Future Occurrence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wind (Includes High, Strong and Thunderstorm Winds ONLY)</td>
<td>5.21</td>
<td>Highly Likely</td>
</tr>
<tr>
<td>Tornado</td>
<td>0.04</td>
<td>Unlikely</td>
</tr>
<tr>
<td>Hail</td>
<td>0.83</td>
<td>Highly Likely</td>
</tr>
<tr>
<td>Lightning</td>
<td>0.04</td>
<td>Unlikely</td>
</tr>
<tr>
<td>Diablo Wind**</td>
<td>2.5</td>
<td>Not Rated</td>
</tr>
<tr>
<td>Santa Ana Wind**</td>
<td>32</td>
<td>Not Rated</td>
</tr>
<tr>
<td>Sundowner Wind**</td>
<td>2 to 3</td>
<td>Not Rated</td>
</tr>
<tr>
<td>** Note: The Santa Ana, Diablo, and Sundowner wind hazards are not present in Humboldt County, and therefore are not rated for probability of future occurrence. They are included here for information purposes only.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Vulnerability to the Hazard

People, structures, and assets on the Humboldt State campus are all vulnerable to the impacts associated with severe weather. Infrastructure can be damaged or destroyed by hail, wind, tornadoes, thunderstorms, and lightning, which can result in service interruptions and outages. Structures can be damaged or destroyed by hail, wind, tornadoes, thunderstorms, and lightning. People can be injured or killed by lightning, flying debris, hail, or extreme wind events. The Humboldt State campus also has
vehicles, as well as off-campus conference and recreational facilities, that are all vulnerable to a severe weather event.

Estimate of Potential Losses

Severe weather is a non-spatial hazard that affects the entire Humboldt State campus. Each of the hazards associated with severe weather can result in losses throughout the planning area.

All structures within the Humboldt State campus are at risk from severe weather. There are approximately 118 buildings on the Humboldt State campus that could be damaged by wind, hail, and/or lightning hazard events. If even a fraction of these assets were to be damaged, the resulting estimated losses would still be in the millions of dollars. The total replacement costs due to severe weather hazard are $117,600,736 for 91 of the buildings, and are unknown for the remaining 27 buildings. An analysis of projected dollar losses to campus buildings from severe weather as a percentage of building replacement costs is also not currently available, though CSU leadership may pursue such data in the future.

The population at the Humboldt State University campus varies throughout the day. As of Fall, 2019, Humboldt State had 6,983 students and 1,171 faculty and staff. All are at risk from severe weather events, with 8,154 being directly vulnerable in this scenario.

Vulnerability Assessment Conclusions

Severe weather presents a variety of hazards to the Humboldt State campus. People, assets, infrastructure, and vehicles can all be damaged by this hazard, and losses can quickly begin to rise. In the aggregate, severe weather is a frequently occurring hazard (mostly in the form of wind hazard events) that presents a variety of risks to Humboldt State.

It is evident that the Humboldt State campus has vulnerabilities to and risks from severe weather hazard incidents, and that pre-event planning, communication, and mitigation efforts should be implemented. Public education and outreach regarding areas of shelter that could be used by campus populations during severe weather events is considered by campus leadership to be one viable mitigation option. The campus planning committee will continue to look for feasible and cost-effective options for the mitigation of severe weather risks going forward.

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186 Retrieved on 07.19.2021 from https://www2.calstate.edu/csu-system/about-the-csu/facts-about-the-csu/enrollment/Pages/default.aspx

Identified Data Limitations

Numerous federal agencies maintain a variety of records regarding losses associated with hazards. Unfortunately, no single source is considered to offer a definitive accounting of all losses. The Federal Emergency Management Agency (FEMA) maintains records on federal expenditures associated with declared major disasters. The US Army Corps of Engineers (USACE) and the Natural Resources Conservation Service (NRCS) collect data on losses during the course of some of their ongoing projects and studies. Additionally, the National Oceanic and Atmospheric Administration’s (NOAA) National Centers for Environmental Information (NCEI) collects and maintains data about natural hazards in summary format, as well as occurrences, dates, injuries, deaths, and estimated costs for individual storm events. Many of these databases and other data collection services, including the NCEI, have inherent data limitations when searching for information at a scale as small as a single campus.

The best available data and records have been used throughout this section. Where no data or records exist or could be located, that deficiency is noted.
11.4 Social Resilience Assessment

Overview

While every person is vulnerable to risk, individuals from diverse populations such as those with access and functional needs are disproportionately more vulnerable and may be at a higher risk to harm in a disaster event. In addition to physical vulnerabilities, the intersectionality between physical hazard risks and population social vulnerabilities must be considered to holistically address overall campus risk.

As inclusivity is a high priority for CSU, addressing campus risk and resilience must be done through the lens of inclusion and equity. Addressing social vulnerability is an increasingly critical requirement of state and national doctrines and described in Section 4.4 of the HVRA Base Plan. Every individual of the campus’s richly diverse population group needs to have the capacity, skills, and knowledge in order to understand, access, and participate in risk reduction and disaster response in ways that are meaningful to their own unique situation. In a campus community, having strong social support networks and active involvement in community disaster responses may negatively or positively impact these opportunities and reduce the resilience-building process. This section offers a glimpse into the Humbolt State University campus’s unique social construct, population demographics, strengths and concerns and presents a high-level assessment of the resilience, coping capacities and potential social vulnerabilities of students, staff and faculty. The research variables that were asked are often considered sensitive subjects, and few are traditionally included in emergency management/hazard mitigation planning.

This social resilience assessment of college campuses is the first of its kind in the nation. The research methodology unfolded as the interviews with campuses progressed. The assessment data presented are not definitive or authoritative. The answers, analysis, and suggested trends are strictly indicators for potential social risk. They do not represent an accurate data capture as limitations on the data gathering process influenced an ability to provide accuracy. This assessment provides indications of increased risk, not accuracy of response or a true reflection of the situation of the campus. The information presented is to be considered in the context of the more detailed system-wide CSU social vulnerability assessment that is included in the baseline HVRA.

Campus-Identified Populations of Concern

During the campus interview, the following responses were provided when asked, “In considering the diverse population group(s) amongst student body, faculty and staff, which are of the most concern in your emergency management planning?”
Table 11-34: High level summary of campus populations of concern

<table>
<thead>
<tr>
<th>Question</th>
<th>Campus Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>Which population groups amongst the student body, faculty, and staff,</td>
<td>• Students enrolled in the disability resource center, especially those in need of mental health support</td>
</tr>
<tr>
<td>are of the most concern for physical and social vulnerabilities in</td>
<td>• Students with low socioeconomic standing, not well resourced</td>
</tr>
<tr>
<td>emergency management planning?</td>
<td></td>
</tr>
<tr>
<td>Which population groups are most difficult to reach in an event?</td>
<td>Students and employees who have opted out of the RAVE system</td>
</tr>
<tr>
<td>Which population groups have little/limited support networks if</td>
<td>Students in or ageing out of foster care</td>
</tr>
<tr>
<td>impacted by an event?</td>
<td></td>
</tr>
</tbody>
</table>

Resilience Variables Related to Campus Emergency Management

The interviewees were asked to reflect on a set of 12 variables for the campus populations of student, faculty and staff: homelessness (housing insecurity), food security, health and wellness, disability/access and functional needs (AFN), racial equity, digital equity, communications, international students, immigrants/immigration status issues (undocumented, DACA, etc.), LGBTQI (Lesbian Gay Bisexual Transgender Questioning (or queer) Intersex), and transportation dependency. They were also offered an opportunity to add any other factor they wanted to include. The following two questions were asked:

1. Is this factor a particular issue of concern for emergency management on your campus? Responses were summarized as **Very High, High, Medium, Low**
2. Is this factor reflected in the emergency plans and processes for your campus? Responses were summarized as **Yes, No, In Progress, NA**
In order to provide a high-level qualitative response for the answers, the approach of averaging response was taken. If conflicting answers were expressed by the interviewees, the answer (code) was averaged out. A detailed explanation of the response averaging approach is included in the base HVRA.

Table 11-35: Graph of campus-specific emergency management issues of concern and inclusion in emergency management plans and processes.

<table>
<thead>
<tr>
<th>Issue of Concern</th>
<th>Plans &amp; Processes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Homelessness (Housing Insecurity)</td>
<td>Medium</td>
</tr>
<tr>
<td>Food Security</td>
<td>High</td>
</tr>
<tr>
<td>Health &amp; Wellness</td>
<td>Very High</td>
</tr>
<tr>
<td>AFN</td>
<td>High</td>
</tr>
<tr>
<td>Racial Equity</td>
<td>Very High</td>
</tr>
<tr>
<td>Digital Equity</td>
<td>Medium</td>
</tr>
<tr>
<td>Comms.</td>
<td>Medium</td>
</tr>
<tr>
<td>International Students</td>
<td>Medium</td>
</tr>
<tr>
<td>Immigrants / Immigration Status</td>
<td>Medium</td>
</tr>
<tr>
<td>LGBTQI</td>
<td>Low</td>
</tr>
</tbody>
</table>
Qualitative Narrative: Campus Overview of Potential Resilience Vulnerabilities

The following are interview notes of interest:

- Seventy percent of the students have been impacted with food issues.
- Concern is the health care system is fragile on a good day; recognize if an incident impacts beyond campus – HSU center is only the resource.
- School has the highest number of students on psychiatric drugs; resiliency and potential coping mechanism [of concern in an event]; will need medication and if can’t get the meds [of concern].
- Concern was expressed for the faculty who have opted out of RAVE system and live in geographically disbursed areas.
- Continue to have almost monthly protests regarding the death of a black student a while back.
- Maintain the emergency communications in English and Spanish; outside of that don’t have a system. Have had pushback on the RAVE alerts only going out in English. Would like to translate the EOP into the Spanish for families who don’t speak English.
- Have an annex specific to the international students in the EOP which lists the programs and regulations by law that would trigger the recall of students.
- Have relationship with the Mexican consultant
- Because LGBTQI is such a large portion of the school demographic, “it is incorporated” and a precedent is set on the campus.
- The vast majority of the student come from 8-12 hours away and don’t own cars; they utilize homebound buses to the San Francisco Bay Area and to Los Angeles.

Campus High Hazards and Potentially Vulnerable Populations

This section provides a brief introduction to the link between socially vulnerable populations and a particular hazard type. While extensive research has been conducted on the impacts of hazards, not all linkages have been documented or published, and detail for finding them are beyond the scope of this assessment. It’s important to note, the intersectional nature of what makes an individual’s personal experience and resilience to an event is played out by unique factors for that individual or population. The nuanced social vulnerabilities often come from the social and physical environment in which a person is embedded.

In order to aid in further assessing campus resilience, below is a general description of the known impacts. From some hazards, the descriptions are robust, while others are only brief introductions.
<table>
<thead>
<tr>
<th>Hazard</th>
<th>Future Occurrence Probability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Communicable Disease</td>
<td>Highly Likely</td>
</tr>
<tr>
<td>Drought</td>
<td>Highly Likely</td>
</tr>
<tr>
<td>Earthquake</td>
<td>Possible</td>
</tr>
<tr>
<td>Erosion</td>
<td>Highly Likely</td>
</tr>
<tr>
<td>Flood</td>
<td>Possible</td>
</tr>
<tr>
<td>Hazardous Materials</td>
<td>Possible</td>
</tr>
<tr>
<td>Landslide</td>
<td>Possible</td>
</tr>
<tr>
<td>Power Outage</td>
<td>Likely</td>
</tr>
<tr>
<td>Tsunami</td>
<td>Likely</td>
</tr>
<tr>
<td>Wildfire</td>
<td>Unlikely (Fire); Possible (Smoke)</td>
</tr>
</tbody>
</table>
**Drought**

The 2012-2016 drought had severe effects on two vulnerable sectors of our population: those in low-income brackets, and those, especially Native Americans, who rely on subsistence fishing for their livelihoods. Water bills increased throughout the state. Due to rising water prices, for the working poor, many have paid four to five percent of their income for water. Since many CSU students are commuters, and many living with families, future drought impacts may potentially affect a percentage of non-resident students. NASA’s modeling shows that future droughts are likely to last longer and be more intense, even leading to “megadroughts” in the western states. Fresh water supplies are predicted to be full of extremes, with both droughts and extreme precipitation events being more severe. The interrelationship between drought and other hazard conditions may lead to a set of secondary impacts. Drought conditions lead to water quality issues due to loss of drinking water, increased fire danger that leads to drought-induced fires and elevated AQI levels, as well as extreme heat or prolonged heat events.

**Earthquake**

Impacts on populations from earthquakes are complex, with long-term implications on social stability for all populations. In addition to the physical impact exposure during a no-notice earthquake event and the social and logistical challenges of a recovering community, an earthquake can have lasting impacts long afterwards due to post traumatic stress disorder (PTSD).

Socioeconomic vulnerabilities of populations at risk were analyzed in the hypothetical yet scientifically realistic earthquake sequence that is being used to better understand hazards for the San Francisco Bay region during and after a magnitude-7 earthquake (mainshock) on the Hayward Fault and its aftershocks. In this study, the at-risk populations located in areas of concentrated damage are anticipated to experience longer recovery trajectories, increased long term housing displacement, and transportation impacts due to dependencies on transit dependencies. When neighborhood schools close, families with school age children may move to other areas to keep their children in schools. Persons with access and functions needs are likely to be more dependent on access to functioning medical, social and personal health care services that would be overwhelmed by the event and therefore increasing their vulnerabilities. For the homeless populations, the loss of social community services and damages to shelters could add to protracted relocations. For the young and mobile populations who rent, the major disruption to housing, jobs and transit will also drive relocation. Widespread

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housing damage and preexisting housing market constraints will make it “extremely challenging” for the socially and economically vulnerable populations to find alternative housing near their home communities. Those who utilize interim and irregular housing for months and years after a disaster are more vulnerable to physical, social, and mental disorders, including suicide, substance abuse, and physical and verbal abuse. Aftershocks and post disaster conditions delay population return and increase outmigration.\textsuperscript{190}

\textit{Erosion}

Risk from erosion relates to earthen and infrastructural losses. The degree of vulnerability to these events and their impacts depends on human behavior and the traditional social factors such as situational awareness, prior knowledge of hazards, social capital and decision-making capabilities, as well as increased vulnerability due to social factors, such as racial and economic disparities.

\textit{Flood}

Risk from floods relates to community risk, exposure and infrastructural losses. The degree of vulnerability to these events and their impacts depends on human behavior and the traditional social factors such as situational awareness, prior knowledge of hazards, social capital and decision-making capabilities. The exposure of humans to floods continues to increase, driven by changes in hydrology and land use. The adverse impacts on socially vulnerable populations are amplified because a disproportionately high number live in flood-prone areas. Research has shown that places of social vulnerabilities are places characterized by housing and racial disparities, such as mobile home parks, structural fragility and poverty, and higher percentages of populations such as Black and Native Americans, and others with shared histories of discrimination, marginalization and exclusion.\textsuperscript{191}

Health impacts from flooding are well recognized due to the extensive history of flooding in California and around the nation. The impacts range from waterborne illnesses from contaminated waters, respiratory illnesses that impact the lungs, throat, and airways from airborne particles, mold on flooded buildings that can trigger asthma, allergies and other illnesses—all which are particularly impactful to older, younger and individuals with pre-existing health condition. Foodborne illnesses can increase if there are issues with power outages or sewer overflows. Individuals with


increased mental health concerns can be impacted by the stress or anxiety from the impacts of the flood. Poor quality housing can increase vulnerability to many flood risks, including flood inundation, power outages, mold growth, rodent vectors, and serious health impacts. For those with limited finances, flood inundation and impacts to infrastructure or farmlands may lead to extensive income losses.

The poorest residents suffer disproportionally to flood situations, especially those who have been less able to fund homeowner’s insurance to protect against flood losses. Loss of life is not unusual in flooding situations, as is loss of property, livestock, pets, workplaces, and tourist industries. There is a strong interrelationship between water events and other hazards. Flooding, storms and water quality are related to each other. Drought conditions can exacerbate floods as the surface soils are hardened and not as ready to allow surface water absorption. Extreme heat events can cause snowmelt, inundating waterways and causing flood and water quality issues. Flooding and storm events can have impacts on public health, environmental health, agricultural health and economic system health. Mental health issues are reported for all people who have experience flood losses, including anxiety, fear, anger, anger, sadness and grief. Additionally, waterborne disease outbreaks are reported weeks after the flood events. Mold contamination leads to indoor air issues. Damp indoor environments lead to increased prevalence of asthma, and also upper and lower respiratory symptoms.

These issues may influence the diverse CSU populations, both on and off campus, in a number of ways long after a flood event, or the related hazards impacts, has concluded.

**Hazardous Materials**

The severity of a hazardous materials release depends upon the type of material released, the amount of the release, and the proximity to populations or environmentally sensitive areas such as wetlands or waterways. The release of materials can lead to injuries or evacuation of nearby residents. Wind direction at the time of the release can also have a bearing on the severity (as well as the location and extent) of a hazardous materials release.

The primary threat from the hazardous materials incident hazard is to the structures located along transmission lines and transportation routes or near facilities that use or store hazardous materials. Minor incidents would likely cause no damage and little disruption, assuming they could be contained quickly. Major incidents could have fatal and disastrous consequences. The severity of a hazardous material release relates primarily to its impact on human safety and welfare and on the threat to the environment. Threats to human safety and welfare include:

- Poisoning of water or food sources and/or supply
- Presence of toxic fumes or explosive conditions
- Damage to personal property
- Need for the evacuation of people
- Interference with public or commercial transportation

Environmental risks are not uniformly distributed across groups of people. Age, poverty, and minority status place some groups at a disproportionately high risk for environmental disease. Poor access to health information and health care means less health promotion, less risk avoidance, a less healthy diet, and more adverse conditions that increase susceptibility to exposure. Delayed recognition of exposure, diagnosis, and treatment allows effects to accumulate.

**Landslides**

Although infrastructural losses are of secondary importance to the risk to humans themselves, research investigating the vulnerability of people to landslides is rare. The many reasons for this lack of data are related to the fact that the collapse of occupied buildings which makes it a function of structural vulnerability and therefore, indirect. The degree of vulnerability to landslides by an individual considered at high risk, or even the general populations, also depends on human behavior, including many of the traditional social factors that are difficult to measure such as situational awareness, prior knowledge of hazards, and decision-making capabilities.

Landslides can result in primary lifeline failures through the loss of roads or power and communication lines. Transportation routes are often expensive to clean up, and prolonged obstruction can disrupt the movement of people and goods. Risk from landslide relates to earthen and infrastructural losses. The degree of vulnerability to these events and their impacts depends on human behavior and the traditional social factors such as situational awareness, prior knowledge of hazards, social capital and decision-making capabilities, as well as increased vulnerability due to social factors, such as racial and economic disparities.

**Power Outage/Public Safety Power Shutdowns (PSPS)**

Loss of power creates economic hardship to a region experiencing regular PSPS events, such as those experienced throughout the state over the recent years. Many

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193 https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3222496/


businesses close, including gas stations, grocery stores, and local retail establishments. These impacts may deeply impact students dependent on support jobs, as well impacting family members of campus staff and faculty. PSPS increases risks to the public due to inability to use medical devices, spoilage of food and medicines, and disruption to infrastructure, such as supply of clean water and electricity used to run home medical equipment, such as lift chairs and ventilators.

Tsunami

TBD

Wildfire

Increased wildfire threat occurs especially in the end of fall, when conditions are driest, but before the winter rains have come; an east-to-west wind gusts exacerbate fire risk. Wildfire threats have the concomitant threat of Public Safety Power Shutoffs (PSPS). And, in the case of an actual wildfire, danger exists both from fire and from the smoke. Recent wildfires have demonstrated that some demographics are disproportionately affected. Native Americans are six times more likely to be affected than white people. Blacks and Hispanic people are 50 percent more vulnerable. These values take into account the likelihood of a community being affected and the greater difficulty of that community to recover. These statistics reflect the lack of access to resources to pay for insurance, to rebuild and recover, to implement fire safety measures, and to access other resources. Price gouging after a fire (such as documented in Sonoma County after the 2017 Tubbs Fire) further exacerbates the disparity. 196 Furthermore, the disabled and the elderly are at particular risk from extreme wildfire conditions, as they are often not as able to effectively evacuate. Of the 85 people who died in the Camp Fire in Butte in 2018, 62 of them were at least 65 years old. 197

Smoke from wildfires creates a significant public health threat. Especially vulnerable are individuals who have heart or lung issues, such heart disease, lung disease or asthma. Those most vulnerable include the medically fragile, elderly and children. Air Quality Indexes track the level of the following: 198 particulate matter, surface levels of


ozone, carbon monoxide, sulfur dioxide, and nitrogen dioxide. All of these can cause respiratory distress and harm lungs. 199

The California Department of Public Health reports the increased public health risks, and risk indicators that include: heat-related ED visits, populations living in wildfire areas, adults with multiple chronic conditions, populations living in poverty, race/ethnicity, outdoor workers, public transit access, air conditioner ownership and tree canopy.200

Hazard Mitigation and Emergency Management Planning

The goal of this high-level assessment is to provide a starting point to encourage further exploring campus social risks and vulnerabilities, as well as to inform and to enhance holistic emergency management and hazard mitigation decision making, planning processes and future adaptive risk management strategies. By including the social resilience factors, mitigation investments may move beyond standardized planning and regulations, structure and infrastructure projects, and natural systems protections to embrace a more expanded, customized emergency operations plan and an education and outreach program unique to the campus.

A more robust social resilience inquiry is strongly encouraged to develop an accurate picture, based on methodical and scientific research-based data. Such an effort would be envisioned through both nuanced discussions with a variety of campus stakeholders and the invitation of nontraditional stakeholders to join in a collaborative resilience partnership. Such a forward-leaning effort would be directly in keeping with CSU’s commitment to inclusion and equity in risk reduction.

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Section 12
California State University, Long Beach

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12.1 University Profile

University History

CSU Long Beach was originally known as Los Angeles-Orange County State College when it began its first day of classes on September 28, 1949. The campus’s original site was temporarily in Orange County in a converted apartment building, but later moved north to its current site in the City of Long Beach (Los Angeles County). Initially, classes were only offered to junior and senior students consisting mostly of women and veterans. Course studies emphasized on Teacher Education, Business Education and Liberal Arts. The university went through various name changes up until 1972 when the university became California State University, Long Beach. ACSU Long Beach was the first CSU campus to introduce the Educational Opportunity Program (EOP). CSU Long Beach is designated as both a Hispanic-Serving Institution (HSI) and an Asian American and Native American Pacific Islander-Serving Institution (AANAPISI).

University Governance

The campus president is the chief executive officer who oversees the administration of the entire university. The president manages campus operations and fundraising, sets campus priorities, and oversees the hiring and support of staff and faculty. The president also maintains a close working relationship with the CSU’s systemwide office, reporting to the chancellor and participating in the systemwide Executive Council.

The provost is the chief academic officer of the University, overseeing all academic affairs and programs of the University. The provost reports directly to the president.

University Mission

CSU Long Beach’s Mission Statement is, “To enrich students’ lives through globally informed, high impact educational experiences with superior teaching, research, creative activity, and action for the public good.”

CSU Long Beach highlights the following in ensuring success of reaching its mission and vision: Teaching and learning, accountability for the good of the public, diversity and character.

University Location

CSU Long Beach is located in Long Beach, California (population 456,154). The 322-acre campus is the third largest of the 23 California State University campuses, and one of the largest universities in the state of California by enrollment.

University Population

At CSU Long Beach, the enrollment typically exceeds 35,000 students. The university is overwhelmingly made up of undergraduate students whose average age is 22. Latino students make up 40.2% of undergrad students with Asians as the second most
populous group at 22.5% of the population. The university offers 82 different bachelor's degrees, 65 types of master's degrees, and four doctoral degrees. CSU Long Beach employs more than 8,000 individuals as faculty, staff, and student assistants.

12.2 Interim Final Rule for Hazard Vulnerability and Risk Assessment

Requirement §201.6(c)(2): The plan shall include a risk assessment that provides the factual basis for activities proposed in the strategy to reduce losses from identified hazards. Local risk assessments must provide sufficient information to enable the jurisdiction to identify and prioritize appropriate mitigation actions to reduce losses from identified hazards.

Requirement §201.6(c)(2)(i): [The risk assessment shall include a] description of the type...location and extent of all natural hazards that can affect the jurisdiction. The plan shall include information on previous occurrences of hazard events and on the probability of future hazard events.

Requirement §201.6(c)(2)(ii): [The risk assessment shall include a] description of the jurisdiction’s vulnerability to the hazards described in paragraph (c)(2)(i) of this section. This description shall include an overall summary of each hazard and its impact on the community.

Requirement §201.6(c)(2)(ii): [The risk assessment] must also address National Flood Insurance Program (NFIP) insured structures that have been repetitively damaged floods.

Requirement §201.6(c)(2)(ii)(A): The plan should describe vulnerability in terms of the types and numbers of existing and future buildings, infrastructure, and critical facilities located in the identified hazard area.

Requirement §201.6(c)(2)(ii)(B): [The plan should describe vulnerability in terms of an] estimate of the potential dollar losses to vulnerable structures identified in paragraph (c)(2)(ii)(A) of this section and a description of the methodology used to prepare the estimate ..

Requirement §201.6(c)(2)(ii)(C): [The plan should describe vulnerability in terms of] providing a general description of land uses and development trends within the community so that mitigation options can be considered in future land use decisions.

Requirement §201.6(c)(2)(iii): For multi-jurisdictional plans, the risk assessment must
assess each jurisdiction’s risks where they vary from the risks facing the entire planning area.

12.3 Hazard Identification and Risk Assessment

Overview of California State University, Long Beach History of Hazards

Numerous federal agencies maintain a variety of records regarding losses associated with hazards. Unfortunately, no single source is considered to offer a definitive accounting of all losses. The Federal Emergency Management Agency (FEMA) maintains records on federal expenditures associated with declared major disasters. The US Army Corps of Engineers (USACE) and the Natural Resources Conservation Service (NRCS) collect data on losses during the course of some of their ongoing projects and studies. Additionally, the National Oceanic and Atmospheric Administration’s (NOAA) National Centers for Environmental Information (NCEI) database collects and maintains data about natural hazards in summary format. The data includes occurrences, dates, injuries, deaths, and estimated costs. Many of these databases and other data collection services, including the NCEI, have inherent data limitations when searching for information at a university scale.

The best available data and records were used throughout this assessment.

Hazard Identification

As part of the initial hazard identification process, the Campus Assessment Team considered potential hazards with the most chance to significantly affect the planning area. The hazards include those that have occurred in the past and may occur in the future. A variety of sources were used to develop the list of hazards considered including national, regional, and local sources such as emergency operations plans, FEMA’s How-To Series, websites, published documents, databases, and maps, as well as discussion among the Campus Assessment Team members.

In the initial phase of the planning process, the Campus Assessment Team considered 14 hazards and the risks they create for the University and its material assets, population, and operations. The hazards initially considered, and the determinations as to the treatment of those hazards, are shown in Table 12-1 (following).

Table 12-1: Hazard Identification Determinations

<table>
<thead>
<tr>
<th>Hazard</th>
<th>Determination (Yes/No)</th>
<th>Reason for Determination</th>
<th>Future Occurrence Probability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Communicable Disease</td>
<td>Yes</td>
<td>Hazard of concern for campus</td>
<td>Highly Likely</td>
</tr>
<tr>
<td>Dam and Levee Failure</td>
<td>Yes</td>
<td>Hazard of concern for campus</td>
<td>Unlikely</td>
</tr>
<tr>
<td>Drought</td>
<td>Yes</td>
<td>Hazard of concern for campus</td>
<td>Highly Likely</td>
</tr>
<tr>
<td>Hazard</td>
<td>Yes or No</td>
<td>Hazard of concern for campus</td>
<td>Probability</td>
</tr>
<tr>
<td>------------------------</td>
<td>-----------</td>
<td>---------------------------------------</td>
<td>-------------</td>
</tr>
<tr>
<td>Earthquake</td>
<td>Yes</td>
<td>Hazard of concern for campus</td>
<td>Possible</td>
</tr>
<tr>
<td>Erosion</td>
<td>Yes</td>
<td>Hazard of concern for campus</td>
<td>Likely</td>
</tr>
<tr>
<td>Extreme Temperature</td>
<td>Yes - Heat; No - Cold</td>
<td>Hazard of concern for campus</td>
<td>Possible (Heat only)</td>
</tr>
<tr>
<td>Flood</td>
<td>Yes</td>
<td>Hazard of concern for campus</td>
<td>Possible</td>
</tr>
<tr>
<td>Hazardous Materials</td>
<td>Yes</td>
<td>Hazard of concern for campus</td>
<td>Possible</td>
</tr>
<tr>
<td>Landslide</td>
<td>Yes</td>
<td>Hazard of concern for campus</td>
<td>Unlikely</td>
</tr>
<tr>
<td>Power Outage</td>
<td>Yes</td>
<td>Hazard of concern for campus</td>
<td>Likely</td>
</tr>
<tr>
<td>Sea Level Rise</td>
<td>Yes</td>
<td>Hazard of concern for campus</td>
<td>Highly Likely</td>
</tr>
<tr>
<td>Tsunami</td>
<td>Yes</td>
<td>Hazard of concern for campus</td>
<td>Likely</td>
</tr>
<tr>
<td>Volcano</td>
<td>Yes</td>
<td>Hazard of concern for campus</td>
<td>Unlikely</td>
</tr>
<tr>
<td>Wildfire</td>
<td>Yes</td>
<td>Hazard of concern for campus</td>
<td>Unlikely (Fire); Possible (Smoke)</td>
</tr>
</tbody>
</table>

**Future Occurrence Probability**

In order to determine the probability of future occurrences of each hazard profiled, the following scale was developed:

- **Highly Likely**- 76%-100% that the hazard would occur annually.
- **Likely**- 50%-75% that the hazard would occur annually.
- **Possible**- 11%-49% that the hazard would occur each annually.
- **Unlikely**- 0%-10% that the hazard would occur each annually.
Communicable Disease

Description of the Hazard

Communicable diseases are illnesses that occur due to infectious agents or their toxic products and are infectious due to their potential of transmission from one person or species to another by a replicating agent. They may be transmitted from a reservoir to a susceptible host either directly as from an infected person or animal or indirectly through the agency of an intermediate plant or animal host, vector, or the inanimate environment. Communicable diseases are clinically evident illness resulting from the presence of pathogenic microbial agents, including pathogenic viruses, pathogenic bacteria, fungi, protozoa, multi-cellular parasites, and aberrant proteins known as prions. The degree of spread of a communicable disease depends on both the ability of an organism to enter, survive and multiply in the host and the comparative ease with which the disease is transmitted to other hosts.

Some ways in which communicable diseases spread are by:

- Travel through the air, such as tuberculosis, measles, or COVID-19;
- Physical contact with an infected person, such as through touch (staphylococcus), sexual intercourse (gonorrhea, HIV), fecal/oral transmission (hepatitis A), or droplets (influenza, TB, COVID-19);
- Contact with a contaminated surface or object (Norwalk virus), food (salmonella, E. coli), blood (HIV, hepatitis B), or water (cholera); and
- Bites from insects or animals capable of transmitting the disease (mosquito: malaria and yellow fever; flea: plague)

Collectively, the twenty-three (23) campuses and Chancellor’s Office of the California State University (CSU) system have identified nine (9) communicable disease hazards that that have had significant impacts on their respective student, faculty, and staff populations. Of these communicable diseases, COVID-19 is considered to be the most prominent and widespread agent across all CSU campuses. (See Table 12-1 below.)

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Table 12-2: Communicable Diseases at Identified CSU Campuses

<table>
<thead>
<tr>
<th>Collective List of Communicable Diseases Identified by All CSU Campuses</th>
<th>Number of CSU Campuses (Including Chancellor’s Office) Identifying Communicable Disease Having Significant Impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>COVID-19 (SARS-CoV-2)</td>
<td>24</td>
</tr>
<tr>
<td>Meningitis</td>
<td>7</td>
</tr>
<tr>
<td>Measles</td>
<td>6</td>
</tr>
<tr>
<td>Influenza (Including H1N1/Swine Flu)</td>
<td>6</td>
</tr>
<tr>
<td>Tuberculosis</td>
<td>5</td>
</tr>
<tr>
<td>Norovirus</td>
<td>4</td>
</tr>
<tr>
<td>Mumps</td>
<td>2</td>
</tr>
<tr>
<td>E. Coli</td>
<td>2</td>
</tr>
<tr>
<td>Sexually Transmitted Diseases (STDs)</td>
<td>2</td>
</tr>
</tbody>
</table>

(Source: Interviews with CSU campus staff at CSU campuses and at CSU Chancellor’s Office.)

With the exception of COVID-19, there is variability among CSU campuses regarding which communicable diseases have had the greatest impact on individual campus communities. Table 12-3 shows the communicable disease hazards that have had the greatest impact on each CSU campus.

Table 12-3: Communicable Disease Hazards at CSU Campuses with Greatest Impact

<table>
<thead>
<tr>
<th>CSU Campus</th>
<th>Identified Communicable Disease Hazards with the Greatest Impact on CSU Campus</th>
</tr>
</thead>
<tbody>
<tr>
<td>CSU Bakersfield</td>
<td>COVID-19, Meningitis</td>
</tr>
<tr>
<td>CSU Channel Islands</td>
<td>COVID-19, Measles</td>
</tr>
<tr>
<td>Chico State</td>
<td>COVID-19, Tuberculosis</td>
</tr>
<tr>
<td>CSU Dominguez Hills</td>
<td>COVID-19</td>
</tr>
<tr>
<td>Cal State East Bay</td>
<td>COVID-19, Meningitis</td>
</tr>
<tr>
<td>Fresno State</td>
<td>COVID-19, Meningitis, Tuberculosis</td>
</tr>
<tr>
<td>Institution</td>
<td>Communicable Disease Hazard(s)</td>
</tr>
<tr>
<td>-----------------------------</td>
<td>--------------------------------------------------------------------</td>
</tr>
<tr>
<td>Cal State Fullerton</td>
<td>COVID-19, Influenza</td>
</tr>
<tr>
<td>Humboldt State</td>
<td>COVID-19, Measles, Norovirus, Influenza, STDs</td>
</tr>
<tr>
<td>Cal State Long Beach</td>
<td>COVID-19</td>
</tr>
<tr>
<td>Cal State LA</td>
<td>COVID-19, E. coli, Measles</td>
</tr>
<tr>
<td>Cal Maritime</td>
<td>COVID-19</td>
</tr>
<tr>
<td>CSU Monterey Bay</td>
<td>COVID-19</td>
</tr>
<tr>
<td>CSUN (Northridge)</td>
<td>COVID-19, Measles</td>
</tr>
<tr>
<td>Cal Poly Pomona</td>
<td>COVID-19, Influenza (Swine Flu - H1N1)</td>
</tr>
<tr>
<td>Sacramento State</td>
<td>COVID-19</td>
</tr>
<tr>
<td>Cal State San Bernardino</td>
<td>COVID-19, Tuberculosis</td>
</tr>
<tr>
<td>San Diego State</td>
<td>COVID-19, Meningitis, Mumps</td>
</tr>
<tr>
<td>San Francisco State</td>
<td>COVID-19</td>
</tr>
<tr>
<td>San José State</td>
<td>COVID-19, H1N1</td>
</tr>
<tr>
<td>Cal Poly San Luis Obispo</td>
<td>COVID-19, Meningitis, Norovirus</td>
</tr>
<tr>
<td>CSU San Marcos</td>
<td>COVID-19</td>
</tr>
<tr>
<td>Sonoma State</td>
<td>COVID-19, H1N1, Norovirus</td>
</tr>
<tr>
<td>Stanislaus State</td>
<td>COVID-19, Tuberculosis</td>
</tr>
<tr>
<td>Office of the Chancellor</td>
<td>COVID-19</td>
</tr>
<tr>
<td>CSU System-Wide</td>
<td>COVID-19, Meningitis, Measles, Tuberculosis, Influenza-Swine Flu-H1N1, Mumps, Norovirus, E. coli, STDs</td>
</tr>
</tbody>
</table>

(Source: Interviews with CSU campus staff at CSU campuses and at CSU Chancellor’s Office.)

**Descriptions of Identified Communicable Disease Hazards at CSU Long Beach**

CSU Long Beach has identified one (1) communicable disease hazard that has had the greatest impact on campus – COVID-19. The following is a brief description of the communicable disease hazard at CSU Long Beach.

**COVID-19 (SARS-CoV-2)**

Coronaviruses are a family of viruses that can cause illnesses such as the common cold, severe acute respiratory syndrome (SARS) and Middle East respiratory syndrome (MERS). In 2019, a new coronavirus was identified as the cause of a disease outbreak that originated in China. This virus is now known as the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2). The disease it causes is called
Coronavirus Disease 2019 (COVID-19). In March 2020, the World Health Organization (WHO) declared the COVID-19 outbreak a pandemic.

Signs and symptoms of coronavirus disease 2019 (i.e., COVID-19) may appear two to 14 days after exposure. Common signs and symptoms can include fever, cough, and tiredness. Early symptoms of COVID-19 may also include a loss of taste or smell.

The virus that causes COVID-19 spreads easily among people, and more continues to be discovered over time about how it spreads. Data has shown that the COVID-19 virus spreads mainly from person to person among those in close contact (within about 6 feet, or 2 meters). The virus is transmitted by respiratory droplets being released when someone with the virus coughs, sneezes, breathes, sings or talks. These droplets can be inhaled or land in the mouth, nose or eyes of a person nearby. In some situations, the COVID-19 virus can spread by a person being exposed to small droplets or aerosols that stay in the air for several minutes or hours (i.e., airborne transmission). It's not yet known how common it is for the virus to spread this way. The COVID-19 virus can also spread if a person touches a surface or object with the virus on it and then touches his or her mouth, nose or eyes; however, this is not considered to be a main way it spreads.

The severity of COVID-19 symptoms can range from very mild to severe. Some people may have only a few symptoms, and some people may have no symptoms at all. However, some people may experience worsened symptoms, such as worsened shortness of breath and pneumonia. People who are older have a higher risk of serious illness from COVID-19, and the risk increases with age. People who have existing medical conditions also may have a higher risk of serious illness from COVID-19. In some cases, the disease can cause severe medical complications and may even lead to death.5

Location of the Hazard

Communicable diseases have the potential to affect the entire CSU Long Beach planning area equally. As a result, the communicable disease hazard can be found at the CSU Long Beach campus located in Long Beach, CA (Los Angeles County). Because of the ubiquitous nature of many communicable diseases, students, faculty, staff at (and visitors to) CSU Long Beach are at risk of exposure to the communicable disease hazard.

CSU Student Housing Locations and Populations

Although CSU-campus-owned student housing opportunities have been severely limited due to the COVID-19 pandemic, this situation is temporary. Eventually, students will be allowed back on campus at full capacity, and many of these students

will be living in campus-owned housing. When this occurs, over 53,000 students (i.e., just over 11% of the CSU total enrollment) will be at increased risk of exposure to communicable disease hazards, owing to the “close-quarters” living arrangements in student housing. For CSU – Long Beach, approximately 9% of its 38,074 enrolled students or 3,427 students reside in student housing. \(^{6,7}\)

**Extent of the Hazard**

Various communicable diseases are categorized by the Center for Disease Control and Prevention (CDC) by levels of containment called Biosafety Levels (or BSLs). The higher the BSL, the greater the level of containment and level of effort necessary to prevent transmission of the disease, and therefore the greater the hazard. Biosafety Levels prescribe procedures and levels of containment for a particular microorganism or material (including research involving recombinant or synthetic nucleic acid molecules) and procedures associated with that containment. BSLs also consider primary barriers (e.g., biosafety cabinets), secondary barriers, facility design, air handling, laboratory security, etc. BSLs are graded from 1 to 4; as the BSL increases so does the relative risk of the agent/procedures as well the stringency of procedures and facility design.

Figure 12-1 describes the different BSLs and provides examples of communicable diseases that would typically fall into these classifications, as well as the typical protections that would be necessary to prevent transmission of each of the diseases.

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The Extent of CSU Long Beach Communicable Disease Hazards Except COVID-19:

Besides COVID-19, there was no information provided on other communicable disease hazards on campus.

The Extent of CSU Long Beach COVID-19 Communicable Disease Hazard:

As a microorganism, the SARS-CoV-2 (COVID-19) virus requires a high level of containment. It is therefore classified at BSL-3.⁹

History of the Hazard

Over an approximately one-year period, from mid-March, 2020 to March 23, 2021, there were a reported 483 cases of COVID-19 at CSU Long Beach. CSU-campus-specific COVID-19 case data for CSU Long Beach can be found below.

Most communicable disease data are maintained by at the state and at the county levels and are not generally available at the municipal or campus levels, unless (a) the CSU campus falls under the jurisdiction of a city-level health department, or (b) a geographically specific outbreak occurs on campus or in the local community. The exception to this is the current COVID-19 pandemic, where both campus and County-level case data have been collected. As a result, it is important to provide COVID-19

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case statistics for both CSU campuses and the counties where CSU campus assets are located.]

Table 12-5 shows campus-level and County-level COVID-19 Case data for CSU Long Beach. These case data are updated on at least a weekly basis. (Please note that the COVID-19 case numbers here may not reflect the most recent updates.)

Table 12-4: CSU Long Beach COVID-19 Statistics (as of 03/23/2021):\(^{10}\)

<table>
<thead>
<tr>
<th>Population</th>
<th>Confirmed Cases</th>
</tr>
</thead>
<tbody>
<tr>
<td>On-Campus Student Cases</td>
<td>45</td>
</tr>
<tr>
<td>On-Campus Employee Cases</td>
<td>112</td>
</tr>
<tr>
<td>Off-Campus Student Cases</td>
<td>280</td>
</tr>
<tr>
<td>Off-Campus Employee Cases</td>
<td>46</td>
</tr>
<tr>
<td><strong>Total Cases</strong></td>
<td><strong>483</strong></td>
</tr>
</tbody>
</table>

Table 12-5: City of Long Beach COVID-19 Statistics (as of 03/17/2021):\(^{11}\)

<table>
<thead>
<tr>
<th>City of Long Beach</th>
<th>Cases</th>
<th>Deaths</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>51,709</td>
<td>888</td>
</tr>
</tbody>
</table>

Table 12-6: Los Angeles County COVID-19 Statistics (as of 03/17/2021):\(^{12}\)

<table>
<thead>
<tr>
<th>Total Confirmed County Cases</th>
<th>Total Deaths</th>
</tr>
</thead>
<tbody>
<tr>
<td>1,149,878</td>
<td>21,449</td>
</tr>
</tbody>
</table>

Potential Impacts of the Hazard

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Communicable disease outbreaks and pandemics potentially have (and will continue to have) direct impact on life, health, and safety across the CSU system, including the CSU – Long Beach campus. The extent of this impact is contingent on the type of infection or contagion, the severity of the outbreak, and the speed at which it is transmitted. Property and infrastructure integrity may be affected if large portions of the campus population contract communicable diseases at the same time and are therefore unable to perform maintenance, operations, and educational tasks. This would be particularly disruptive if those impacted are first responders or other essential personnel. Long-term outbreaks affecting large numbers of CSU – Long Beach students could result in cancelled classes, delayed matriculation, or other disruptions to the CSU System’s mission. This has already occurred with the current COVID-19 pandemic and could occur again with more virulent strains of communicable diseases, including COVID-19.

Communicable disease hazards found across the CSU system (including CSU – Long Beach) vary both by level of containment (BSL) (described previously) and by level of individual/public health risk, or Risk Group (RG) level. While BSLs describe the procedures and required levels of containment in a laboratory setting, Risk Groups (RGs) reflect the potential effects of disease exposure on humans or animals. Like BSLs, RGs range from Level 1 (RG1) to Level 4 (RG4), with Level 1 (RG1) posing minimal risk to healthy individuals and public health and Level 4 (RG4) posing a very serious or extreme risks to individuals and public. BSLs generally correlate with Risk Group (RG) Levels (e.g., a RG2 agent is worked with at BSL-2), but there are exceptions (e.g., production volumes, high-risk procedures, etc.).

The World Health Organization’s (WHO) Laboratory Biosafety Manual, 3rd ed., NIH Guidelines, categorizes Risk Groups (RGs) in the following way:

Table 12-7: WHO Risk Group Categorization

<table>
<thead>
<tr>
<th>Risk Group (RG)</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>RG1</td>
<td>Rarely associated with disease in healthy adult humans or animals and pose no-to-little public health risk (e.g., Saccharomyces cerevisiae, E. coli K-12 strain derivatives often used for recombinant/molecular biology, many environmental organisms)</td>
</tr>
<tr>
<td>RG2</td>
<td>Associated with mild to moderate disease for which preventative measures or post exposure treatments are</td>
</tr>
</tbody>
</table>


often available; public health impact is limited (e.g., Streptococcus pyogenes, Salmonella, hepatitis B virus)

<table>
<thead>
<tr>
<th>RG3</th>
<th>Associated with serious to lethal human disease for which preventative vaccines or post-exposure therapies may be scarce. Public health impact is limited-to-moderate (e.g., Mycobacterium tuberculosis, hantaviruses, West Nile virus, SARS)</th>
</tr>
</thead>
<tbody>
<tr>
<td>RG4</td>
<td>Associated with serious to lethal human disease for which preventative vaccines or post exposure therapies are not usually available. Public health impact is high (e.g., Ebola virus, Marburg virus, smallpox virus, etc.)</td>
</tr>
</tbody>
</table>

Table 12-9 describes the four (4) Risk Group Levels (RGs), and provides examples of communicable diseases that would typically fall in to these classifications, and the typical protections that would be necessary to prevent transmission of the disease. It is important to note that all but two (2) communicable disease hazards identified by CSU campuses fall under either the lower-risk RG1 or RG2 categories. COVID-19 and tuberculosis are the two (2) communicable diseases fall under the higher-risk RG3 category. However, with the advent of the recently-developed COVID-19 vaccine, and with the expectation of an increasingly robust vaccine supply, it is possible that the RG level for COVID-19 could be lowered in the future, thereby reducing both the extent and the potential impact of COVID-19.

Table 12-8: Risk Group Levels (RGs) with Example Diseases and Recommended Precautions

<table>
<thead>
<tr>
<th>Level</th>
<th>Examples</th>
<th>Typical Protection to Prevent Transmission</th>
</tr>
</thead>
<tbody>
<tr>
<td>RG I</td>
<td>E. Coli</td>
<td>Precautions are minimal, most likely involving gloves and some sort of facial protection. Usually, contaminated materials are left in open (but separately indicated) waste receptacles. Decontamination procedures for this level are similar in most respects to modern precautions against everyday viruses (i.e.: washing one's hands with anti-bacterial soap, washing all exposed surfaces of the lab with disinfectants, etc.).</td>
</tr>
</tbody>
</table>

---

<table>
<thead>
<tr>
<th>RG 2</th>
<th>Chicken Pox</th>
<th>Hepatitis A, B, C</th>
<th>Lyme disease</th>
<th>Salmonella</th>
<th>Mumps</th>
<th>Measles</th>
<th>Malaria</th>
<th>Scrapie</th>
<th>Dengue Fever</th>
<th>HIV</th>
</tr>
</thead>
</table>

These bacteria and viruses cause mild disease in humans or are difficult to contract via aerosol. Routine diagnostic work with clinical specimens can be done safely at BSL-2, using BSL-2 practices and procedures.

<table>
<thead>
<tr>
<th>RG 3</th>
<th>Anthrax</th>
<th>West Nile Virus</th>
<th>SARS Virus (Including COVID-19)</th>
<th>Tuberculosis</th>
<th>Typhus</th>
<th>Yellow Fever</th>
<th>Hantaviruses</th>
<th>Avian Flu</th>
</tr>
</thead>
</table>

These bacteria and viruses cause severe to fatal disease in human, but vaccines or other treatments do exist to combat them. Laboratory personnel have specific training in handling pathogenic and potentially lethal agents and are supervised by competent scientists who are experienced in working with these agents. This is considered a neutral or warm zone.

<table>
<thead>
<tr>
<th>RG 4</th>
<th>H5N1 (Bird Flu)</th>
<th>Dengue Hemorrhagic Fever</th>
<th>Marburg Virus</th>
<th>Ebola Virus</th>
<th>Smallpox</th>
<th>Lassa Fever</th>
<th>Crimean-Congo Hemorrhagic Fever</th>
</tr>
</thead>
</table>

These viruses and bacteria cause severe to fatal disease in humans, for which vaccines or other treatments are not available. When dealing with biological hazards at this level the use of a Hazmat suit and a self-contained oxygen supply is mandatory. The entrance and exit of a BSL-4 lab will contain multiple showers, a vacuum room, an ultraviolet light room, autonomous detection system, and other safety precautions designed to destroy all traces of the biohazard. Multiple airlocks are employed and are electronically secured to prevent both doors opening at the same time. All air and water service going to and coming from a BSL-4 lab will undergo similar
decontamination procedures to eliminate the possibility of an accidental release.

**Probability of Future Occurrences of the Hazard**

There are significant data limitations regarding non-COVID-19 communicable disease cases, as the information thereof is outdated, anecdotal, and/or inadequate. As a result, it is not feasible to provide quantitative probabilities of future occurrence for non-COVID-19 communicable disease hazards. However, based on the limited data, it is feasible to present qualitative probabilities of future occurrence based on ranges of communicable disease frequency.

Table 12-10 shows a probability scale of future occurrence for the nine (9) communicable disease hazards profiled in this assessment. This scale is divided into four (4) levels of probability:

<table>
<thead>
<tr>
<th>Table 12-9: Likelihood of Future Hazard Occurrence</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Likelihood</strong></td>
</tr>
<tr>
<td>Highly Likely</td>
</tr>
<tr>
<td>Likely</td>
</tr>
<tr>
<td>Possible</td>
</tr>
<tr>
<td>Unlikely</td>
</tr>
</tbody>
</table>

Due to significant data limitations surrounding non-COVID communicable diseases, the probability of future occurrence of CSU-system-wide communicable disease is measured by the proportion of campuses that have identified a particular communicable disease as having an impact on the campus community. In this measure, the more frequent a communicable disease is seen as impactful CSU-wide, the greater the probability of future occurrence.

Note: Each communicable disease’s system-wide probability ranking (below) reflects the ranking at the individual CSU campus level unless noted otherwise.
Table 12-10: Probability of Future Occurrence of Communicable Disease Hazard for CSU System

<table>
<thead>
<tr>
<th>Collective List of Communicable Diseases Identified by All CSU Campuses</th>
<th>Number of CSU Campuses (Including Chancellor’s Office) Identifying Communicable Disease Having Significant Impact</th>
<th>Proportion of CSU Campuses Identifying Communicable Disease as Having Significant Impact System-Wide</th>
<th>CSU System-Wide Probability Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>COVID-19 (SARS-CoV-2)</td>
<td>24</td>
<td>1.00</td>
<td>Highly Likely</td>
</tr>
<tr>
<td>Meningitis</td>
<td>7</td>
<td>0.29</td>
<td>Possible</td>
</tr>
<tr>
<td>Measles</td>
<td>6</td>
<td>0.25</td>
<td>Possible</td>
</tr>
<tr>
<td>Influenza (Including H1N1/Swine Flu)</td>
<td>6</td>
<td>0.25</td>
<td>Possible</td>
</tr>
<tr>
<td>Tuberculosis</td>
<td>5</td>
<td>0.21</td>
<td>Possible</td>
</tr>
<tr>
<td>Norovirus</td>
<td>4</td>
<td>0.17</td>
<td>Possible</td>
</tr>
<tr>
<td>Mumps</td>
<td>2</td>
<td>0.08</td>
<td>Unlikely</td>
</tr>
<tr>
<td>E. Coli</td>
<td>2</td>
<td>0.08</td>
<td>Unlikely</td>
</tr>
<tr>
<td>Sexually Transmitted Diseases (STDs)</td>
<td>2</td>
<td>0.08</td>
<td>Unlikely</td>
</tr>
</tbody>
</table>

(Source: Interviews with staff at CSU campuses and at the CSU Chancellor’s Office.)

Vulnerability to the Hazard

Vulnerability to a communicable diseases hazard resides in the population of a given area – both human and animal – not in the infrastructure or physical assets. While CSU assets and infrastructure could be impacted indirectly by the communicable disease hazard, these impacts would be secondary to the impact that the communicable disease hazard would have on students, faculty, staff, and visitors at the CSU – Long Beach campus.
CSU campus settings are geographically diverse, with locations ranging from small towns to medium-sized cities to densely populated urban areas. Hundreds of thousands of people work, study, and/or pass through CSU campuses on any given day. (As of Fall 2019, CSU – Long Beach had 38,074 students along with additional faculty and staff.)\(^{16,17}\) Each of these persons is vulnerable to communicable disease, particularly if it is a pathogen that individual has not been immunized against, or for which no immunization exists. Prolonged outbreaks could result in a loss of services, failure of infrastructure (from lack of operators or maintenance), and closure of facilities. This exact scenario has played out to some degree in the current COVID-19 pandemic on the CSU – Long Beach campus.

**Estimate of Potential Losses**

**COVID-19 Pandemic Health Impact on CSU Campuses and Surrounding Communities**

The most prescient metric for estimating losses from COVID-19 is loss of life. The nationwide campus-related COVID-19 death rate of 0.02% remains well below the average COVID-19 death rate in the U.S. However, due to data limitations, there is no information on CSU-campus-specific deaths by COVID-19 or by any other communicable diseases. In fact, COVID-19 is the only communicable disease for which case reports have been readily available for CSU campuses.

At some point in the future, CSU campuses will return to full capacity. Without adequate surveillance regarding campus access and student and employee interaction, CSU campuses (including CSU – Long Beach) are at risk of developing an extreme incidence of COVID-19 and may become “super-spreaders” for adjacent communities.\(^{18}\) The emergence of more virulent COVID-19 variants would only add to the potential for high negative impacts on life safety, operations, and service delivery across the CSU system. (Other communicable diseases would also re-emerge, but with low to moderate negative impacts on life safety, operations, and service delivery.)

**Economic Impact of COVID-19 Pandemic on CSU Financial Health**

During the first few months of the COVID-19 pandemic in 2020, the CSU system suffered tremendous negative fiscal impacts. From March through July of 2020 alone, over $146 million worth of revenue losses were sustained across the CSU system due

\(^{16}\) The California State University. *Enrollment.* Retrieved 05.03.2021 from: https://www2.calstate.edu/csu-system/about-the-csu/facts-about-the-csu/enrollment/Pages/default.aspx

\(^{17}\) The California State University. *Employee Head Count by Campus.* Retrieved 05.03.2021 from: https://www2.calstate.edu/csu-system/faculty-staff/employee-profile/csustaff/Pages/employee-headcount-by-campus.aspx

to refunds to students for parking, housing and dining service fees during Spring Semester, 2020. Several CSU campuses saw refund losses surpass $10 million. (See Figure 12-2 below for economic impacts to CSU – Long Beach).

Figure 12-2: CSU COVID-19 Cost Tracking Showing Revenue Refund Losses and Increased Costs

Mitigative Relief from Federal Assistance

The $1.5 billion in total federal assistance sent to the CSU system will help relieve the losses of revenues from services like dorms, parking and dining services during a year of mainly empty campuses. (See Table CD.10) However, because of staggering COVID-related revenue losses, the CSU system is planning for three (3) years of fiscal duress.

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### Table 12-11: Total Federal Assistance to CSU for COVID-19 Related Losses, 2020 – 2021

<table>
<thead>
<tr>
<th>Institution</th>
<th>December 2020 Stimulus</th>
<th>CARES Act</th>
<th>APLU Projection of HEERF Total ARP Act Funding Allocation</th>
<th>Total Estimated Federal COVID Relief Funding</th>
</tr>
</thead>
<tbody>
<tr>
<td>California Polytechnic State University</td>
<td>$20,752,799</td>
<td>$14,725,000</td>
<td>$37,000,928</td>
<td>$72,478,727</td>
</tr>
<tr>
<td>California State Polytechnic University, Pomona</td>
<td>$48,614,353</td>
<td>$31,102,000</td>
<td>$86,044,649</td>
<td>$165,761,002</td>
</tr>
<tr>
<td>California State University Channel Islands</td>
<td>$14,288,099</td>
<td>$8,512,000</td>
<td>$24,915,170</td>
<td>$47,715,269</td>
</tr>
<tr>
<td>California State University Maritime Academy</td>
<td>$1,381,700</td>
<td>$1,204,000</td>
<td>$2,472,622</td>
<td>$5,058,322</td>
</tr>
<tr>
<td>California State University - Sacramento</td>
<td>$59,891,260</td>
<td>$35,643,000</td>
<td>$104,900,133</td>
<td>$200,434,393</td>
</tr>
<tr>
<td>California State University, Bakersfield</td>
<td>$22,855,632</td>
<td>$12,483,000</td>
<td>$40,285,565</td>
<td>$75,624,197</td>
</tr>
<tr>
<td>California State University, Chico</td>
<td>$31,603,856</td>
<td>$20,019,000</td>
<td>$55,754,538</td>
<td>$107,377,394</td>
</tr>
<tr>
<td>California State University, Dominguez Hills</td>
<td>$31,843,563</td>
<td>$18,312,000</td>
<td>$55,915,410</td>
<td>$106,070,973</td>
</tr>
</tbody>
</table>


<table>
<thead>
<tr>
<th>Institution</th>
<th>Revenue 2019</th>
<th>Revenue 2020</th>
<th>Revenue 2021</th>
<th>Revenue 2022</th>
</tr>
</thead>
<tbody>
<tr>
<td>California State University, East Bay</td>
<td>$24,243,652</td>
<td>$14,394,000</td>
<td>$42,929,208</td>
<td>$81,566,860</td>
</tr>
<tr>
<td>California State University, Fresno</td>
<td>$52,725,317</td>
<td>$32,557,000</td>
<td>$92,926,594</td>
<td>$178,208,911</td>
</tr>
<tr>
<td>California State University, Fullerton</td>
<td>$67,736,949</td>
<td>$41,088,000</td>
<td>$120,859,884</td>
<td>$229,684,833</td>
</tr>
<tr>
<td><strong>California State University, Long Beach</strong></td>
<td>$67,421,424</td>
<td>$41,202,000</td>
<td>$119,508,329</td>
<td>$228,131,753</td>
</tr>
<tr>
<td>California State University, Los Angeles</td>
<td>$61,905,561</td>
<td>$40,067,000</td>
<td>$108,543,672</td>
<td>$210,516,233</td>
</tr>
<tr>
<td>California State University, Monterey Bay</td>
<td>$13,455,716</td>
<td>$8,705,000</td>
<td>$23,922,768</td>
<td>$46,083,484</td>
</tr>
<tr>
<td>California State University, Northridge</td>
<td>$74,004,088</td>
<td>$47,458,000</td>
<td>$131,021,450</td>
<td>$252,483,538</td>
</tr>
<tr>
<td>California State University, San Bernardino</td>
<td>$42,438,131</td>
<td>$27,924,000</td>
<td>$74,982,459</td>
<td>$145,344,590</td>
</tr>
<tr>
<td>California State University, San Marcos</td>
<td>$26,602,684</td>
<td>$15,542,000</td>
<td>$46,496,808</td>
<td>$88,641,492</td>
</tr>
<tr>
<td>California State University, Stanislaus</td>
<td>$22,007,207</td>
<td>$12,928,000</td>
<td>$38,636,391</td>
<td>$73,571,598</td>
</tr>
<tr>
<td>Humboldt State University</td>
<td>$16,130,016</td>
<td>$11,146,000</td>
<td>$28,831,619</td>
<td>$56,107,635</td>
</tr>
<tr>
<td>San Diego State University</td>
<td>$45,914,127</td>
<td>$30,394,000</td>
<td>$80,592,385</td>
<td>$156,900,512</td>
</tr>
<tr>
<td>San Francisco State University</td>
<td>$47,404,409</td>
<td>$30,000,000</td>
<td>$83,075,470</td>
<td>$160,479,879</td>
</tr>
<tr>
<td>San Jose State University</td>
<td>$46,631,939</td>
<td>$30,977,000</td>
<td>$82,976,130</td>
<td>$160,585,069</td>
</tr>
<tr>
<td>Sonoma State University</td>
<td>$13,980,795</td>
<td>$9,153,000</td>
<td>$24,732,994</td>
<td>$47,866,789</td>
</tr>
</tbody>
</table>
Vulnerability Assessment Conclusions

Before the COVID-19 pandemic, populations at all CSU campuses and CSU-affiliated facilities were substantial. Collectively, as of Fall 2019, CSU campuses had 480,541 students and 53,763 faculty and staff. All were at risk from the communicable disease events, with 534,304 people being directly vulnerable. The COVID-19 pandemic has caused campus population numbers to plummet to a small fraction of full capacity.

At some point in the future, campus population numbers will return to their pre-pandemic levels, and students, faculty, and staff will again be vulnerable to the communicable disease hazard. If just 10% of the total CSU population were to become ill with a highly infective communicable disease like influenza or another strain of SARS, this would mean that approximately 53,430 people would be sick at the same time. This scenario would likely overwhelm available on-campus medical services could even overwhelm portions of the larger community’s medical resources – especially if there were large numbers of infected people with immune system compromises or other underlying health problems. (See Table CD.11 below for the “10% outbreak scenario” projections both for the CSU – Long Beach campus and for the entire CSU system.

Table 12-12: Scenario of Communicable Disease Hazard Affecting 10% of the CSU Population

<table>
<thead>
<tr>
<th>CSU Campus</th>
<th>Approximate Enrollment Population (Fall 2019)</th>
<th>Approximate Total FT/PT Faculty/Staff Population (Fall 2019)</th>
<th>Total Combined Approximate Student and Faculty/Staff Population</th>
<th>10% Outbreak Scenario (Students and Faculty/Staff Combined)</th>
</tr>
</thead>
<tbody>
<tr>
<td>CSU Bakersfield</td>
<td>11,199</td>
<td>1,277</td>
<td>12,476</td>
<td>1,248</td>
</tr>
<tr>
<td>CSU Channel Islands</td>
<td>7,093</td>
<td>994</td>
<td>8,087</td>
<td>809</td>
</tr>
<tr>
<td>Chico State</td>
<td>17,019</td>
<td>1,969</td>
<td>18,988</td>
<td>1,899</td>
</tr>
</tbody>
</table>


<table>
<thead>
<tr>
<th>Institution</th>
<th>Fall 2020</th>
<th>Spring 2021</th>
<th>Fall 2021</th>
<th>Spring 2021</th>
</tr>
</thead>
<tbody>
<tr>
<td>CSU Dominguez Hills</td>
<td>17,027</td>
<td>1,761</td>
<td>18,788</td>
<td>1,879</td>
</tr>
<tr>
<td>Cal State East Bay</td>
<td>14,705</td>
<td>1,764</td>
<td>16,469</td>
<td>1,647</td>
</tr>
<tr>
<td>Fresno State</td>
<td>24,139</td>
<td>2,534</td>
<td>26,673</td>
<td>2,667</td>
</tr>
<tr>
<td>Cal State Fullerton</td>
<td>39,868</td>
<td>3,736</td>
<td>43,604</td>
<td>4,360</td>
</tr>
<tr>
<td>Humboldt State</td>
<td>6,983</td>
<td>1,171</td>
<td>8,154</td>
<td>815</td>
</tr>
<tr>
<td><strong>Cal State Long Beach</strong></td>
<td><strong>38,074</strong></td>
<td><strong>4,004</strong></td>
<td><strong>42,078</strong></td>
<td><strong>4,208</strong></td>
</tr>
<tr>
<td>Cal State LA</td>
<td>26,361</td>
<td>2,821</td>
<td>29,182</td>
<td>2,918</td>
</tr>
<tr>
<td>Cal Maritime</td>
<td>911</td>
<td>329</td>
<td>1,240</td>
<td>124</td>
</tr>
<tr>
<td>CSU Monterey Bay</td>
<td>7,123</td>
<td>1,059</td>
<td>8,182</td>
<td>818</td>
</tr>
<tr>
<td>CSUN (Northridge)</td>
<td>38,391</td>
<td>3,832</td>
<td>42,223</td>
<td>4,222</td>
</tr>
<tr>
<td>Cal Poly Pomona</td>
<td>27,914</td>
<td>2,650</td>
<td>30,564</td>
<td>3,056</td>
</tr>
<tr>
<td>Sacramento State</td>
<td>31,156</td>
<td>3,228</td>
<td>34,384</td>
<td>3,438</td>
</tr>
<tr>
<td>Cal State San Bernardino</td>
<td>20,311</td>
<td>2,118</td>
<td>22,429</td>
<td>2,243</td>
</tr>
<tr>
<td>San Diego State</td>
<td>35,081</td>
<td>3,702</td>
<td>38,783</td>
<td>3,878</td>
</tr>
<tr>
<td>San Francisco State</td>
<td>28,880</td>
<td>3,401</td>
<td>32,281</td>
<td>3,228</td>
</tr>
<tr>
<td>San José State</td>
<td>33,282</td>
<td>3,568</td>
<td>36,850</td>
<td>3,685</td>
</tr>
<tr>
<td>Cal Poly San Luis Obispo</td>
<td>21,242</td>
<td>2,871</td>
<td>24,113</td>
<td>2,411</td>
</tr>
<tr>
<td>CSU San Marcos</td>
<td>14,519</td>
<td>1,687</td>
<td>16,206</td>
<td>1,621</td>
</tr>
<tr>
<td>Sonoma State</td>
<td>8,649</td>
<td>1,338</td>
<td>9,987</td>
<td>999</td>
</tr>
<tr>
<td>Stanislaus State</td>
<td>10,614</td>
<td>1,276</td>
<td>11,890</td>
<td>1,189</td>
</tr>
<tr>
<td>Office of the Chancellor</td>
<td>0</td>
<td>673</td>
<td>673</td>
<td>67</td>
</tr>
<tr>
<td><strong>CSU System-Wide</strong></td>
<td><strong>480,541</strong></td>
<td><strong>53,763</strong></td>
<td><strong>534,304</strong></td>
<td><strong>53,430</strong></td>
</tr>
</tbody>
</table>

*Note: Enrollment figures do not include non-specific CSU campus International Programs (455 students) or CALStateTEACH Program (933 students).*

While the case numbers of COVID-19 have been significantly lower (about 1% of the total CSU population) than those in the 10% scenario, the degree of virulence and resultant morbidity and mortality caused by COVID-19 have led to widespread campus shutdowns, educational disruption, and economic harm to the CSU system, including
CSU – Long Beach. In short, the real-time COVID-19 communicable disease outbreak scenario has proven far more devastating than the 10% simulated scenario.

**Identified Data Limitations**

There is a wealth of technical information available for communicable disease. However, there is also limited non-COVID-19 communicable disease data available regarding risk or vulnerability of specific populations throughout the CSU. Much of the data that does exist is protected by privacy policies, and therefore cannot be obtained for more specific populations. As a result, performing a detailed quantitative assessment for this hazard is difficult.

Data that could be collected prior to the next update in order to improve this methodology includes:

- Data regarding infection rates at the campus level and for specific populations;
- Data regarding communicable disease case numbers and outcomes, by CSU campus;
- Data regarding projected population changes;
- Data regarding absenteeism; and
- Data regarding increased operating costs as a result of absenteeism (i.e., temporary shifting of duties resulting in business interruption).

**Dam and Levee Failure**

**Description of the Hazard**

A dam failure represents the structural collapse of a dam that stores water in a reservoir behind the dam. These failures are typically the result of structural age, damage to the structure caused by earthquake or flooding, inadequate discharge or spillway capacity, inadequate maintenance, improper construction materials, or extreme inflow of water into the reservoir. Prolonged precipitation may result in overtopping of the dam resulting in structural compromise. The tremendous energy generated by a sudden breach of the dam will have significant downstream effects. Flood damage resulting from dam failures potentially will result in economic losses, environmental damage, destruction of agriculture, and human casualties. This type of incident is extremely dangerous as it can occur rapidly, with no warning resulting in an inability to effectively evacuate threatened communities.

A levee failure is similar to dam failures as the result will be a breach causing flooding on the dry side of the levee. Levees are embankments whose primary purpose is to
furnish flood protection from seasonal high water or divert the flow of water. Most
levees in California are intended to withstand peak water levels generated by heavy
precipitation or rapid snowmelt in a watershed. Other levees are designed to
withstand fluctuating water levels on a continuous basis such as those in the
California Delta exposed to tidal influences. Levees routinely extend for lengthy
distances immediately protecting communities. Levees can be found throughout the
state but are most prominent in the Sacramento and San Joaquin Valleys.

Levee failures can vary from over topplings to small uncontrolled discharge to
catastrophic failure. Areas downstream of the failure will be subject to inundation
dependent on the volume of water released. These levee failures are also typically the
result of structural age, damage to the structure caused by earthquake or flooding,
slumping, seepage underneath the levee, high velocity flows eroding the levee,
inadequate capacity, inadequate maintenance, improper construction materials, or
extreme inflow of water into the system. Flood damage resulting from levee failures
potentially will result in economic losses, environmental damage, destruction of
agriculture, and human casualties.

A Dam or levee failure flooding will vary depending on a number of factors including
the extent of the collapse or breach, the volume of water behind the structure, and the
nature of the exposed downstream features. This unpredictable flooding presents a
threat to life and property in addition to critical infrastructure. Lifelines and supply
routes will likely be damaged or made impassible by flood erosion or standing water.
Water quality and health concerns would likely be cascading effects of dam or levee
failures.

Location of the Hazard

Los Angeles County is home to a variety of flood control facilities and levee systems
mostly along the base of the various mountains and hills throughout the county.
Levees have been constructed along numerous flood control channels providing
community protection. The CSU Long Beach campus is in general proximity to dams
upstream along the Los Angeles River and Rio Hondo systems in addition to flood
control channels lined with levees.

There are a number of dam facilities along the base of the San Gabriel Mountains and along the river systems extending from the mountains. The larger facilities include the San Gabriel Dam, Morris Dam, Santa Fe Dam, and Whittier Narrows. Each of these facilities regulate water that flow along the San Gabriel River and Rio Hondo systems. The CSU Long Beach campus lies outside of dam inundation zones for these facilities.
The San Gabriel River drains the San Gabriel Mountains and much of the eastern Los Angeles Basin south towards Long Beach. A number of flood control systems feed into the San Gabriel River. The length of the San Gabriel River from between Downey and Norwalk to the outlet into the ocean is a large concrete lined channel. The channel is located almost ¾ mile east of the CSU Long Beach campus and is separated from the campus by additional flood control channels.

The Los Cerritos Channel is a flood control and drainage channel ¼ mile east of the campus that drains much of the urban water collection of the South Bay communities. The channel feeds into the Pacific Ocean at the Alamitos Bay with drainage from South Bay communities such as North Long Beach, Lakewood, and Bellflower. The Los Cerritos Channel is a concrete lined flood control channel fed by additional channels above the campus.

The Bouton Creek channel is an additional flood control channel that crosses through the campus from the northwest to the southeast. The 2-mile channel feeds into the Los Cerritos Channel and ultimately into the Pacific Ocean at Alamitos Bay. The
channel drains the Signal Hill and eastern Long Beach areas. The center of the Long Beach campus has been built over the channel.

Figure 12-5: Dams and Levees with Critical Assets

extent of the hazard

Dams are classified according to the hazard that they pose to life and property in the event of failure, rather than the likelihood of that failure.

- **High hazard potential dams** may result in loss of human life, and will likely result in economic, environmental, or lifeline losses.
- **Significant hazard potential dams** are not expected to result in loss of life, but are expected to cause economic, environmental, and lifeline losses.
- **Low hazard potential dams** are not expected to result in loss of life, and there is a low expectation of economic, environmental, or lifeline losses. What losses do occur are generally limited to the dam owner.
Dams classified as high hazard are required to have Emergency Action Plans (EAP). EAPS are formal documents that identify potential emergency conditions at the dam and specify preplanned actions to be followed in case of failure. An EAP is required for all high hazard dams and is recommended for all significant hazard dams.

Table 12-13: Los Angeles County Dams Upstream from CSU Long Beach

<table>
<thead>
<tr>
<th>River</th>
<th>Dam</th>
<th>Storage</th>
<th>Hazard Severity</th>
</tr>
</thead>
<tbody>
<tr>
<td>San Gabriel</td>
<td>Morris</td>
<td>27,500af</td>
<td>High Hazard</td>
</tr>
<tr>
<td>San Gabriel</td>
<td>San Gabriel</td>
<td>45,832af</td>
<td>High Hazard</td>
</tr>
<tr>
<td>San Gabriel</td>
<td>Santa Fe</td>
<td>45,409af</td>
<td>High Hazard</td>
</tr>
<tr>
<td>San Gabriel</td>
<td>Whittier Narrows</td>
<td>66,702af</td>
<td>High Hazard</td>
</tr>
</tbody>
</table>

The CSU Long Beach campus lies outside of the inundation zone of the dams listed above. In the event of a catastrophic failure of the identified dams, the CSU Long Beach campus is expected to remain out of the inundation area. The inundation area is expected to spread water in areas upstream from the campus and remain within the flood control channels in proximity to the campus. However, there are multiple transportation corridors that lie within the dam inundation zones that could compromise transportation routes and areas the campus community reside or work. Based on these conditions, the planning committee ranks the extent of the hazard on campus as Low.

**Extent – Levee Failure**

Levees are used along numerous flood control channels and other waterways including the Los Angeles River, San Gabriel River, and Los Cerritos Channel. The CSU Long Beach campus lies outside of the levee flood protected area. In the event any of these channels were flowing at elevated levels and a failure of a levee were to occur, while the campus would not experience direct impacts, the community surrounding the campus would likely experience flood related damages. This specific hazard could alter the ability of the campus to maintain operations. Based on these conditions, the planning committee ranks the extent of the levee failure hazard as Low.

**History of the Hazard**

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There are no records of dam or levee failures in areas that present a threat to the CSU Long Beach campus. The City of Long Beach has not identified a history of dam or levee failures elsewhere in the city. Los Angeles County has experienced the following dam failures:

Table 12-14: Los Angeles County Dam Failures

<table>
<thead>
<tr>
<th>Date</th>
<th>Dam</th>
<th>Release</th>
<th>Damage</th>
</tr>
</thead>
<tbody>
<tr>
<td>3/12/1928</td>
<td>St. Francis</td>
<td>38,000af</td>
<td>Extensive; 450 fatalities</td>
</tr>
<tr>
<td>12/14/1963</td>
<td>Baldwin Hills</td>
<td>770af</td>
<td>277 residences, 5 fatalities</td>
</tr>
</tbody>
</table>

Potential Impacts of the Hazard

Dam Failure Impacts – While the campus is not within a dam inundation zone, transportation routes, critical infrastructure, and campus community members may reside within inundation zones. Water that is released due to a dam that has failed generates tremendous energy and force causing a flood that will be catastrophic to life and property. Water levels from the failed dam could be significantly higher than those experienced in worst case scenario flood events. Areas closer to the failed dam will be more likely to experience complete devastation while other areas within the inundation zone will see varying levels of flood waters. The extent of the impacts of a failed dam would vary based on a number of factors such as the volume of water released, the base flow of the river, the time of the failure, the amount of warning provided, and the distance from the dam. Impacts resulting from a dam failure include:

- Loss of life
- Property destruction or damage
- Loss of property contents
- Infrastructure damage
- Flooded or destroyed lifelines/supply routes
- Damaged or destroyed utilities
- Loss of community economic base
- Employment losses
- Agricultural (crops and livestock) damages or destruction
- Environmental damage
- Floods generating threats to public health
- Flood generated debris
- Damage or destruction of academic materials, fine arts, and research
- Damage or destruction of university computer systems and networks
- Damaged university infrastructure
- Reduced or eliminated student engagement with academic programs
- Reductions in campus revenues

Levee Failure Impacts – A levee failure may result in substantial amounts of water to enter into developed areas protected by the levee. The force and volume of water that is generated by a levee failure may cause extensive structural damage in close proximity to the breach and effects of flooding spreading well beyond the point of the failure. The extent of the impacts would vary based on a number of factors such as the volume of water released, the time of the failure, the amount of warning provided, the location of the breach, elevation, and distance from the breach. Potential impacts resulting from a levee failure include:

- Loss of life
- Property destruction or damage
- Loss of property contents
- Infrastructure damage
- Public health hazards resulting from mold, mildew, and disease due to flood water
- Flooded or destroyed lifelines/supply routes
- Damaged or destroyed utilities
- Loss of community economic base
- Employment losses
- Agricultural (crops and livestock) damages or destruction
- Environmental damage
- Prolonged periods of necessary dewatering
- Disruptions to education delivery to community
- Damage or destruction of academic materials, fine arts, and research
- Damage or destruction of university computer systems and networks
- Damaged university infrastructure
- Reduced or eliminated student engagement with academic programs
- Reductions in campus revenues

Probability of Future Occurrence of the Hazard
The location of the CSU Long Beach campus downstream from the Santa Fe Springs Dam and other flood control facilities along the San Gabriel River and Coyote Creek demonstrates that the potential exists for future dam or levee related secondary impacts. However, the distance from the river channel provides an additional mitigating factor, meaning that the City of Long Beach including the CSU Long Beach campus resides outside of known dam inundation zones. Los Angeles River 39 levee system resides immediately to the east of the campus, however, the campus is outside of the levee protected zone. There are no official recurrence intervals that have been calculated for dam or levee failures. Based on historical experience and occurrences, and based on consistent dam and levee monitoring and maintenance protocols, the probability of future occurrence for both dam and levee failures is Unlikely.

Vulnerability to the Hazard

Given High Priority dam monitoring and maintenance practices in place, a catastrophic dam or levee failure is highly unlikely. In addition, the campus does not lie within an inundation zone. As such, the campus is not considered to be vulnerable on a daily basis. However, in the unlikely event of a catastrophic failure, the effects of flooding from compromised dams and levees on campus would most likely be limited to indirect or secondary effects in terms of disruption to regional transportation networks and services, and the amount of time to respond to the needs of the campus community prior to inundation will be limited.

It is likely that response action will not be fully implemented until the incident situational intelligence provides adequate information as to compromised locations. These variables place all those working and living within the dam inundation and flood protection zones in vulnerable locations.

The distributed placement of levees, most near development may expose significant vulnerabilities to other areas of the region even if the campus is unaffected. There is potential the campus community will be affected as a breach may cause flooding and damages to the homes of students, faculty, and staff or to access/supply routes, utilities, or other critical services. The potential for flood damaged structures being left uninhabitable including campus residence halls will result in the vulnerability of displaced individuals and households. The lack of flood insurance will cause extreme financial burdens on those affected.

Vulnerability to a dam or levee failure on the CSU Long Beach campus will vary depending on the degree of breach or structural failure and when the failure were to occur. The risk to the campus population will be lessened during periods when classes are not in session or during periods of breaks. Conversely, during the days and hours that classes are in session and staff are at their workplaces, the human vulnerability increases. However, in low probability, region-wide events this vulnerability may be shared with the homes and workplaces of members of the campus community and their families.
Some areas of particular vulnerability to dam failure from the Fullerton Reservoir on the campus includes:

- Water inundation of the Children’s Center.
- Water inundation of the campus corporation yard
- Water inundation of the University Police Department
- Chemicals, bottled gases, radioactive materials, biological materials, and explosive compounds are stored in campus science labs, chemical storage facilities, Facilities Maintenance Shops, and Engineering Labs
- Inundation of the Tri-Gen Powerplant
- Residential halls are located on east side of campus likely outside of inundation zone but will require evacuation and mass care and shelter assistance needs
- State College Blvd and Yorba Linda Blvd potential for flood inundation limiting access to and from the campus.

Certain campus populations will experience greater challenges to a post-flood / failure environment. Vulnerable populations will likely need to navigate through flood generated debris, face extreme health safety issues from flood waters, experience extreme stresses of a disaster, an inability to communicate to or gain access to support networks, and find difficulty in accessing equipment or supplies to aid in a specific need.

Estimate of Potential Losses

Estimates of potential losses will be influenced by a variety of factors. The volume and force of the water will determine the scale of damages affecting campus infrastructure, equipment, and other impacted features. The proximity to the failure and elevation above flood waters will affect the level of damage and individuals exposed. The time of the academic year, the day of week, and hour in which the failure was to occur will influence the number of people on campus and potential casualties. Losses will be generated by the physical damages, the loss of revenue, loss of academic research, loss of building contents, and community wide economic reductions.

Based on estimate replacement costs of facilities and structures on campus, the total replacement costs due to dam or levee failure are $453,426,848. However, it is unlikely for a dam or levee failure event to cause catastrophic destruction at CSU Long Beach.

Vulnerability Assessment Conclusions

While the occurrence of dam and levee failures have not been historically relevant near the CSU Long Beach campus, the potential for hazards related to the region’s levees and dams still exist. However, the presence of earthquake faults in proximity to the existing dam and levee structures presents a valid danger to downstream locations in the event of an earthquake. The consequences of a dam failure would
generate catastrophic results to downstream communities. The potential for dam or levee failure further generates the added potential for a number of cascading effects such as disruptions to the local economy, utility failures, disruptions to providing for the needs of the community, and development of public health hazards. These effects would be exacerbated by effects of seasonal flooding, ongoing heavy precipitation, or excessive run-off from the watershed contributing to the river system. The potential for widespread flooding and damage of structures due to the force of water has exponentially powerful impacts on particular populations among the campus community including those with access or functional needs, international students, the homeless, and students residing in the residence halls.

**Identified Data Limitations**

Missing campus structural replacement costs and complete inventory of building construction features or mitigation efforts to lessen the impact due to flood inundation.
**Drought**

**Hazard Description**

Drought is defined as a condition where moisture levels fall significantly below normal for an extended period of time over a large area that adversely affects plants, animal life, and humans. Drought is a gradual phenomenon. Although droughts are sometimes characterized as emergencies, they differ from typical emergency events. Most natural disasters, such as floods or forest fires, occur relatively rapidly and afford little time for preparing for disaster response. Droughts occur slowly, over a multi-year period, and it is often not obvious or easy to quantify when a drought begins and ends.

Throughout California, one dry year does not normally constitute a drought. California’s extensive system of water supply infrastructure (reservoirs, groundwater basins, and conveyance assets) mitigates the effect of short-term dry periods for most water users. Defining when a drought begins is a function of drought impacts to water users. Drought in one location may not constitute a drought for all water users, as some users in relative proximity may have a different water supply. For example, individual water suppliers may use a combination of sources such as rainfall/runoff, water in storage, or expected supply from a water wholesaler to define their water supply conditions.

Drought can be characterized as one or more of the following types:

- **Meteorological drought** is defined on the basis of the degree of dryness (in comparison to some “normal” or average amount) and the duration of the dry period. A meteorological drought must be considered as region-specific since the atmospheric conditions that result in deficiencies of precipitation are highly variable from region to region.

- **Hydrological drought** is associated with the effects of periods of precipitation (including snowfall) shortfalls on surface or subsurface water supply (e.g., streamflow, reservoir and lake levels, ground water). The frequency and severity of hydrological drought is often defined on a watershed or river basin scale. Although all droughts originate with a deficiency of precipitation, hydrologists are more concerned with how this deficiency plays out through the hydrologic system. Hydrological droughts are usually out of phase with or lag the occurrence of meteorological and agricultural droughts. It takes longer for precipitation deficiencies to show up in components of the hydrological system such as soil moisture, streamflow, and ground water and reservoir levels. As a result, these impacts are out of phase with impacts in other economic sectors.

- **Agricultural drought** focus is on soil moisture deficiencies, differences between actual and potential evaporation, reduced ground water or reservoir levels, and so forth. Plant water demand depends on prevailing weather conditions, biological characteristics of the specific plant, its stage of growth, and the physical and biological properties of the soil.
Socioeconomic drought refers to when physical water shortage begins to affect health, well-being, and quality of life of people, or when the drought starts to affect the supply and demand of an economic product that relies on water.

The drought issue in California is further compounded by water rights. The central challenge is how to prioritize water usage among a broad variety of contexts. It is for this reason that water is a commodity possessed and utilized under a variety of legal doctrines. As such, many competing sets of interests create a dynamic prioritization process between, for example, farming and federally protected fish habitats and water supply for municipal/public use (including usage for CSU - Long Beach) versus water usage for wildfire abatement or natural resource protection.

Location of the Hazard

Drought conditions have been identified in Los Angeles County where CSU – Long Beach is located, though the campus committee reports no drought history or locations specific to the campus, as the campus has no “Ag” programs or resources. That said, drought is not a location-specific hazard and affects the entire planning area equally. Drought location is not isolated to each campus footprint but occurs as a geographic sub-set of drought conditions occurring at larger scales. From 2000-2020, drought conditions existed continuously somewhere in the state, with 80-100% of the state impacted for 12 of the last 20 years.27

(Insert reference to drought map locations in the plan)

Extent of the Hazard

Given the historical occurrence of severe drought impacts throughout the county surrounding the planning area and the potential future impact exacerbated by climate change, the CSU Planning Committee recognizes that drought will continue to pose a high degree of risk statewide, potentially impacting crops, livestock, water resources, the natural environment at large, buildings and infrastructure (from land subsidence), and local economies.

In addition, although drought affects the entire CSU system wide planning area, the potential impacts may be variable and specific to each campus/jurisdiction, depending on contextual factors such as the degree of assets and activities, historically impacted by drought within each jurisdiction.

Also, land subsidence has occurred and will continue in areas where the groundwater basin has been subject to overdraft and long-term recharge is inadequate to maintain the water table elevation, leaving underground voids. Subsidence levels have been

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measured up to 30-feet in California with subsidence bowls covering hundreds of square miles. As such, drought-related subsidence may result in serious structural damage to buildings, roads, irrigation ditches, underground utilities, and pipelines. These same effects, though not identified on campus, will remain issues of concern over the long term.

For CSU – Long Beach, the extent of the hazard is Low (corresponding to D0-D1 on the extent scale below). However, the campus planning committee recognizes that the potential for more severe conditions exists and is tied to regional water resource vulnerabilities.

The U.S. Drought Monitor developed tables of impacts reported during past droughts in California in order to depict the extent of drought risk for each level of drought on the U.S. These possible extent conditions for California complement the general impacts column of the U.S. Drought Monitor Classification Scheme.

Table 12-15: Impacts of Drought Levels as Determined by US Drought Monitor

<table>
<thead>
<tr>
<th>Category</th>
<th>Impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>D0</td>
<td>Soil is dry; irrigation delivery begins early</td>
</tr>
<tr>
<td></td>
<td>Dryland crop germination is stunted</td>
</tr>
<tr>
<td></td>
<td>Active fire season begins</td>
</tr>
<tr>
<td></td>
<td>Winter resort visitation is low; snowpack is minimal</td>
</tr>
<tr>
<td>D1</td>
<td>Dryland pasture growth is stunted; producers give supplemental feed to cattle</td>
</tr>
<tr>
<td></td>
<td>Landscaping and gardens need irrigation earlier; wildlife patterns begin to change</td>
</tr>
<tr>
<td></td>
<td>Stock ponds and creeks are lower than usual</td>
</tr>
<tr>
<td></td>
<td>Grazing land is inadequate</td>
</tr>
<tr>
<td></td>
<td>Producers increase water efficiency methods and drought-resistant crops</td>
</tr>
<tr>
<td>D2</td>
<td>Fire season is longer, with high burn intensity, dry fuels, and large fire spatial extent; more fire crews are on staff</td>
</tr>
<tr>
<td></td>
<td>Wine country tourism increases; lake- and river-based tourism declines; boat ramps close</td>
</tr>
<tr>
<td></td>
<td>Trees are stressed; plants increase reproductive mechanisms; wildlife diseases increase</td>
</tr>
<tr>
<td></td>
<td>Water temperature increases; programs to divert water to protect fish begin</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>River flows decrease; reservoir levels are low and banks are exposed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Livestock need expensive supplemental feed, cattle and horses are sold; little pasture remains, producers find it difficult to maintain organic meat requirements</td>
</tr>
<tr>
<td>Fruit trees bud early; producers begin irrigating in the winter</td>
</tr>
<tr>
<td>Federal water is not adequate to meet irrigation contracts; extracting supplemental groundwater is expensive</td>
</tr>
<tr>
<td>Dairy operations close</td>
</tr>
<tr>
<td>Marijuana growers illegally tap water out of rivers</td>
</tr>
<tr>
<td>Fire season lasts year-round; fires occur in typically wet parts of state; burn bans are implemented</td>
</tr>
<tr>
<td>Ski and rafting business is low, mountain communities suffer</td>
</tr>
<tr>
<td>Orchard removal and well drilling company business increase; panning for gold increases</td>
</tr>
<tr>
<td>Low river levels impede fish migration and cause lower survival rates</td>
</tr>
<tr>
<td>Wildlife encroach on developed areas; little native food and water is available for bears, which hibernate less</td>
</tr>
<tr>
<td>Water sanitation is a concern, reservoir levels drop significantly, surface water is nearly dry, flows are very low; water theft occurs</td>
</tr>
<tr>
<td>Wells and aquifer levels decrease; homeowners drill new wells</td>
</tr>
<tr>
<td>Water conservation rebate programs increase; water use restrictions are implemented; water transfers increase</td>
</tr>
<tr>
<td>Water is inadequate for agriculture, wildlife, and urban needs; reservoirs are extremely low; hydropower is restricted</td>
</tr>
<tr>
<td>Fields are left fallow; orchards are removed; vegetable yields are low; honey harvest is small</td>
</tr>
<tr>
<td>Fire season is very costly; number of fires and area burned are extensive</td>
</tr>
<tr>
<td>Many recreational activities are affected</td>
</tr>
<tr>
<td>Fish rescue and relocation begins; pine beetle infestation occurs; forest mortality is high; wetlands dry up; survival of native plants and animals is low; fewer wildflowers bloom; wildlife death is widespread; algae blooms appear</td>
</tr>
<tr>
<td>Policy change; agriculture unemployment is high, food aid is needed</td>
</tr>
<tr>
<td>Poor air quality affects health; greenhouse gas emissions increase as hydropower production decreases; West Nile Virus outbreaks rise</td>
</tr>
</tbody>
</table>
| Water shortages are widespread; surface water is depleted; federal irrigation water deliveries are extremely low; junior water rights are
History of the Hazard

Historically, drought has been so prevalent in California that its presence is almost continuous across the state. Los Angeles county (which includes the CSU - Long Beach footprint) has experienced 5 or more periods of drought from 2000-2021 including a severe statewide event from 2012-2019.

According to the National Drought Mitigation Center, over 3,500 reports and publications covering 370 drought-related events took place across the state (many of which were statewide events) between 2000-2020. In addition, the National Center for Environmental Information (NCEI) reports more than 500 events statewide during this same time period. These events produced a comprehensive range of impacts to water supply, regulations and allocations to businesses and municipalities, budgets and resources for firefighting, water law and policy, and physical impacts to built and natural environments. As such, data records of previous occurrences can be viewed as separate time and event demarcations for a hazard almost continuously in effect across the state with cascading impact potential.

According to the Department of Water Resources, droughts exceeding three years are relatively common in Southern California, but relatively rare in Northern California - the region is the geographic source of much of the state’s developed water supply.

The 1929-34 drought established the criteria commonly used in designing storage capacity and yield of large Northern California reservoirs.\textsuperscript{30}

According to the US Drought Monitor’s time series data, from 2000-2021 (with the exception of a 2–3-month period in 2000 and 2011), some degree of drought conditions have been continuously in effect somewhere in California. In fact, 80% - 100% of the state has been subjected to drought conditions for 12 of the last 20 years, with the most severe drought being the 100% state-wide event from 2012-2017.

Figure 12-7: Periods of Drought in State of California, 2001 – 2021\textsuperscript{31}

Although no drought events or impacts have been reported that are specific to the campus, given the extent of the drought risk in California, the following drought event was selected as an exemplar due to its broad and significant impacts on the state including Los Angeles County where the CSU - Long Beach campus planning area:

\textbf{2012 – 2017} – Drought produced severe impacts to water wells throughout the state of California, with a high number of wells running dry. Land subsidence due to increased groundwater pumping also occurred in numerous areas of the state such as the San Joaquin and Central Valleys. Crop damage was widespread as well. Water allotments were drastically reduced in many towns and water agencies, with extremely high costs for procuring water. In addition, job loss occurred with many families requiring food supply assistance, and water supply assistance provided to home-owners with dry wells. According to a report released by UC Davis Center for Watershed Sciences, the 2012-2017 period of the California drought cost the state’s agriculture industry about $1 billion in lost revenue, with a total statewide economic cost of the drought calculated to be $2.2 billion. The report says, ‘it is responsible for the greatest water loss ever seen in California agriculture - about one third less than normal”. The report


calls the groundwater situation in California "a slow-moving train wreck." Spring snowpack at Donner Summit reached record low levels in 2014, exceeded in 2015 by a remarkable April 1 snow-water-equivalent value of only 5% of average. Decreased precipitation since contributed to near-record low levels in the Shasta Reservoir. The ongoing drought has contributed to declines in crop values across the state. For example, crops including cotton, corn silage and barley (the field crop category) fell by 42 percent. 32

Potential Impacts of the Hazard

Drought impacts are wide-reaching and may be economic, environmental, and/or societal. This assessment of its impact recognizes that historic occurrences of drought throughout the planning area are a sub-set of larger and inter-connected local and regional droughts, and that the (related) historic impacts provide a sound basis for understanding potential (future) impacts.

The most significant potential impact associated with drought across the CSU - Long Beach campus planning area is a reduction in water availability for the municipal area tied to the campus. Other potential impacts include damage to trees and other natural features (See Tree Mortality below).

As a secondary impact of drought, wildfire is directly attributable to dry atmospheric conditions. Wildfires almost always coincide with drought in California, though not limited to such.33 However, the wildfire hazard is analyzed separately in this plan. See wildfire section towards the end of this plan.

In reviewing the occurrences of drought for Los Angeles County, the US Drought Monitor and the National Drought Mitigation Center report that tens of millions of trees died during the (2014-2017) state-wide drought disaster. Though data sources do not provide data for tree mortality specific to CSU - Long Beach, the broad geographic extent of the impact makes it fairly likely that tree mortality occurred to some degree on the campus. Due to the lasting and ongoing effects of drought on the landscape, trees will continue to be impacted within the municipalities, counties and regions wherein lies the CSU campus system as long as drought conditions continue to occur.

Given the absence of data, in order for the CSU Committee to assess the impact of tree mortality, it is useful to view it as a risk sub-set to the probability, location, extent, severity and duration of the drought hazard within each campus-located municipality, county and region. Regarding potential impacts, standing dead trees could fall, posing a risk to people, buildings, power lines, roads and other infrastructure. In addition,


drought-impacted trees become susceptible to diseases and insect infestations (bark beetle) further adding to the risk of tree mortality and related potential impacts. No data is currently available for tree mortality on campus, however, the CSU Planning Team will pursue data on this issue in the future.

As a potential tertiary impact, prolonged and repeated drought conditions over time can produce land subsidence and the risk of damage to building foundations and infrastructure on campus resulting from ground instability and collapse. Land subsidence is defined as the vertical sinking of the land over manmade or natural underground voids. Subsidence is often the direct result of groundwater over-extraction in response to drought conditions, as well as oil and gas extraction. Weight can accelerate the process of subsidence resulting from surface development and infrastructure such as roads and buildings, vibrations from construction blasting and heavy truck or train traffic. For example, the State Water Project’s 444-mile-long California Aqueduct has required repairs such as the raising of canal linings, bridges, and water control structures on the Aqueduct – in the Central Valley a five-mile reach of the Eastside Bypass was impacted by subsidence, and the Department of Water Resources estimated that it may cost in the range of $250 million to acquire flowage easements and levee improvements to restore the design capacity of the subsided area.34

At present, drought related damage to campus buildings and infrastructure at CSU - Long Beach has not been reported, but the potential for such impacts is possible. With regard to overall potential impact, water supply/availability for CSU - Long Beach is ultimately tied to broader inter-dependent, and more intensive modes of water use at local and regional scales such as agriculture and ranching, wildfire protection, larger metropolitan/municipal usage, manufacturing and commerce, tourism, recreation, and wildlife preservation. During drought periods, the State of California’s regulated water allocations are modified and often reduced, which can result in reduced water availability for all usage contexts, including CSU - Long Beach. A reduction of electric power generation and water quality deterioration are also potential impact factors.

____________________________
Table 12-16: Summary of Drought Impacts on Water Resources

<table>
<thead>
<tr>
<th>Resource</th>
<th>Type of Impact</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sea Level</td>
<td>Direct</td>
<td>Sea level is rising and will likely impact coastal areas</td>
</tr>
<tr>
<td>Soil Moisture</td>
<td>Direct</td>
<td>Prolonged dry seasons can lead to decreases in soil moisture; drier vegetation</td>
</tr>
<tr>
<td>Vegetation</td>
<td>Indirect</td>
<td>Longer and more intense fire season with increased extent of area burned</td>
</tr>
<tr>
<td>Stream Conditions</td>
<td>Direct</td>
<td>Increases in water temperature; potential effects on fish</td>
</tr>
<tr>
<td>Snowpack</td>
<td>Indirect</td>
<td>Increases in temperature will lead to decreases in snowpack</td>
</tr>
<tr>
<td>Runoff</td>
<td>Direct</td>
<td>Warmer temperatures are likely to lead to a shift in peak runoff from spring to winter and a likely decrease in summer base flow</td>
</tr>
<tr>
<td>Hydropower</td>
<td>Indirect</td>
<td>Decreased summer flows resulting from earlier snowmelt and a shift in peak runoff could affect hydropower generation during summer months</td>
</tr>
<tr>
<td>Precipitation</td>
<td>Direct</td>
<td>Warmer winter temperatures will result in a greater percentage of precipitation falling as rain rather than as snow</td>
</tr>
<tr>
<td>Groundwater</td>
<td>Indirect</td>
<td>Reduction in snowpack and extended periods of drought are likely to increase dependency on groundwater</td>
</tr>
</tbody>
</table>

Probability of Future Occurrence of the Hazard

**Highly Likely** — The US Drought Monitor’s time series data (2000-2020) indicates that some degree of drought has nearly a 100% probability of occurrence somewhere in the state in any given year. Given that CSU - Long Beach lies within a drought

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impacted region, it is prudent to extend this likelihood of occurrence to the planning area.

Vulnerability to the Hazard

In California, rising temperatures are projected to increase the average lowest elevation at which snow falls, reducing water storage in the snowpack, particularly at those lower mountain elevations which are now on the margins of reliable snowpack accumulation. Higher spring temperatures will also result in earlier melting of the snowpack. The shift in snow melt to earlier in the season is critical for California’s water supply because flood control rules require that water be allowed to flow downstream and that water cannot be stored in reservoirs for use in the dry season. As such, state-level drought risk factors that have led to drought’s state-wide severity and extent, and potential impacts also create drought vulnerabilities at the level of the CSU - Long Beach campus.

Moreover, climate change will likely adversely impact the vulnerability of watersheds and ecosystems in their ability to deliver important ecosystem services. These changes may limit the natural capacity of healthy forests to capture water and regulate stream flows. Sierra Nevada mountain winters and springs are warming, and on average, precipitation as snowfall relative to rain is decreasing. A warming climate with reduced snowpack will result in earlier snowmelt and will subsequently reduce downstream water availability during summer and early fall.

As such, the state and the CSU - Long Beach planning area stakeholders potentially have less capacity to address future drought risks due to projected temperature increases and shortages in water; ground-water withdrawals have been occurring at a deficit rate of 1 – 2-million-acre feet per year, where the impacts of drought include decreased availability of water for agriculture and environmental uses. In forested and other vegetated areas, prolonged drought decreases the moisture content of forest fuels and increases the risk of high severity wildfires. 36

It should be pointed out that California is the single most productive agricultural state and its agricultural industry relies heavily on reservoir water supplied by snowmelt and rainfall runoff. Yearly variations in snowpack depths have implications for water availability as snowmelt from the winter snowpack feeds a network of reservoirs. Spring snowpack at Donner Summit reached record low levels in 2014, exceeded in 2015 by a remarkable April 1 snow-water-equivalent value of only 5% of average.

Decreased precipitation since 2011 has contributed to near-record low levels in the Shasta Reservoir. 37

**Vulnerability of Populations**

Drought vulnerabilities include agricultural sector job loss, secondary economic losses to local businesses and public recreational resources, increased cost to local and state government for large-scale water acquisition and delivery, and water rationing and water wells running dry for individuals and families. As drought is often accompanied by prolonged periods of extreme heat, negative health impacts such as dehydration can also occur, where children and elderly are most susceptible. Air quality often declines in times of drought which can affect those with respiratory ailments. These same vulnerability measures apply to the students, faculty and staff of the CSU – Long Beach campus.

**Property Vulnerability**

Drought vulnerabilities include crop loss, injury and death of livestock and pets, and damage to infrastructure, homes and other buildings resulting from the secondary drought impact of land subsidence. The related drought impacts of tree mortality and land subsidence pose risks to vulnerable critical infrastructure and property. These same vulnerability measures apply to the properties of the CSU - Long Beach campus.

**Natural Environment Vulnerability**

Natural environment vulnerabilities are widespread throughout public and private lands within the state, including tree mortality, impacts to all flora and fauna, and destabilization (subsidence) of land along streams and rivers, and within watersheds.

Drought vulnerabilities throughout California is water supply and demand. Several factors play into the issue including groundwater basins, surface water run-off, public and agricultural demand, and surface water storage water sheds. A USGS led analysis was first conducted in 2010 through the Forest and Rangeland Assessment and ongoing through the USGS Forest and Rangeland Ecosystem Science Center to identify threats and assets where water supply would benefit from environmental management designed to protect or enhance water resources, the key effort which, in part, both defines and mitigates the severity of drought risk and vulnerabilities.

With regard to overall threat and asset findings shaping the potential severity of drought, the watersheds in the Sierra region contribute most greatly to the state’s water supply, but are under threat from climate change, wildfire and development. In

addition, groundwater basins in the San Joaquin Valley and Sacramento Valley bioregions are an abundant resource that is heavily threatened by over pumping.

**Critical Facilities Vulnerabilities**

Drought vulnerabilities for CSU - Long Beach’s critical facilities include water shortfalls for facility operations and critical functions, and potential structural destabilization and damage resulting from land subsidence.
Estimate of Potential Losses

An estimate of potential losses from drought has not been calculated for the campus or the CSU system as a whole. However, drought related losses to the city and county of Los Angeles, and the surrounding region such as crop loss and cost increases for water resources have re-occurred over time. Please consult city and county level government, and/or state agricultural agencies for data on the financial impacts from drought.

Vulnerability Assessment Conclusions

The CSU Planning Committee understands that the high degree of vulnerability posed by drought will be exacerbated by greater climate variation in the future and therefore greater variation and uncertainty regarding the availability of water supplies which are already under tremendous stress. In response to such vulnerability, state legislation passed in 2014 requires local governments to regulate pumping and recharge to better manage groundwater supplies, and groundwater-dependent regions are required to halt overdraft and bring basins into sustainable levels of pumping and recharge by the early 2040s. That said, the Committee will continue to work with local, regional and state partners and stakeholders to explore solutions for mitigating the drought hazard on its campuses by accessing the best available data and resources on climate change and its relationship to drought.

Identified Data Limitations

Data is limited concerning campus-related agricultural assets as well as data on campus tree mortality.
**Earthquake**

Description of the Hazard

An earthquake is a sudden motion or shaking caused by the release of pressure accumulated along the edge of tectonic plates covering the earth. These huge plates are constantly moving and move ever so slowly under, over, or by passing one another. This movement is gradual however the plates may lock together accumulating enormous amounts of energy. When this energy builds, stress develops, and the adjoining plates will eventually break free and result in ground shaking – an earthquake.

Large earthquakes may result in fissuring, ground settlement, and/or vertical or horizontal displacement. Earthquakes occur without warning and can result in extensive damages and human casualties. Damages associated to earthquake generated ground shaking is normally confined to a narrow area along fault trend from the earthquake epicenter. However, seismic waves may generate ground shaking resulting in damages in areas outside of the fault trend.

**Fault Rupture** – The rupture of faults is the differential movement of the two sides of the earth’s plates at the point of the fault. Horizontal or vertical displacement may be significant and occur over great distances. The movement and energy that occurs along a fault is released in waves resulting in ground shaking. The intensity of ground shaking varies based on the magnitude of the earthquake, the proximity to the earthquake epicenter, the composition of the ground sediment or rock the waves travel through, and the depth of the earthquake.

**Liquefaction** – In addition to the primary fault rupture that occurs right along a fault during an earthquake, the ground many miles away can also fail during intense shaking. As seismic waves travel through saturated granular soil; the soil begins to liquefy and act as a fluid. Soil strength and stability is lost causing the effects of ground shaking to intensify and for ground deformation to occur. These water saturated soils when shaken quickly lose the ability to support buildings, bridges, utilities, and other structures. Areas susceptible to liquefaction include places where sandy sediments have been deposited by rivers along their course or by wave action along beaches. The greater the magnitude of an earthquake and longer duration of strong ground shaking will result in an enhanced potential for liquefaction to occur. Settlement can cause damage when the amount settlement varies significantly across the length of a structure. Lateral spreading occurs when liquefaction occurs on gently sloping ground and the liquefied material at depth allows the area to slide, often toward a vertical discontinuity or “free face” such as a creek or stream channel. Liquefaction can occur in susceptible soils below bodies of water, and settlement and lateral spreading can damage structures built on or adjacent to these areas. Transportation bridges across water bodies, wharves, piers and other structures at ports and harbors, and underwater utility lines can be severely damaged by this hidden hazard.
**Subsidence** - Changes in the local environment that cause subsidence or sinkholes are called triggering mechanisms. Water is the primary factor that affects the local environment and causes subsidence. Water level decline, changes in groundwater flow, increased loading, and deterioration (such as abandoned mines) are all triggering mechanisms. Water level decline may occur naturally, or it may be the result of human action. Factors that lead to water decline are pumping (from wells), localized drainage (for construction activities), dewatering, or drought. Changes in groundwater flow can result from an increase in the velocity of groundwater movement, and increase in the frequency of water table fluctuations, and changes in discharge (either increase or decrease). Increased loading can cause pressure in the soil, leading to the failure of underground cavities and space, such as caves. Vibrations from earthquakes, heavy machinery, and blasting may result in structural collapse, followed by surface resettlement.

**Location of the Hazard**

The State of California is particularly vulnerable to earthquake activity due to California’s location residing between two large tectonic plates. CSU Long Beach is located in the southern portion of the Los Angeles Basin. In general, fault systems surround and traverse through Los Angeles and Orange Counties including the area of CSU Long Beach. Throughout the basin the ground is saturated with sediment eroded from the mountains and foothills via multiple stream and river channels and resulting in liquefaction zones scattered across the region.

In addition to the main campus, the CSU Long Beach satellite facilities liquefaction site status is included. The CSU Long Beach, Lancaster University Center in Lancaster, CA does not reside within a liquefaction zone. The Southern California Marine Institute located on Terminal Island in San Pedro has been identified as being located on a liquefaction zone.

The Pacific Plate and the North American Plate come together at the San Andreas Fault 50-55 miles northeast of the CSU Long Beach campus. In addition to the San Andreas Fault, Los Angeles County is home to or near additional fault systems with the potential to generate strong ground shaking. The Newport-Inglewood Fault traverses south to north paralleling the Orange County coastline extending within ¾ mile of CSU Long Beach from the southwest corner of the campus. The Palos Verdes Fault crosses the Palos Verdes Peninsula approximately 11 miles east of the campus. The 40-mile-long Compton Fault parallels the Palos Verdes Fault in a southeast to northwest direction 9 miles east of the CSU Long Beach campus. The Whittier-Elsinore Fault extends from the eastern base of the Santa Ana Mountains and western base of the Puente Hills 15 miles to the northeast of the campus. There are numerous additional faults in the area on all sides of the campus.
The CSU Long Beach campus reside outside of areas designated to be liquefaction zones for the portions of the campus south of the Bouton Creek channel. Campus facilities north of the Bouton Creel channel are located within the liquefaction zone. Additionally, substantial areas of the community surrounding the campus to the north, east, and south do reside within the liquefaction zone. This also includes major transportation corridors including Interstate 405, Interstate 605, State Route 22, State Route 1, Bellflower Blvd., and Atherton Street. The liquefaction zone includes multiple campus facilities.

Figure 12-9: Liquefaction Zones in Proximity to CSU Long Beach

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Extent of the Hazard

The extent or severity of earthquake damage is expressed in terms of magnitude, intensity and duration. The amount of energy released during an earthquake is normally conveyed as a magnitude measured from a seismogram. Magnitude is expressed in numbers and decimals representing the physical size of the earthquake. The strength and effect of the shaking on the surface of the earth is classified as the intensity. Intensity is further defined from the effects the earthquake has on people, structures, and the natural environment. The intensity of an earthquake in terms of measuring magnitude and evaluating its effects is generally expressed using the Modified Mercalli (MM) Intensity Scale. Duration is the length of time the earthquake’s energy is released.

The Richter magnitude scale was developed in 1935 by Charles F. Richter of the California Institute of Technology as a mathematical device to compare the size of earthquakes. The Richter Scale (below) is the best-known scale for measuring the magnitude of earthquakes. The magnitude value is proportional to the logarithm of the amplitude of the strongest wave during an earthquake. A recording of 7, for
example, indicates a disturbance with ground motion 10 times as large as a recording of 6. The energy released by an earthquake increases by a factor of 31 for every unit increase in the Richter scale.

Table 12-17: Earthquake Intensity and Frequency Comparisons

<table>
<thead>
<tr>
<th>Magnitude</th>
<th>Mercalli Intensity</th>
<th>Potential Damage</th>
<th>Global Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 2.0</td>
<td>I</td>
<td>None</td>
<td>Continually</td>
</tr>
<tr>
<td>2.0 - 2.9</td>
<td>I to II</td>
<td>None</td>
<td>&gt; IM per year</td>
</tr>
<tr>
<td>3.0 - 3.9</td>
<td>II to IV</td>
<td>None</td>
<td>&gt; 100,000 per year</td>
</tr>
<tr>
<td>4.0 - 4.9</td>
<td>IV to VII</td>
<td>Light</td>
<td>10K to 15 K per year</td>
</tr>
<tr>
<td>5.0 - 5.9</td>
<td>VI to VII</td>
<td>Moderate</td>
<td>1K to 1,500 per year</td>
</tr>
<tr>
<td>6.0 - 6.9</td>
<td>VII to X</td>
<td>Heavy</td>
<td>100 to 150 per year</td>
</tr>
<tr>
<td>7.0 - 7.9</td>
<td>VII &lt;</td>
<td>Very Heavy</td>
<td>10 - 20 per year</td>
</tr>
<tr>
<td>8.0 - 8.9</td>
<td>VII &lt;</td>
<td>None</td>
<td>1 per year</td>
</tr>
<tr>
<td>&gt; 9.0</td>
<td>VII &lt;</td>
<td>None</td>
<td>1 per 10-50 years</td>
</tr>
</tbody>
</table>

The Modified Mercalli Intensity Scale provides descriptive values of earthquake intensity that may provide greater meaning to the broader population as the description of intensity refers to the effects actually experienced. This scale uses an arbitrary ranking based on observed earthquake effects. The scale is composed of increasing levels of intensity ranging from shaking that is not recognizable to intense shaking resulting in catastrophic damages and casualties. The Modified Mercalli Intensity Scale is demonstrated below:
Table 12-18: Modified Mercalli Intensity Scale

<table>
<thead>
<tr>
<th>Intensity</th>
<th>Shaking</th>
<th>Description / Damage</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Not felt</td>
<td>Not felt except by a very few under especially favorable conditions.</td>
</tr>
<tr>
<td>II</td>
<td>Weak</td>
<td>Felt only by a few persons at rest, especially on upper floors of buildings.</td>
</tr>
<tr>
<td>III</td>
<td>Weak</td>
<td>Felt quite noticeably by persons indoors, especially on upper floors of buildings. Many people do not recognize it as an earthquake. Standing motor cars may rock slightly. Vibrations similar to the passing of a truck. Duration estimated.</td>
</tr>
<tr>
<td>IV</td>
<td>Light</td>
<td>Felt indoors by many, outdoors by few during the day. At night, some awakened. Dishes, windows, doors disturbed; walls make cracking sound. Sensation like heavy truck striking building. Standing motor cars rocked noticeably.</td>
</tr>
<tr>
<td>V</td>
<td>Moderate</td>
<td>Felt by nearly everyone; many awakened. Some dishes, windows broken. Unstable objects overturned. Pendulum clocks may stop.</td>
</tr>
<tr>
<td>VI</td>
<td>Strong</td>
<td>Felt by all, many frightened. Some heavy furniture moved; a few instances of fallen plaster. Damage slight.</td>
</tr>
<tr>
<td>VII</td>
<td>Very strong</td>
<td>Damage negligible in buildings of good design and construction; slight to moderate in well-built ordinary structures; considerable damage in poorly built or badly designed structures; some chimneys broken.</td>
</tr>
<tr>
<td>VIII</td>
<td>Severe</td>
<td>Damage slight in specially designed structures; considerable damage in ordinary substantial buildings with partial collapse. Damage great in poorly built structures. Fall of chimneys, factory stacks, columns, monuments, walls. Heavy furniture overturned.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>IX</th>
<th>Violent</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Damage considerable in specially designed structures; well-designed frame structures thrown out of plumb. Damage great in substantial buildings, with partial collapse. Buildings shifted off foundations.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>X</th>
<th>Extreme</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Some well-built wooden structures destroyed; most masonry and frame structures destroyed with foundations. Rails bent.</td>
</tr>
</tbody>
</table>

The graph below illustrates the increasing intensity of energy that is released and as the measured magnitude increases. While each whole number increases in magnitude represents a tenfold increase in the measured amplitude, it represents an increasing rate of 32 times more energy released in the same increase in magnitude. As the magnitude of an earthquake is measured higher, the intensity of the earthquake worsens progressively from one category to the next.

Figure 12-10: Earthquake Magnitude and Equivalent Energy Release

![Graph Showing Earthquake Magnitudes and Equivalent Energy Release](https://www.usgs.gov/media/images/graph-showing-earthquake-magnitudes-and-equivalent-energy-release)

Based on the history of earthquake occurrences in Los Angeles County, including a near catastrophic event in Long Beach, and the presence of 9 fault systems.

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throughout the county, and ongoing predicted severe events statewide, the planning committee ranks the extent of the hazard as **Moderate**.

**History of the Hazard**

The State of California has a long history of chronic and destructive earthquakes throughout the state. On average, earthquakes strong enough to result in structural damages occur three to four times a year in California, while earthquakes Magnitude 6.0 to 6.9 occur once every two to three years. Los Angeles County also has a long history of earthquake activity. The entire area of Los Angeles County is at risk to seismic activity and has a history of significant earthquakes resulting in damages.

The most recent significant earthquake to occur in immediate proximity to Long Beach was in July of 1933. The earthquake occurred on the Newport-Inglewood Fault off of the coast of Newport Beach. The earthquake was felt throughout Southern California and resulted in damages in multiple counties. Long Beach experienced multiple fires, 127 water main breaks, and liquefaction was experienced along the waterfront. Regionally, including Long Beach, 120 people were killed, 5,000 injured, 20,000 homes were damaged, and 75% of schools were destroyed\(^{41}\).

Table 12-19: Historic Earthquakes Near Long Beach, CA\(^{42}\)

<table>
<thead>
<tr>
<th>Date</th>
<th>Location</th>
<th>Magnitude</th>
<th>Damages</th>
</tr>
</thead>
<tbody>
<tr>
<td>12/8/1812</td>
<td>San Juan Capistrano</td>
<td>7.5</td>
<td>40 fatalities</td>
</tr>
<tr>
<td>7/11/1855</td>
<td>Los Angeles</td>
<td>6.0</td>
<td>Structural damages</td>
</tr>
<tr>
<td>3/10/1933</td>
<td>Long Beach</td>
<td>6.4</td>
<td>120 fatalities, $40 million</td>
</tr>
<tr>
<td>2/9/1971</td>
<td>San Fernando</td>
<td>6.6</td>
<td>58-65 fatalities, $553 million</td>
</tr>
<tr>
<td>1/1/1979</td>
<td>Malibu</td>
<td>5.2</td>
<td>Minor</td>
</tr>
<tr>
<td>10/1/1987</td>
<td>Whittier</td>
<td>5.9</td>
<td>8 fatalities, $358 million</td>
</tr>
<tr>
<td>2/28/1990</td>
<td>Upland</td>
<td>5.7</td>
<td>30 injuries, $12.7 million</td>
</tr>
<tr>
<td>6/28/1991</td>
<td>Sierra Madre</td>
<td>5.6</td>
<td>1 fatality, $40 million</td>
</tr>
<tr>
<td>1/17/1994</td>
<td>Northridge</td>
<td>6.7</td>
<td>57 fatalities, $40 billion</td>
</tr>
<tr>
<td>7/29/2008</td>
<td>Chino Hills</td>
<td>5.5</td>
<td>Minor</td>
</tr>
<tr>
<td>3/28/2014</td>
<td>La Habra</td>
<td>5.1</td>
<td>$10 million</td>
</tr>
</tbody>
</table>

\(^{41}\) City of Long Beach Hazard Mitigation Plan, February 28, 2017

\(^{42}\) 2019 County of Los Angeles All-Hazards Mitigation Plan, 2019
Other earthquakes of significance include, the more recent January 17, 1994 Northridge Earthquake estimated a Magnitude 7.7 earthquake struck at 4:52 am. The earthquake occurred on the White Wolf Fault in hills east of Bakersfield resulting in numerous surface ruptures. Twelve people were killed in the county and several hundred were injured. The shaking was strong enough to cave in railroad tunnels near Tehachapi, 40 miles east of Bakersfield. Railroad lines were warped, buildings collapsed in Bakersfield, and there was widespread underground utility and pipeline damage. Shaking was felt from Sacramento to San Diego.

The October 1, 1987 Whittier Narrows Earthquake shook a large part of southern California. The earthquake caused $358 million in damages, especially in the Alhambra, Pasadena, and Whittier areas. The earthquake resulted in extensive infrastructure damages, multiple injuries, and 8 fatalities. The earthquake was provided a federal disaster declaration (DR-799).

The February 9, 1971 Magnitude 6.5 San Fernando Earthquake struck the San Fernando Valley in Los Angeles just after 6am. The intense shaking caused the collapse of freeway overpasses, hospitals, and other infrastructure. It damaged thousands of homes and businesses, a reservoir, and critical infrastructure. 65 people were killed and 2,000 more were injured. The shaking was felt for 300 miles including in Las Vegas, Nevada. The earthquake was provided a federal disaster declaration (DR-299).

The Fort Tejon Earthquake, a Magnitude 7.9 earthquake, struck in 1857 along the San Andreas fault just north of Los Angeles County. The earthquake was able to shift the Kern River upstream and run four feet over its banks. Structural damage was limited as the area was sparsely populated at the time. The Fort Tejon Earthquake remains one of the greatest earthquakes ever recorded in the United States producing a surface rupture extending over 220 miles.

Potential Impacts of the Hazard

The shaking of the ground from earthquakes can result in building collapse, bridge failure, utility disruptions and other structural collapse. Large earthquakes can additionally cause natural gas lines to break resulting in structure fires. The proximity to the unstable soils surrounding the campus presents a potential for liquefaction creating greater ground instability during seismic events. A major earthquake in the Los Angeles area would likely result in region-wide social disruptions in addition to structural damages. The region-wide structural damages may disrupt lifelines and supply chain routes limiting the campus from effective evacuation routes and receiving necessary supplies or equipment.

Most injuries resulting from earthquakes are from collapsing walls, flying glass, or other objects moved by ground shaking. The lack of warning allows individuals minimal time to react and find areas of safety. A moderate earthquake occurring near Long Beach could cause injuries or fatalities to members of the campus community or
support networks the campus relies on. These earthquake effects might be aggravated by collateral incidents such as fire, flooding, hazardous material spills, dam/levee compromises, and other cascading events. A catastrophic earthquake near Long Beach could result in extensive casualties, expansive structural damages, panic, widespread utility outages, communication failures, and secondary emergencies such as fire. A catastrophic earthquake would certainly affect the broader Los Angeles County and Orange County region limiting immediate assistance that the campus may normally expect.

- Local impacts to CSU Long Beach campus caused by an earthquake could include:
  - Damage to nearby refineries and petrol-chemical plants
  - Damage and secondary fires to industrial buildings to the east of campus
  - Potential hazardous material releases on and off campus
  - Potential liquefaction-based effects to most areas of the campus and large areas of the surrounding cities
  - Infrastructure to freeway system
  - Structural damage to bridges over waterways and flood control channels
  - Structural damage to flood control systems
  - Potential isolation of campus from community
  - Potential isolation among on-campus residents
  - Structural damage to San Gabriel River and Los Cerritos Channel levees
  - Structural damage to campus academic and support buildings
  - Structural damage to residence halls resulting in displaced student populations
  - Structural damage to nearby residences
  - Community members arriving on campus for refuge from damaged homes
  - Damaged university communications, computer systems, and networks
  - Considerable stress and fear among community
  - Closure or reduction of service to campus operations
  - Reduction of campus revenue

**Probability of Future Occurrence of the Hazard**

The Working Group on California Earthquake Probabilities (WGCEP), a collaboration between the United States Geological Survey (USGS), the Southern California Earthquake Center (SCEC), and the California Geological Survey (CGS) develops
Uniform California Earthquake Forecasts (UCERFs) using the best currently available science and technology. The UCERF version 3 provides a three-dimensional view of the likelihood a region in California will experience a Magnitude 6.7 or greater earthquake in the next 30 years. The likelihood for the Los Angeles County fault systems surrounding Long Beach is included in the following table.

Table 12-20: Table xx Major Potentially Active Faults in Proximity to CSU Long Beach

<table>
<thead>
<tr>
<th>Fault Zone</th>
<th>Recurrence</th>
<th>Maximum Magnitude</th>
<th>UCERF3 Likelihood</th>
</tr>
</thead>
<tbody>
<tr>
<td>Compton</td>
<td>Historic: Unknown</td>
<td>6.5 to 7.1</td>
<td>1%</td>
</tr>
<tr>
<td>Hollywood</td>
<td>Historic: 1,600 years</td>
<td>5.8 to 6.5</td>
<td>1-2%</td>
</tr>
<tr>
<td>Newport-Inglewood</td>
<td>Historic: Unknown</td>
<td>6.0 to 7.4</td>
<td>1%</td>
</tr>
<tr>
<td>Palos Verdes</td>
<td>Historic: Unknown</td>
<td>6.0 to 7.0</td>
<td>3%</td>
</tr>
<tr>
<td>San Andreas</td>
<td>Varies: 100-300 years</td>
<td>6.8 to 8.0</td>
<td>18-20%</td>
</tr>
<tr>
<td>Santa Monica</td>
<td>Historic: Unknown</td>
<td>6.0 to 7.0</td>
<td>1%</td>
</tr>
<tr>
<td>Sierra Madre</td>
<td>Historic: 1,000-3,000 years</td>
<td>6.0 to 7.0</td>
<td>1-2%</td>
</tr>
<tr>
<td>Verdugo</td>
<td>Historic: Unknown</td>
<td>6.0 to 6.8</td>
<td>1%</td>
</tr>
<tr>
<td>Whittier</td>
<td>Historic: Unknown</td>
<td>6.0 to 7.2</td>
<td>1%</td>
</tr>
</tbody>
</table>

Based on the earthquake shaking potential in the Los Angeles Basin, the proximity to the above listed fault systems, the probability of seismic ground shaking generating damage is considered Possible.

Vulnerability to the Hazard

A considerable challenge regarding earthquakes is they generally occur without warning. The fault systems surrounding the region all cross major transportation routes potentially reducing the availability of access and the supply chain. The geographic location of Long Beach places the campus in a busy commercial and industrial areas that is heavily populated. Earthquake effects experienced in the neighboring local community will likely spill over onto the campus. The north-western corner of the campus is designated as a liquefaction zone and may be impacted by the levee systems to the north and west if full and compromised.

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43 2019 County of Los Angeles All-Hazards Mitigation Plan, 2019

The known fault systems generating the threat to Long Beach generally surround the city and some cross into the city including near to the CSU Long Beach campus. The proximity and potential for large earthquake development from these surrounding systems expose significant vulnerabilities. The potential for earthquake damaged structures being left uninhabitable including campus residence halls will result in numerous displaced individuals and households. The lack of earthquake insurance will cause extreme financial burdens on those affected. Campus buildings and equipment would be vulnerable to damages from building, seismic shaking, secondary fires, and secondary building floods from broken pipes.

Some areas of particular vulnerability on the campus includes:

- Numerous multi-level buildings including a 9-story building and 6 story parking structure.
- Temporary office structures include FO4 and FO5
- Chemicals, bottled gases, radioactive materials, biological materials, and explosive compounds are stored in campus science labs, chemical storage facilities, Facilities Maintenance Shops, and Engineering Labs
- Two elevated water towers located to the southwest of campus south and the West Turn Around
- The campus childcare center is located in the Family and Consumer Sciences Building close to the water towers
- The pool chemical storage facility is located next to the swimming pool north of the staff parking area behind the Kinesiology Building
- Underground gas lines are distributed across the campus feeding kitchens in the University Student Union, Food Services dining areas, and the Residence Halls dining areas
- Underground gas lines additionally feed laboratories in Peterson Hall, Microbiology, Molecular Science, and Family and Consumer Science buildings.

Elements of the vulnerability to a major earthquake on the CSU Long Beach campus will vary depending on when the earthquake were to strike. The risk to the campus population will be lessened during periods when classes are not in session or during periods of breaks. Conversely, during the days and hours that classes are in session and staff are at their workplaces, the human vulnerability increases. Generally, people are safer when at home in wood frame structures as earthquakes tend to generate less structural damage to wood construction than in commercial or industrial facilities. The greater number of people on campus at the time of an earthquake will result in more people being exposed to effects from damaged campus facilities or equipment and require greater evacuation assistance. However, in region-wide events this vulnerability may simply shift to the homes and workplaces of members of the campus community and their families.
The aftermath of a major earthquake will likely result in widespread search and rescue operations for trapped and injured individuals. The demand on emergency services will be great, potentially requiring the campus community to be prepared for these scenarios and initiate response actions as needed. There will be needs for emergency medical care, shelter, water, and food for individuals who have been displaced by the earthquake. In earthquakes causing significant damages, there may be a necessity to provide assistance with identification and support to local agencies in mass fatality management.

There may be a need to evacuate members of the campus community from the campus and to other locations that are deemed to be safer locations. As the CSU Long Beach campus is areas exposed to levee facilities, the decision to evacuate will need to take into account whether flood control facilities are filled with water and the actual threat to the dam or levees.

Certain campus populations will experience greater challenges to a post-earthquake environment. Vulnerable populations will likely need to navigate through earthquake generated debris, extreme stresses of a disaster, an inability to communicate to or gain access to support networks, and find difficulty in accessing equipment or supplies to aid in a specific need.

**Estimate of Potential Losses**

Estimates of potential losses will be influenced by a variety of factors. The intensity of the earthquake will determine what scale of damages affecting campus infrastructure, equipment, and other impacted features. Losses will be generated by the physical damages, the loss of revenue, loss of academic research, loss of building contents, and community wide economic reductions.

Based on estimate replacement costs of facilities and structures on campus, the maximum total replacement costs due to earthquake are $453,426,848.

Table 12-21: HAZUS Peak Ground Acceleration (PGA) Zone Estimated Losses

<table>
<thead>
<tr>
<th>PGA Zone Designation</th>
<th>Intensity</th>
<th>No. of Buildings</th>
<th>Maximum Replacement Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Extreme</td>
<td>X+</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Violent</td>
<td>IX</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Severe</td>
<td>VIII</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Very Strong</td>
<td>VII</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Strong</td>
<td>VI</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Moderate</td>
<td>V</td>
<td>37</td>
<td>$179,257,992</td>
</tr>
<tr>
<td>Light</td>
<td>IV</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Weak</td>
<td>II-III</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Not Felt</td>
<td>I</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>NA</td>
<td>NA</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>
Vulnerability Assessment Conclusions

It is difficult to predict the severity of casualties, property, and cascading impacts generated by future seismic events affecting the greater Los Angeles region and the CSU Long Beach campus. Each of the earthquake generated effects will vary widely based on the intensity of the earthquake, location of the epicenter, proximity to people and development, time of day and year, the soil composition under the impacted structures, building construction, among others. In any case, the potential for a major earthquake exists affecting the campus and causing extensive challenges to the CSU Long Beach campus and community.

In the event that a major earthquake was to strike along the many fault systems surrounding Long Beach, the effects could be significant to the campus community and campus operations. The widespread impacts generated by a major earthquake would extend the effects of casualties, damages, and other impacts to the broader Los Angeles region creating large-scale regionwide needs for critical assistance and a heavy demand on limited emergency resources. The threat and impacts presented to the campus will be shared with the campus community from their homes and places of work. The campus will likely be required to address critical needs independently during early phases of the disaster.

Vulnerabilities will be seen in the physical infrastructure on the campus and the human population of the campus community. Campus infrastructure is vulnerable to severe shaking particularly in areas where the ground is loose or susceptible to liquefaction. Specifically older buildings, masonry constructed buildings, and other structures susceptible to shaking related damage are the most vulnerable. Communication systems, computer networks, and other electronic systems may be vulnerable when overwhelmed by increased demand during emergencies or by shaking related damages. The people of the campus community are vulnerable to effects of intense shaking in the form of injuries from falling debris, exposure to secondary floods or fires, loss of employment, extreme disaster induced stress, and loss of access to critical services or social contacts.

The campus population are additionally vulnerable to the effects of major ground shaking that are far reaching. The psychological and social impacts a major earthquake will give rise to will potentially harm individuals and cause tremendous fear. The willingness to return indoors may be hampered especially as after-shocks
continue. These effects are magnified for populations having specific vulnerabilities or access limitations. Populations having various limitations or specific needs may be vulnerable to reduced or eliminated access to essential services that have been rendered incapable to respond.
Identified Data Limitations

Missing campus structural replacement costs and an inventory of building construction types to include status of earthquake retrofitting. HAZUS generated analysis is focused on the broader community level versus finetuning the analysis to the micro-level for facilities such as a university campus.

**Erosion**

*Description of the Hazard*

The US Geological Survey (USGS) defines erosion as “the process whereby materials of the earth’s crust are loosened, dissolved, or worn away and simultaneously moved from one place to another.”

Erosion may occur in areas of streams and rivers, along bluffs, around immovable objects (such as buildings or bridge abutments), or as a cascading result of other natural hazards, such as earthquakes or wildfires. When erosion occurs along bodies of water, the removal of material causes the shore to move further landward.

Forces such as sea level rise and changes in sediment supply impact erosion gradually and can be difficult to recognize. In contrast, the impacts of short-term events, such as storms and flooding, can be severe and are immediately recognizable. Along the Pacific coast, rain, wind, and waves can induce significant short-term erosion.

*Location of the Hazard*

Erosion is a severe hazard in coastal communities, where sea level rise and storms contribute to de-sedimentation and the retreat of coastal cliffs, bluffs, and beaches. While coastal erosion can happen in any storm, it is more likely during El Nino events, which occur every 5-7 years. For the purpose of this campus-level analysis, the erosion hazard poses a consistent risk across those areas of the campus with erosion-prone characteristics.

Other incidents of erosion, such as occurs around buildings, is relatively non-spatial and can occur in any locations with conducive soil structure and a source of movement, such as water or wind. An area’s potential for erosion is determined by several factors, including rainfall, topography, soil characteristics, and vegetative cover.

*Extent of the Hazard*

Erosion is occurring on the Pacific coastline west of CSU Long Beach. While there is no published scale of severity or extent for this geologic hazard on the CSU Long

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Beach campus, erosion may occur if conditions are favorable and the erosion process goes unmitigated. However, given no historical occurrence of erosion on campus, the planning committee ranks the extent of this hazard as Low.

History of the Hazard

Erosion mitigation is occurring along Long Beach’s coastline, including sand pumping and slope stabilization projects. However, there are no recorded incidents of erosion on the CSU Long Beach campus.

Potential Impacts of the Hazard

Coastal erosion can result in severe impacts to local infrastructure, including the undermining of foundations, exposure of underground infrastructure, and breaches of natural or constructed protections. The latter can expose communities to the destructive forces of floodwaters, surge, and debris impacts. On campus, areas of erosion can create pedestrian and transportation hazards, and structures may become unsafe if erosion is not controlled. Public health and safety, structures, and infrastructure can all be negatively impacted, damaged, or destroyed by the erosion hazard.

Probability of Future Occurrence of the Hazard

Erosion is an on-going and dynamic process that occurs regularly. As climate change raises sea levels and induces more frequent and intense weather events, coastal and other erosion may generally become more widespread or severe. These events can cause erosion or exacerbate areas already experiencing erosion. As a result, and in consideration of the potential extent of erosion, and its occurrence along the nearby coastline, the probability of future occurrence is Likely over the long term.

Vulnerability to the Hazard

Topography, soil structure, land use, and precipitation are all factors of erosion. CSU Long Beach infrastructure and buildings located on steep slopes, in areas with little vegetation, or in areas with conducive soil types are more vulnerable to erosion.

In the wider Long Beach community, erosion vulnerabilities include agricultural sector job loss, degradation of riverine ecosystems and coastlines, and loss of water quality. As such, CSU leadership may consider a more in-depth analysis of erosion vulnerabilities on campus in the future.

Estimate of Potential Losses

The historic and potential impacts of erosion on property statewide include reduced agricultural productivity, lower surface water quality, and damaged drainage networks.

Current modeling is not precise enough to allow for an assessment of potential losses to buildings and infrastructure on campus.
Vulnerability Assessment Conclusions

While the ability to predict future erosion on the CSU Long Beach campus is limited, the core issues shaping erosion vulnerability on campus are flora and landscaping. If left unchecked, erosion can cause significant damage to campus infrastructure and the surrounding environment.

Identified Data Limitations

The complex interactions between soil erosion factors make predictive modeling, determination of hazard areas, and quantification of loss difficult. Localized data on this hazard is also limited, resulting in more generalized findings.

Extreme Temperatures (Includes Extreme Cold and Extreme Heat)

Description of the Hazard

What is considered an excessively hot temperature varies according to the normal climate for that region. However, when temperatures are extremely high, people are at higher risk for heat-related illnesses, such as dehydration, heat exhaustion, heat stroke, and in severe cases, death.46

Hazards from extreme heat are made worse when high temperatures are accompanied by high levels of humidity, which is defined as the amount of moisture in the air.47 As the temperature climbs, the air is able to hold more moisture. High humidity prevents the human body from cooling down naturally, which leads people to perceive that the temperatures “feels” hotter. The combination of temperature and humidity is known as the heat index.48

Heat stroke, the most serious heat-related illness, occurs when the body is unable to control its temperature. Body temperature rises rapidly, the sweating mechanism fails, and the body cannot cool down.49 In extreme causes, heat stroke can cause confusion and unconsciousness, so the victim is unable to seek treatment without assistance.

There are several groups of people who are uniquely vulnerable to the effects of extreme heat, such as infants and children, older adults aged 65 and up, athletes and


48 Ibid.

outdoor workers, low-income households, and individuals with certain chronic medical conditions.\(^{50}\)

**Location of the Hazard**

Extreme heat events are a non-spatial hazard, and may occur throughout the Cal State Long Beach campus.

**Extent of the Hazard**

Extreme heat has a wide range of extent and severity markers and characteristics. Monthly average maximum temperatures in June through October range approximately from the high 70s to mid-80s in Long Beach. According to data from the National Climatic Data Center (NCDC), the highest daily temperature recorded at the Long Beach Daugherty Airport was 111° F on September 27, 2010.

The National Weather Service issues a Heat Advisory when the heat index value is expected to reach 100° – 104° F within the next 12 to 24 hours. Excessive Heat Warnings are issued when there is an anticipated heat index of 105° F or greater that will last for two (2) or more hours. Excessive Heat Warnings are issued by the county when any location in the county is expected to reach that criteria.\(^{51}\) In anticipation of an Excessive Heat Warning, an Excessive Heat Watch may be issued 1 to 2 days in advance, when the Heat Warning criteria is 50 – 79% likely to occur.

Figure 12-11 (following) depicts the National Weather Service’s methodology for determining the heat index, using the % humidity and the actual temperature.


As the heat index rises, so does the potential danger to people and animals. Table xx (following) shows the health hazards associated with extreme heat.

Table 12-22: Health Risks Associated with Heat Index

<table>
<thead>
<tr>
<th>Category</th>
<th>Heat Index</th>
<th>Health Hazards</th>
</tr>
</thead>
<tbody>
<tr>
<td>Extreme Danger</td>
<td>130° F or higher</td>
<td>Heat stroke / sunstroke is likely with continued exposure.</td>
</tr>
<tr>
<td>Danger</td>
<td>105° – 129° F</td>
<td>Sunstroke, heat cramps, and/or heat exhaustion is likely with prolonged exposure and/or physical activity.</td>
</tr>
<tr>
<td>Extreme Caution</td>
<td>90° – 104° F</td>
<td>Sunstroke, heat cramps, and/or heat exhaustion is possible with prolonged exposure and/or physical activity.</td>
</tr>
<tr>
<td>Caution</td>
<td>80° – 89° F</td>
<td>Fatigue is possible with prolonged exposure and/or physical activity.</td>
</tr>
</tbody>
</table>

Given no extreme heat events in Long Beach in over a decade, only 5 recorded events overall, and that the City of Long Beach Hazard Mitigation Plan does not consider

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excessive heat to be a considerable hazard\textsuperscript{53}, the planning committee ranks the extent of the hazard as Low.

History of the Hazard

Based on data gathered from the National Centers for Environmental Information (NCEI) Storm Events Database, there have been five excessive heat events in Los Angeles County since 2007. These events were grouped together as part of the same heat waves.

**August 30, 2007; September 1, 2007; September 3, 2007:** A combination of high temperatures and high humidity produced an extreme heat event across Southern California. Heat index values ranged from 105° to 112° F. There were eight deaths attributable to this excessive heat event.

**June 20-21, 2008:** During this large-scale heat wave that impacted much of the state, afternoon high temperatures climbed as high as 114° F. The heat resulted in several power outages due to excessive electrical use.

The NCDC database also lists 85 additional times that the recorded temperature at the Long Beach Daugherty Airport has reached 100° F or greater between 1980 and 2018.

Potential Impacts of the Hazard

Cal State Long Beach may experience impacts from extreme heat due to cancelled classes or postponed outdoor events in order to protect students, faculty, and staff from the weather.

In addition to the threat extreme heat poses to humans, high temperatures also pose a threat to utility production, which in turn threaten facilities and operations that rely on utilities. As temperatures rise, more people stay indoors, increasing the demand for air conditioning, fans, and other electronics. This puts a strain on the electrical grid, which can cause temporary outages. These outages can impact operations throughout campus, resulting in interruptions and delays in service. Outages may also negatively impact research efforts on campus, as the inability to maintain a steady, constant temperature may impact research specimens and experimental results.

Probability of Future Occurrence of the Hazard

There have been no extreme heat events in Long Beach in over a decade. Therefore, using the scale provided, it is only possible that the hazard will occur annually.

\textsuperscript{53} Hazard Mitigation Plan, City of Long Beach. *Table of Contents.* Print. Retrieved 01.27.21 from: https://www.longbeach.gov › longbeach-hazard-mitigation-plan
Notably, the Hazard Mitigation Plan prepared by the City of Long Beach does not consider excessive heat to be a considerable hazard.\textsuperscript{54}

Vulnerability to the Hazard

When dealing with an extreme heat event, the most common impacts are those generally felt by the people living in the targeted area. For people in particular, heat can kill when the body is pushed beyond its limits. Most heat disorders occur because the victim has been overexposed to heat. As discussed, the major human risks associated with extreme heat include dehydration, sunburn, fatigue, heat exhaustion, heat stroke, and in severe cases, death.

Some portions of the population are more at risk to the effects of extreme heat. The very young, the elderly, and certain groups with chronic medical conditions (such as asthma or other pulmonary illnesses, heart disease, poor blood circulation, neurological illnesses, and obesity) are generally more vulnerable to the effects of extreme heat, and are more likely to suffer illness or death as a result.\textsuperscript{55} This is especially true if exposure is extended for a period of time and preventative measures are not taken immediately.

Cal State Long Beach is aware of the potential for extreme heat events. The campus sponsors training for all new hires so they are aware of the California State laws and federal regulations guiding safe working conditions in the heat. The campus does not sponsor cooling centers during heat waves because all buildings are air-conditioned, but Cal State Long Beach has faced local power outages that have forced the shutdown of individual buildings or facilities.

Therefore, even though this is a hazard that the campus does not face regularly, the campus has ample familiarity with excessive heat in order to handle the risks and vulnerabilities of hot weather.

Estimate of Potential Losses

Based on the previous historical occurrences, annualized losses are considered to be negligible. In an extreme heat event, loss of human life or health impacts are a greater concern than is property damage.

Vulnerability Assessment Conclusions

While the ability to predict future heat events at Cal State Long Beach is limited, the effects of climate change may provide some information. According to the Environmental Protection Agency (EPA), Southern California has warmed about three

\textsuperscript{54} Hazard Mitigation Plan, City of Long Beach. \textit{Table of Contents}. Print. Retrieved 01.27.21 from: https://www.longbeach.gov › longbeach-hazard-mitigation-plan

\textsuperscript{55} Centers for Disease Control and Prevention. \textit{Heat and People with Chronic Medical Conditions}. Retrieved 03.13.21 from https://www.cdc.gov/disasters/extremeheat/medical.html
degrees on average over the last century, with less rainfall. This may lead to stronger and longer-lasting heat events, drought, and an increased risk of wildfires.56

**Identified Data Limitations**

Numerous public and private actors conduct research, acquire data and disseminate meteorological information and forecasting to the general public, including the CSU university system. Currently, it is assumed that, apart from regular access to climate change models on changes to temperature extremes over time, the CSU community maintains sufficient access to the data needed to plan for, respond to, and mitigate the effects of extreme heat and cold.

**Flood**

**Description of the Hazard**

The incredible geographic diversity in California presents tremendous challenges for flood planning and response. The state is home to extensive mountain ranges such as the Sierra Nevada, Cascades, Klamath, Coastal Ranges, and the Southern California Transverse Range all creating tremendous watersheds. Large river systems drain the mountains traveling through populated communities including the Sacramento and San Joaquin Rivers draining into the California Delta. The state has a complex system of reservoirs, dams, and levees providing water storage and flood protection. Finally, California’s 840-mile coastline exposes the coastal regions to tidal influences.

Floods are characterized by the rising and overflowing of excess water from a water source such as a stream, river, lake, canal, or coastal body onto an area of normally dry floodplain. A floodplain is a lowland area downstream and adjacent to water bodies that are subject to flood events. Flooding is a naturally occurring event that become hazardous when populations and property are affected.

Flooding can result from excessive precipitation from weather systems generating prolonged rainfall, excessive snowmelt from watersheds upstream from the floodplain, infrastructure failure, exceeding the capacity of dams or levees, tidal influences, or a combination from any of the previous factors.

Floods represent one of the costliest and most frequent natural disasters that influences human suffering and economic impact in the United States. Flooding will likely result in significant damage to structures, infrastructure, utilities, landscapes, and the environment. Erosion of stream banks, roadways, other feature may result from the movement of flood waters. The saturated ground resulting from standing

Flood waters may cause ground instability, collapse, erosion, or other damages. Further, floods will often generate substantial debris that will accumulate and be deposited throughout the flooded areas.

Floods can be either slow-rise or rapid onset floods. With slow rise floods, there is often warning preceding water rise by hours or days before dangerous conditions present themselves. Slow rise floods that are expected to enter into populated areas generally allow for some time to initiate evacuation and sand bagging efforts. Flooding that occurs rapidly conversely are water events that present with extremely limited warning times and a limited ability to take response actions until flooding has already begun to occur.

Flooding may take on different forms:

- **Flash Flooding** – Flash flooding is typically characterized by a rapid rise, short duration, and large volume of water in a localized area. Heavy rainfall in areas that have limited drainage capacities often contribute to flash flooding conditions. These flooding events frequently occur with limited notice requiring immediate evacuation or rapid response efforts such as sand bagging. Flash flooding may arrive with fast moving water creating added hazardous conditions.

- **Riverine Flooding** – Riverine flooding is usually caused by prolonged rainfall or rainfall combined with heavy snowmelt. When soils are already saturated, the ability for the ground to absorb water is minimized. In a riverine flood, the water way exceeds channel capacity and extends into areas outside of the channel, often in developed communities. In California, riverine flooding is most likely to occur from November through April. The duration of riverine floods may vary from a period of hours to weeks.

- **Localized Flooding** – Localized flooding is commonly the result of stormwater drainage systems being overwhelmed by unusually heavy rainfall. These flooding events frequently occur in areas that are urbanized or developed with greater amounts of impervious surfaces not allowing ground absorption. This generates added runoff into the drainage systems and onto roadways creating backups.

- **Infrastructure Failure** – Failures of dams or levees presents a serious flooding concern for areas downstream from the compromised structure. This situation may result in a catastrophic flood with limited warning time and widespread areas affected.

- **Coastal Flooding** – Coastal flooding can occur in multiple areas along the California coastline. Flooding may result from intense storms coming from the Pacific Ocean that generate elevated water levels or storm surge. The size, duration, winds generated, and intensity of the storm will influence the effect the waves will have on the shoreline. Periods of high tide can aggravate the conditions allowing greater wave impingement into coastal areas.
Atmospheric River

California, including the location of this campus, is subject to the effects of a phenomenon referred to as atmospheric rivers. These weather events consist of long, narrow regions in the atmosphere transporting tremendous amounts of water vapor from the tropics. These weather regions behave like rivers in the sky. They can carry heavy volumes of water vapor compared to the amount of water flow at the mouth of the Mississippi River. As these atmospheric rivers arrive into California they tend to generate significant rain and snow.

Atmospheric rivers can arrive in many different shapes and sizes. The larger events are able to generate extreme rainfall amounts resulting in flooding. They can stall over watersheds vulnerable to flooding, often saturated with heavy snow amounts. The atmospheric rivers known as a “Pineapple Express” coming from the tropics and arriving with warmer air may produce heavy rains that will melt ground snow adding to the water volume that will be added in the flood runoff.

These events can produce heavy amounts of precipitation creating extensive damages. However, these events may present as weaker systems that produce precipitation that is enough to be beneficial for the local water supply. At the higher elevations in the California mountains, these events have the potential to generate a tremendous snowpack providing a source of water during the dry summer months.
Location of the Hazard

Long Beach is at the south end of the South Bay communities and at the terminus is the Los Angeles and San Gabriel Rivers. The area around Long Beach is relatively flat and sits between the Palos Verdes Hills and hills further to the east. These include the Puente and Chino Hills which provide a potential for developing water run-off during heavy precipitation events. The rivers that drain into the Pacific Ocean serve as drainage basins for the watersheds of the Santa Monica and San Gabriel Mountains. There are a number of flood retention basins and flood control channels along the base of these hills that drain towards Long Beach to protect Los Angeles and Orange County communities. The area surrounding the campus is a developed suburban environment predominately consisting of residential and commercial land uses.

57 National Oceanic and Atmospheric Administration, “What are atmospheric rivers?”, https://www.noaa.gov/stories/what-are-atmospheric-rivers
The CSU Long Beach campus is located 2 miles north of the Pacific Ocean, ¾ mile from the San Gabriel River, ½ mile from the Los Cerritos Channel, and sees the Bouton Creek channel transit through the center of campus. The San Gabriel River watershed receives the majority of its water from snowfall from the San Gabriel Mountains. The San Gabriel River and Los Cerritos Channel contribute to a direct flood hazard to the campus and would compromise access routes to the campus if failed. The campus north of the Bouton Creek in the CSU Long Beach campus sits within a Special Flood Hazard Area (SFHA) Zone X: Area with Reduced Flood Risk Due to Levee designation on the Flood Insurance Rate Map. The campus south of the Bouton Creek channel is removed from a flood risk designation and classified as Zone X: Area of Minimal Flood Hazard. Access routes and critical infrastructure to the east and north are located in Zone X: Area with Reduced Flood Risk Due to Levee while those access routes and critical infrastructure west and south of the campus are designated Zone X: Area of Minimal Flood Hazard.

Extent of the Hazard
The CSU Long Beach campus resides in a minimally threatened flood zone. However, flood events are still possible and isolated heavy precipitation events can still pose localized flooding hazards. In fact, there is a historic record of isolated urban or street flood events on the campus that have generated damages. This specific hazard could substantially alter the ability of the campus to maintain operations. In addition, 6 Federally Declared events have occurred in LA County during the 25-year period from 1996-2021. Based on these facts, the planning committee ranks the extent of the hazard on campus as Moderate.

In support of the NFIP, FEMA identifies those areas that are more vulnerable to flooding by producing Flood Hazard Boundary Maps (FHBM), Flood Insurance Rate Maps (FIRM), and Flood Boundary and Floodway Maps (FBFM). Several areas of flood hazards are commonly identified on these maps, including the 1% annual chance flood zone. Flood zones are further delineated by risk and are assigned a letter signifier. The flood zone designations are defined and described in the following table.

Table 12-23: Flood Zone Designations and Descriptions

<table>
<thead>
<tr>
<th>Zone Designation</th>
<th>Percent Annual Chance of Flood</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Zone V</td>
<td>1%</td>
<td>Areas along coasts subject to inundation by the 1% annual chance of flooding with additional hazards associated with storm-induced waves. Because hydraulic analyses have not been performed, no BFEs or flood depths are shown.</td>
</tr>
<tr>
<td>Zones VE and V1-30</td>
<td>1%</td>
<td>Areas along coasts subject to inundation by the 1% annual chance of flooding with additional hazards associated with storm-induced waves. BFEs derived from detailed hydraulic analyses are shown within these zones. (Zone VE is used on new and revised map in place of Zones V1-30.)</td>
</tr>
<tr>
<td>Zone A</td>
<td>1%</td>
<td>Areas with a 1% annual chance of flooding and a 26% chance of flooding over the life of a 30-year mortgage. Because detailed analyses are not performed for such areas, no depths or base flood elevations are shown within these areas.</td>
</tr>
<tr>
<td>Zone</td>
<td>Chance (%)</td>
<td>Description</td>
</tr>
<tr>
<td>------</td>
<td>------------</td>
<td>-------------</td>
</tr>
<tr>
<td>AE</td>
<td>1%</td>
<td>Areas with a 1% annual chance of flooding and a 26% chance of flooding over the life of a 30-year mortgage. In most instances, BFEs derived from detailed analyses are shown at selected intervals within these zones.</td>
</tr>
<tr>
<td>AH</td>
<td>1%</td>
<td>Areas with a 1% annual chance of flooding where shallow flooding (usually areas of ponding) can occur with average depths between 1 – 3 feet.</td>
</tr>
<tr>
<td>AO</td>
<td>1%</td>
<td>Areas with a 1% annual chance of flooding, where shallow flooding average depths are between 1 – 3 feet.</td>
</tr>
<tr>
<td>X (shaded)</td>
<td>0.2%</td>
<td>Represents areas between the limits of the 1% annual chance flooding and 0.2% chance flooding.</td>
</tr>
<tr>
<td>X (unshaded)</td>
<td>Undetermined</td>
<td>Areas outside of the 1% annual chance floodplain and 0.2% annual chance floodplain, areas of 1% annual chance sheet flow flooding where average depths are less than one (1) foot, areas of 1% annual chance stream flooding where the contributing drainage area is less than one (1) square mile, or areas protected from the 1% annual chance flood by levees. No BFEs or depths are shown within this zone.</td>
</tr>
</tbody>
</table>

History of the Hazard

Flooding in Long Beach and the broader Los Angeles County region have typically occurred during the winter months when Pacific storms are more common. The occurrences of significant flooding typically have been the result of successive intense storms with heavy precipitation. The region has experienced flood events that have caused tens of millions of dollars in damages and casualties. The following provides insight into information of past flooding events that are significant to the CSU Long Beach campus. Also, there is a historic record of isolated urban or street flood events on the campus that have generated damages.
<table>
<thead>
<tr>
<th>Date</th>
<th>Event</th>
<th>Declaration</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>March 1962</td>
<td>Flood</td>
<td>DR-122-CA</td>
<td>Countywide</td>
</tr>
<tr>
<td>October 1962</td>
<td>Flood</td>
<td>DR-138-CA</td>
<td>Countywide</td>
</tr>
<tr>
<td>February 1963</td>
<td>Flood; Heavy Rains</td>
<td>DR-145-CA</td>
<td>Countywide</td>
</tr>
<tr>
<td>February 1978</td>
<td>Flood; Winter Storms</td>
<td>DR-547-CA</td>
<td>Countywide</td>
</tr>
<tr>
<td>February 1980</td>
<td>Flood; Winter Storms</td>
<td>DR-615-CA</td>
<td>Countywide</td>
</tr>
<tr>
<td>December 1988</td>
<td>Winter Storms</td>
<td>DR-812-CA</td>
<td>Countywide</td>
</tr>
<tr>
<td>February 1992</td>
<td>Winter Storms</td>
<td>DR-935-CA</td>
<td>Countywide</td>
</tr>
<tr>
<td>January 1993</td>
<td>Winter Storms</td>
<td>DR-979-CA</td>
<td>Countywide</td>
</tr>
<tr>
<td>January 1995</td>
<td>Flash Flood; Heavy Rains</td>
<td>DR-1044-CA</td>
<td>Countywide</td>
</tr>
<tr>
<td>March 1995</td>
<td>Flash Flood; Heavy Rains</td>
<td>DR-1046-CA</td>
<td>Countywide</td>
</tr>
<tr>
<td>December 1996</td>
<td>Flood; Winter Storms</td>
<td>DR-1155-CA</td>
<td>Countywide</td>
</tr>
<tr>
<td>January 1997</td>
<td>Flood</td>
<td>DR-1155-CA</td>
<td>Countywide</td>
</tr>
<tr>
<td>February 1998</td>
<td>Flood; Winter Storms</td>
<td>DR-1203-CA</td>
<td>Countywide</td>
</tr>
<tr>
<td>January 2005</td>
<td>Flood; Winter Storms</td>
<td>DR-1577-CA</td>
<td>Countywide</td>
</tr>
<tr>
<td>February 2005</td>
<td>Flood; Debris Flows</td>
<td>DR-1585-CA</td>
<td>Countywide</td>
</tr>
<tr>
<td>January 2017</td>
<td>Flood; Winter Storms</td>
<td>DR-4305-CA</td>
<td>Countywide</td>
</tr>
</tbody>
</table>

58 2019 County of Los Angeles All-Hazard Mitigation Plan, 2019
Potential Impacts of the Hazard

A flood will potentially result in extensive amounts of water entering onto developed areas. The force and volume of water that is generated by a flood may cause extensive structural damage in areas subject to standing or moving water. The effects of flooding may spread over significant distances covering large areas of land. The extent of the impacts would vary based on a number of factors such as the volume of water flooding, the time of the flood event, the amount of warning provided, the location and extent of the flood boundary, facility elevation, and distance from the flood source. Potential impacts resulting from flooding include:

- Injuries or loss of life
- Property destruction or damage
- Loss of property contents
- Infrastructure damage including roadways, bridges, other transportation means
- Public health hazards resulting from mold, mildew, and disease due to flood water
- Flooded or destroyed lifelines/supply routes
- Damaged or destroyed utilities
- Loss of community economic base
- Employment losses
- Agricultural (crops and livestock) damages or destruction
- Environmental damage
- Prolonged periods of necessary dewatering
- Flooding erosion may alter natural drainage channels
- Societal and community impacts
- Psychological impacts of impacted populations
- Disruptions to education delivery to community
- Damage or destruction of academic materials, fine arts, and research
- Damage or destruction of university computer systems and networks
- Damaged university infrastructure
- Inability for campus operations to resume
- Reduced or eliminated student engagement with academic programs
- Reductions in campus revenues
Additionally, individuals who were unable to evacuate in time or refused to leave will likely need assistance or rescue from the flooded area. Remaining in or being trapped by flood waters places individuals in significant risk of injury or death. The impacts extend beyond the danger placed upon the affected individual and places greater resource demands on agencies and organizations making efforts to rescue trapped individuals.

Probability of Future Occurrence of the Hazard

Floods can occur at any time but are most common in the Los Angeles area with winter storms saturated with subtropical moisture. Flooding occurs on average every 6.1 years from heavy precipitation that could generate potential 50- or 100-year floods in the CSU Long Beach area. The CSU Long Beach campus is located within both a Zone X Special Flood Hazard Area (Area with Reduced Flood Risk Due to Levee) and Zone X (Area of Minimal Flood Hazard), as well as in close proximity to the Bouton Creek channel. There are specific buildings and low lying areas of the campus that have a greater risk for isolated flooding. There is a historic record of isolated urban or street flood events on the campus that have generated damages further providing a demonstration of potential flood activity.

As such, the planning committee ranks the probability of future occurrence for flooding as Possible.

Vulnerability to the Hazard

The CSU Long Beach campus is subject to the effects of flooding resulting primarily from excessive precipitation and isolated strong storms. There is a more remote potential for severe flooding and damage on campus and surrounding residential and commercial areas of Long Beach due to overflow or damage to flood control systems. The flood control channels and drainage systems that surround the campus have limited storage or volume capacities. The campus and the campus community are vulnerable to the effects generated by flooding from these systems.

Vulnerability to flooding on the CSU Long Beach campus will vary depending on the severity of flooding and when the flood were to occur and the location of people and assets in low lying, flood-prone areas. The risk to the campus population will be lessened during periods when classes are not in session or during periods of breaks. Conversely, during the days and hours that classes are in session and staff are at their workplaces, the human vulnerability increases. Members of the campus community may become trapped on campus depending on the level of flooding occurring on surface streets. However, in rare, region-wide events this vulnerability may be extended to the homes and workplaces of members of the campus community and their families.

CSU Long Beach is in proximity to a variety of industrial and commercial facilities in the surrounding communities. When these facilities are inundated with flood water,
the potential for chemical release exists presenting possible exposures to individuals from the campus community. These facilities additionally line many of the primary access routes in and out of the campus.

Some campus buildings and infrastructure, especially those in low lying areas, would be vulnerable to low probability, large-scale flooding if it reaches the university. Campus utilities and communication capabilities could be impacted by flood waters rendering them disabled. A flood covering a large portion of the city could affect communication capabilities well beyond the boundaries of the campus. Remaining flood waters will leave behind molds and other health concerns in affected campus buildings and facilities likely requiring extensive restoration or demolishing. The residents of the on-campus residence halls, if located in low lying, flood-prone areas, may have transportation limitations requiring evacuation and alternative housing procedures to be implemented if populated. Flood waters may result in damage to campus equipment, communication systems, protected documents, artwork, academic materials, computer systems, research, and other critical activities on lower levels of buildings.

Certain campus populations will experience greater challenges to a post-flood / failure environment. Vulnerable populations will likely need to navigate through flood generated debris, face extreme health safety issues from flood waters, experience extreme stresses of a disaster, an inability to communicate to or gain access to support networks, and find difficulty in accessing equipment or supplies to aid in a specific need. Students remaining on campus such as those residing in the residence halls would be particularly vulnerable especially those without access to adequate transportation.

Estimate of Potential Losses

Estimates of potential losses will be influenced by a variety of factors. The volume and force of the water will determine the scale of damages affecting campus infrastructure, equipment, and other impacted features. The location and elevation above flood waters will affect the level of damage and individuals exposed. The time of the academic year, the day of week, and hour in which the flooding was to occur will influence the number of people on campus and potential casualties. The severity of the storms producing precipitation, the speed of the storms moving across the area, the level of snowpack in the higher elevations, and amount of resulting snowmelt will produce varying effects on damages produced and costs incurred. Losses will be generated by the physical damages, the loss of revenue, loss of academic research, loss of building contents, and community wide economic reductions.

Based on estimate replacement costs of facilities and structures on campus, the maximum total replacement costs due to flood are $453,426,848. However, it is unlikely for flood to cause destructive losses to the entire campus.

Table 12-25: Special Flood Hazard Area (SFHA) Estimated Losses
<table>
<thead>
<tr>
<th>Zone Designation</th>
<th>No of Buildings</th>
<th>Maximum Replacement Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Zone V</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Zone VE &amp; V 1-30</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Zone A</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Zone AE</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Zone AH</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Zone AO</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Zone X .2%</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Zone X Levee</td>
<td>26</td>
<td>$55,356,592</td>
</tr>
<tr>
<td>Reduced Risk</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Zone X Minimal Risk</td>
<td>37</td>
<td>$398,070,256</td>
</tr>
<tr>
<td>Not in a SFHA</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>No Building Value</td>
<td>28</td>
<td>Unknown</td>
</tr>
<tr>
<td>Data Provided*</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Buildings with no value defined are also included in the respective Zones they are found in.

Vulnerability Assessment Conclusions

While the campus is located in an area of minimal flood potential (Zone X), the primary vulnerabilities to flood on campus are people and assets in low lying areas exposed to mostly localized flooding and ponding from overflow of campus creeks or low probability, large-scale storms that produce heavy amounts of precipitation directly over the campus and surrounding neighborhoods. The campus’ proximity to Bouton Creek, Los Cerritos Channel, and San Gabriel River adds an additional risk and degree of vulnerability for the campus.

The potential for flooding generates the potential for a number of cascading effects such as disruptions to the local economy, utility failures, disruptions to providing for the needs of the community, and development of public health hazards. These effects would be exacerbated by effects of seasonal flooding, ongoing heavy precipitation, or excessive run-off from the watershed contributing to the river system. The potential for widespread flooding and damage of structures, while unlikely, has exponentially powerful impacts on particular populations among the campus community including those with access or functional needs, international students, the homeless, and students residing in the residence halls.

Identified Data Limitations
Lack of comprehensive historic flooding occurrences, missing campus structural replacement costs, and complete inventory of building construction features or mitigation efforts to lessen the impact due to flood inundation.
**Hazardous Materials**

Description of the Hazard

A hazardous material is defined in California’s State Hazardous Materials Incident Contingency Plan (1991) as “a substance or combination of substances which, because of quantity, concentration, physical, chemical, or infectious characteristics may: cause, or significantly contribute to an increase in deaths or serious illnesses; and/or pose a substantial present or potential hazard to humans or the environment.”59 Hazardous materials are one or more of the following: flammable, corrosive or an irritant, oxidizing, explosive, toxic (poisonous or infectious), thermally unstable or reactive, or radioactive. Hazardous materials are ubiquitous in modern society and may be found at all stages of production, consumption, and disposal.

Federal and state laws permit the intentional release of some hazardous materials into the environment such that the risk to human health and the environment is thought to be acceptable. However, sometimes releases are unintentional, resulting from leaks, accidents, or natural hazards. This section focuses on such accidental releases and fall into the following key categories:

**Fixed Hazardous Materials Incident:** A fixed hazardous materials incident is the accidental release of chemical substances or mixtures during production or handling at a fixed facility.

**Transportation Hazardous Materials Incident:** A transportation hazardous materials incident is the accidental release of chemical substances or mixtures during highway, waterway or air transport. Populations, built and natural environments are potentially impacted.

**Pipeline Incident:** A pipeline transportation incident occurs when a break in a pipeline creates the potential for an explosion or leak of a dangerous substance (oil, gas, etc.) possibly requiring evacuation. An underground pipeline incident can be caused by environmental disruption, accidental damage, or sabotage. Incidents can range from a small, slow leak to a large rupture where an explosion is possible. Inspection and maintenance of the pipeline system along with marked gas line locations and an early warning and response procedure can lessen the risk to those near the pipelines.

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Hazardous materials can also be classified according to worker safety and health. Information provided by California Division of Safety and Health includes guidelines related to:

- **Safety hazards**: fire and fire byproducts, electricity, flammable gases, unstable structures, demolition, sharp or flying objects, excavations)
- **Health hazards**: carbon monoxide ash, soot and dust; asbestos; hazardous liquids; other hazardous substances; heat illness)

**Natural-Technological Incidents (Natechs):** During the past two decades, increasing attention has been given to hazardous materials releases resulting from Natechs or a natural disaster event that triggers a technological hazard event. Natechs are of particular concern for the following reasons:

- They can produce a simultaneous effect on many industrial facilities
- Can overwhelm response capacity
- Containment systems may fail
- May produce cascading disasters
- Response may be hindered by a disaster’s impact on the physical environment

**Location of the Hazard**

Hazardous materials and infrastructure such as fuel tanks, rail lines, chemicals, hazardous waste sites and gas pipelines to varying degrees are located within the CSU system and/or within all surrounding communities. The planning committee indicates that chemicals are located in the science lab, but otherwise no known hazardous materials are present on campus. At larger scales (beyond the campus planning area) extensive hazardous materials and infrastructure are located throughout the city of Long Beach and throughout Los Angeles County, and reflect different types, configurations and scales dispersed across these geographic areas.

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Extent of the Hazard

There is no comprehensive statewide vulnerability assessment available at this time. As such, the true extent of the hazardous materials risk in California and its communities is not known, meaning no overarching conclusions have been reached which have been able to integrate all qualitative and quantitative risk factors to produce a comprehensive measure of the extent of the hazard.

However, for the CSU – Long Beach planning committee, although only small chemical spills have taken place on campus, and hazardous materials are limited to chemicals in the science building, an extensive array of gas pipelines, rail lines, fuel tanks, chemical industries and hazardous waste sites are located close to the campus. Based on these factors, it is prudent to rank the extent of the hazard for the CSU – Long Beach campus as High, and to consider worst case scenarios as the main driver of policy in order to fully mitigate all possible hazardous materials event outcomes - In recent years, Long Beach has experienced several chemical fires and oil refinery explosions resulting in injuries and deaths.

Moreover, according to the 2018 CA State Hazard Mitigation Plan, 400 hazardous materials problems are tied to 32 past earthquakes, including over 150 problems from the Loma Prieta Earthquake alone. That said, the plan indicates that it is likely that many such hazardous materials releases have received little attention in the past because public authorities, the media, and the public have overlooked them in the rush to address and recover from immediate disaster threats, and that responsible parties may have an incentive to understate the extent of releases or not to report them at all.

History of the Hazard

According to the CA Governor’s Office of Emergency Services’ Hazardous Materials Spill Report, the state experiences from 10 to 30 spill events daily. As of April 20th, 2021 already 2096 spill events had occurred. Such events have occurred in all the cities and/or counties where CSU campuses are located.

According to the 2018 CA State Hazard Mitigation Plan, with regard to natural-technological hazard events (Natechs), 400 hazardous materials events are tied to 32 past earthquakes, including over 150 Natech events from the Loma Prieta Earthquake alone.

For more details on specific hazmat events, please refer to the local, county and/or multi-jurisdictional hazard mitigation plans where CSU campuses are located at:


According to the campus planning committee, a small chemical spill took place in the science building on the CSU – Long Beach campus about 3 years ago, though none recently and none required evacuation. However, the City and Port of Long Beach have experienced numerous deadly hazardous materials explosions.

Potential Impact of the Hazard

A large hazardous materials release could affect an entire community or city under certain conditions related to direction of air flow (air-based chemical release) and population density or the contamination of a community’s main water supply. Either type of release could necessitate large scale evacuation. By contrast, in the rural unincorporated areas where population densities are low, even in the event of a large release, the number of homes that may need to be evacuated would be significantly lower than in an urban environment. The occurrence of a hazmat incident can also result in the shut-down of transportation corridors which can last for hours at a time while the impacted area is stabilized.

The release of some toxic gases may cause immediate death, disablement, or sickness if absorbed through the skin, injected, ingested, or inhaled. Contaminated water resources become unsafe and unusable, depending on the amount of contaminant. Some chemicals cause painful and damaging burns if they come in direct contact with skin. Prolonged and concentrated exposure to such chemicals can produce severe long-term impacts to respiratory, endocrine and nervous systems, heart and brain health.

The potential impacts of chemicals and toxic gases discussed here also apply to the students, staff and environment on the CSU – Long Beach campus.

With regard to the natural environment overall, contamination of air, ground, or water may result in harm to fish, wildlife, livestock, and crops. The release of hazardous materials into the environment may cause debilitation, disease, or birth defects over a long period of time. Loss of livestock and crops may lead to economic hardships within the community.

Recent California examples include the 2016 Aliso Canyon methane gas leak, which caused evacuation of nearby residents, many of whom experienced temporary health problems such as difficulty breathing and eye irritation; and the 2016 Fruitland metal recycle plant fire in Maywood, which released heavy metals such as lead, magnesium, copper, aluminum, antimony, calcium, iron, sulfur, tin, potassium, and zinc which pose severe risks to public health. Health effects from exposure to these metals included short-term symptoms such as irritation to the eyes, nose, throat, and lungs.

Potential Impact of the Hazard (Natechs)

Natural disasters, including earthquake, flood, and fire also pose risks to public health and the environment. For example, following the Northridge Earthquake, California State University (CSU) Northridge laboratories and chemical storage rooms experienced multiple chemical spills. Such incidents, triggered by a natural disaster, pose a significant risk to students, faculty, staff, and first responders. At a minimum, all CSU campuses with a science lab (including CSU – Long Beach) is at risk of potential impact from a natural-technological (combined impact) event.

In a severe flood event, floodwaters are often contaminated with hazardous materials posing a threat to public and animal health, groundwater, and other parts of the environment. These hazardous materials may be released from damaged or flooded underground tank sites (e.g., gas stations or chemical storage facilities), propane tanks, manure or human waste handling facilities, fertilizer and pesticide storage, agricultural sites, and household hazardous waste.

In a fire event, (such as the October 2017 Northern California firestorms which destroyed approximately 6,000 residences) entire neighborhoods can be burned to the ground. Hazardous material release creates public health concerns which can delay the initial steps of fire recovery, including reopening burned areas to residents and initiating debris removal activities. The post-fire “toxic sweep” poses a risk of coming into contact with toxic substances due to the presence of synthetic and hazardous materials.67

Probability of Future Occurrence of the Hazard

The probability of occurrence for a hazmat event on the CSU – Long Beach campus can be viewed in two different ways: the history of occurrence serves as a sound predictor of future probability assuming current risk and vulnerability factors remain somewhat constant. For the purposes of the current estimate, no current data clearly indicates otherwise. As such, the probability of occurrence originating on campus is Low to Moderate - the campus has experienced small-scale chemical spills. However, extensive hazardous materials and infrastructure are close to the campus, and several deadly chemical explosions have taken place in recent years. Therefore, the probability of occurrence near the campus is High or Likely. Moreover, hazmat occurrences are largely based on human error, and any changes in risk and vulnerability factors such as a decreased vigilance in materials oversight and handling practices or changes in the amount of chemicals or exposure will likely increase the probability on campus.

Vulnerability to the Hazard

Hazardous materials pose a high degree of risk to the CSU – Long Beach campus. As identified by the campus planning committee and on the hazmat map, the following vulnerabilities are present on campus: chemicals are present in the science lab, and a high degree of hazardous waste sites, chemical sites, rail lines, gas pipelines, fuel tanks and more are close to the campus. Gases, fuels, chemicals or hazardous waste, if spilled, released or exploded, could lead to injury and death, and/or severely impact human health as well as campus operations.

Although it is quite difficult to produce a quantitative measure of vulnerability because (unlike natural hazards) the probability of occurrence is dependent on human error, which itself is variable based upon a fluctuating set of interrelated factors, some of which lack prediction or control, given the complexity of how all natural and built environments and hazmat risks factors interrelate at the local or campus level, it is prudent to assume for planning purposes that the campus’ vulnerability is a sub-set of the larger community’s vulnerability. As such, the CSU – Long Beach leadership maintains vigilance to mitigate the campus’ vulnerabilities identified above at a minimum.

**Estimate of Potential Losses**

As discussed previously, it is difficult if not impossible to produce an accurate quantitative measure of vulnerability because of the variable nature of a hazardous materials spill. For example, the release of a toxic airborne chemical in a populated area has severe impact potential, whereas the impact potential of a small chemical spill in a remote or rural area is most likely limited to remediation of soil. And, in both cases, the probability of occurrence is dependent on human error, which itself is variable based upon a fluctuating set of interrelated factors, some of which lack prediction or control. In all cases, different types and amounts of hazardous materials interact with fluctuating combinations of human error to produce different event outcomes with variable impact costs.

**Vulnerability Assessment Conclusions**

It is well understood that with regards to hazmat vulnerability, each campus and its surrounding community (including CSU – Long Beach) operates through a complex and dynamic interaction between industrial and commercial inputs and outputs and the natural and built environment. Such activity produces hazardous materials that move through the environment along both convergent and divergent routes and across all levels of land-use from site to campus to city and county and beyond. It is also clear from a review of the City of Long Beach and Los Angeles County hazard mitigation plans and Cal OES’ records of hazardous material spills, that such events occur with great frequency in Long Beach and to varying degrees of severity across jurisdictions statewide. As such, in assessing the vulnerability of the CSU – Long Beach campus, campus-level risks and vulnerabilities are not discreet or isolated but can become exacerbated or augmented through connections to broader community-level hazmat risks and vulnerabilities.
Finally, in order to draw conclusions on vulnerability, it should be noted that any identified vulnerabilities at the campus level and/or community level are circumscribed and potentially reduced by targeted policy and program interventions. Numerous policies and programs have been established in recent years in response to California’s widespread and complex and integrated hazardous materials risks - California established the Unified Program which consolidates and integrates the administrative requirements, permits, inspections, and enforcement activities of the following environmental and emergency response programs: the Aboveground Petroleum Storage Act (APSA) Program, Area Plans for Hazardous Materials Emergencies, the California Accidental Release Prevention (CalARP) Program, the Hazardous Materials Release Response Plans and Inventories (Business Plans), Hazardous Material Management Plan (HMMP) and Hazardous Material Inventory Statement (HMIS) requirements (California Fire Code), the Hazardous Waste Generator and Onsite Hazardous Waste Treatment (tiered permitting) Programs, and the Underground Storage Tank Program.

Identified Data Limitations

The CSU – Long Beach planning committee has provided information on campus-level hazmat materials and risks. Data limitations pertain to a comprehensive understanding of human activity and error related to materials control over the long term.

**Landslide**

Description of the Hazard

A landslide is a down-slope movement of soil, rock, or other debris, and can also be referred to as a mass movement or slope failure.68 These geological hazards can range in size from a few feet to over a mile in length and width and, when heavy and rapidly moving, can cause serious damage and loss of life.

Landslides are classified based on the type of material and type of movement involved. They can range from slow-moving earth flows to fast-moving debris flows, though many large slope failures involve more than one type of movement. The primary natural triggers of slope failures are water, seismic activity, and volcanic activity. Slope saturation by water can occur from intense rainfall, snowmelt, changes in ground-water levels, and surface-water level changes along coastlines. In winter months, El Nino storms or other high rainfall events may saturate soils and trigger slope failure.

**Deep-Seated Landslides**

Deep-seated landslides, ranging in depth from ten to several hundred feet, occur as a result of geologic and hydraulic changes, such as earthquakes or increased levels of groundwater. These landslides can move slowly or quickly and can cause extensive property damage, but rarely result in loss of life.

**Debris Flows Related to Shallow Landslides**

Shallow landslides may mobilize into rapidly moving debris flows and typically occur after sudden saturation of the ground. These types of debris flows are typically more dangerous because they move rapidly, causing both property damage and loss of life.

Debris flows may also occur as a result of post-fire conditions, where wildfires have left barren ground exposed to heavy rainfall. Intense rainfall, generally greater than .5 inch per hour, has the potential to trigger a post-fire debris flow.69 These landslides may impact lives and properties within its deposition zone, and can result in downstream flooding. These post-fire debris flows often occur during the fall and winter following major summer fires.

**Location of the Hazard**

The susceptibility of an area to landslides depends on several variables, including magnitude of slope gradients, water content, ground cover, presence of erosion, and slope material and structure. However, landslides are most prevalent in terrain with weak material and steep slopes, and the highest risk is found in areas with high rainfall or high earthquake potential. Slope failures are also most likely to occur in areas where they have occurred in the past. In California, the most landslide-prone areas are found along the coast and in the northern Franciscan Formation.

General landslide vulnerability can be estimated from the distribution of weak rocks and steep slopes as seen in Figure 12-15 below. Based on the Figure below, the CSU-Long Beach campus is not connected to, or close to areas susceptible to landslide.

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Extent of the Hazard

In Los Angeles County, landslides are more likely to occur in the steep slopes outside of the metropolitan area and along the coastline. The San Gabriel mountains, both steep and erosive, contain steeply walled canyons above areas with high population density. When heavy rain occurs, there is significant potential for floods and landslides throughout the County, and the indirect impacts of landslides in the region may cover a larger geographical extent. Based on the campus’ distance from the landslide hazard zone, and no history of occurrence on or near the campus, the planning committee ranks the extent of the landslide hazard for the campus as Low.

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History of the Hazard

FEMA has declared thirteen major disasters involving landslides, mudslides, debris flows, or mud flows in Los Angeles County since 1978. NOAA has recorded five debris flow events in the County since 2004, most of which occurred in the areas directly surrounding metropolitan Los Angeles. The 2018, the Southern California Mudflows damaged 40 to 45 homes in Sun Valley and caused a vehicle to strike a natural gas pipeline, which began to leak. No landslide events on or near the campus have been recorded.

Potential Impacts of the Hazard

The CSU Long Beach campus may experience secondary impacts such as the disruption of campus operations as a result of landslides in the region. Students, faculty, and staff living elsewhere in Los Angeles may be more directly impacted. Landslides can result in physical damage to buildings and property and have the potential to significantly effect infrastructure in the region. As a landslide moves, it distresses structural foundations by settlement, cracking, and tilting. Fast-moving flows can remove entire structures in one instance, while other types of flows can cause damage gradually.

Transportation and utility infrastructure are particularly vulnerable to landslides, since the failure of any component can disrupt service over a large area. The loss of power and communication and disruption of transportation can have cascading effects throughout an area, including impaired disposal of sewage, contamination of water supplies, and the release of flammable fuels. Transportation routes are also often expensive to clean up, and prolonged obstruction can disrupt the movement of people and goods for long periods of time.

Probability of Future Occurrence of the Hazard

Slope failures are also often triggered by other natural hazards, so landslide frequency is often related to the frequency of these other hazards. As climate change impacts the frequency and intensity of triggers such as rain events, fires, and coastal erosion, landslides may generally occur more often. Historically, landslides have occurred frequently in the San Gabriel Mountains and therefore are likely to occur in the future. However, given the location of the campus far removed from landslide susceptibility zones, and no historical occurrence of landslides on or near campus, the planning committee ranks the probability of the landslide hazard on the campus as Unlikely.

Vulnerability to the Hazard

The vulnerability of the built environment to landslides depends on exposure and is more likely to incur damage as a result of proximity, rather than inferior structural design. The structures most vulnerable to landslides are buildings and utility/transportation lifelines, which can be impacted by either impact or ground deformation. Utilities and transportation infrastructure are particularly vulnerable, due to their geographic extent and susceptibility to physical distress. Moreover, any
population proximal to a landslide when it occurs is vulnerable to its impacts. However, other than the temporary disruption of transportation routes or campus operations, the CSU-Long Beach campus does not exhibit these vulnerabilities.

Estimate of Potential Losses

There are no current models for estimating potential losses from a landslide directly impacting the campus.

Although the economic impact of landslide damage can exceed that of the direct repair costs, there are currently no applicable methods for estimating indirect costs related to CSU Bakersfield.

Vulnerability Assessment Conclusions

Landslides could impact the campus primarily related to indirect impacts to transportation and utilities. Utility outages can impact health, particularly for vulnerable populations, and can cause interruptions in operations. Interruptions may impact student and employee’s ability to travel to campus and the delivery of classes and events.

Identified Data Limitations

The ability to predict future landslides at the CSU Bakersfield campus is limited. However, the USGS estimates that climate change-induced shifts in weather will increase the frequency of post-wildfire landslides, which are expected to occur almost every year in California.13

Power Outage

Description of the Hazard

Long Beach, California is Los Angeles County’s second largest city. Approximately 20 miles south of downtown Los Angeles, Long Beach is home to some of the world’s largest ports, oil fields, tourist attractions and CSU Long Beach. The city spans approximately an area of 51 square miles.

Long Beach, like other metropolitan cities, would experience disruptions in most aspects of modern life, and almost all aspects of urban life, rely on the availability of reliable utilities, such as electricity, water, and natural gas. An Interruption in the supply or distribution of these commodities can leave highly populated areas, like Long Beach, with basic services, such as electricity or sanitation with an inability to manage these issues. Power outage interruptions can be cascading effects from other disaster events or incidents, such as the result of major windstorm, floods, or an earthquake. Due to the City of Long Beach’s location and that of the University, Public Safety Power Shut offs due to wildfires are not a factor the campus regularly experiences.
In the event of a power outage at Cal State Long Beach, a power outage event can disrupt day-to-day operations at the campus, like in-person classes, special events, impede or limit digital communications, interrupt telephonic or radio communications, make elevators, entry ways and other devices malfunction or inoperable. Additionally, impacts can occur to the surrounding campus community by forcing temporary closures of local restaurants and other types of vendors. For the thousands of Cal State Long Beach student residents in on-campus housing, a loss of power would affect students residing in off campus housing in the area, as well.

Additionally, a severe outage to Los Angeles County or the City of Long Beach would also directly affect the campus and the community creating social, economic, and potential health and safety impacts. Traffic flow around and to the campus may experience significant challenges due to a combination everyday traffic and large trucks transporting goods in and out of the ports of Long Beach and Los Angeles.

Electric power disruptions and outages fall into two categories: intentional and unintentional.

- The four types of **intentional** disruptions:
  - Planned: Some disruptions are intentional and can be scheduled based on maintenance or upgrading needs.
  - Unscheduled: Some intentional disruptions must be done "on the spot" in response to an emergency.
  - Demand-Side Management: Some customers (i.e., on the demand side) have entered into an agreement with their utility provider to curtail their demand for electricity during periods of peak system loads.
  - Load Shedding: When the power system is under extreme stress due to heavy demand and/or failure of critical components, it is sometimes necessary to intentionally interrupt the service to selected customers to prevent the entire system from collapsing. These intentional interruptions result in rolling blackouts.

**Unintentional** or unplanned disruptions are outages that come with essentially no advance notice or warning. This type of disruption is the most problematic. The following are categories of unplanned disruptions:

- Accident by the utility, utility contractor, or others.
- Malfunction or equipment failure.
- Equipment overload (utility company or customer).
- Reduced capability (equipment that cannot operate within its design criteria).
- Tree contact other than from storms.
- Vandalism or intentional damage.
- Weather, including lightning, wind, earthquake, flood, and broken tree limbs taking down power lines.
- Wildfire that damages transmission lines.

Location of the Hazard

Although power outages can take place within a circumscribed area, it has the potential to affect the entire planning area equally.

Extent of the Hazard

In order to anticipate outage conditions and reduce impacts, campus facility managers and others keep track of conditions and data provided by the media, municipal utilities and the California Independent System Operator (CAISO) which is tasked with managing the power distribution grid that supplies most of California, except in areas served by municipal utilities. CAISO is thus the entity that coordinates statewide flow of electrical supply. CAISO uses a series of stage alerts to the media based on system conditions. The alerts are as follows:

- Stage 1 - reserve margin falls below 7 percent.
- Stage 2 - reserve margin falls below 5 percent.
- Stage 3 - reserve margin falls below 1.5 percent.

Rotating blackouts become a possibility when Stage 3 is reached. Utility agencies aim to advise affected areas approximately 48 hours in advance of a potential PSPS event and will attempt notification again approximately 24 hours before power is shut off. Campus staff respond accordingly.

Given the prevalence of rolling blackouts and other power outages in California, the campus maintains safety precautions, situational awareness, access to emergency power generators and other protocols for managing campus power outages. Although only 1 recorded outage has taken place on campus, they occur from time to time in the City of Long Beach. Therefore, the planning committee ranks the extent of the power outage hazard as Moderate.

History of the Hazard

The City of Long Beach has experienced power outages over time. Their electric utility provider, Southern California Edison (SCE) has experienced outages, which have affected the residents of Long Beach over the years. Major power outages impacting the City of Long Beach in recent years have affected a large number of residents as seen below:
• July 18, 2015: The City of Long Beach experienced a power outage for three days, in what is known as the worst blackout since the 1950’s. Most residents and businesses experienced the large power outage. The power outage was due to an underground electrical fire. A manhole cover flew into the air, with pressurized flames and smoke shooting into the air along with it. The fire led to 4,800 homes and businesses losing power.

• February 20, 2021: A loss of power occurred in South Long Beach due to arcing wires touching down on some parked vehicles. Southern California Edison crews repaired the issue over several hours to de-energize the power cables. The power outage affected approximately 3,000 Long Beach residents.

The campus has also experienced power outages:

• October 20, 2020: SCE notified students that a scheduled power outage would occur over night from 8pm to 6am on October 20 and 21. Due to the Coronavirus pandemic, many classes transitioned to a remote environment and for those students who needed to remain in resident dorms, eating schedules and connectivity issues were an impact the community had to manage. Dining hours were reduced, and internet and electricity resources were unavailable.

Potential Impacts of the Hazard

Instructors, campus residents, staff and administration rely on electricity for basic operations. During a widespread power failure, it may take anywhere from several hours to days to restore operations if a significant event occurs. Electrical power is most likely the only cooling source for many individuals around the campus and its community, and long-term outages can potentially put people’s health and life at risk. Disruptions in the supply of heating fuel may put people and property at risk during extremely cold weather if it relies on electric generation or heating mechanisms instead of gas. Additionally, many medical devices, communications devices, and security rely on power to maintain their functions.

Climate Change and Energy Shortage

Climate change is expected to bring more frequent and intense natural disasters. These changes have created a variability at a rate that makes historical data a poor predictor of future climate. For example, the warmest years on record in California occurred in 2014, 2015, and 2016.

Changes in temperatures, precipitation patterns, extreme events, and sea-level rise have the potential to decrease the efficiency of thermal power plants and substations, decrease the capacity of transmission lines, render hydropower less reliable, spur an increase in electricity demand, and put energy infrastructure at risk of flooding.

With climate warming, higher costs from increased demand for cooling in the summer are expected to outweigh the decreases in heating costs in the cooler seasons. Hotter temperatures in California will mean more energy (typically measured in “cooling-
degree days”) needed to cool homes and businesses both during heat waves and on a daily basis, during the daytime peak of the diurnal temperature cycle. During future heat waves, historically cooler coastal cities (e.g., San Francisco and Los Angeles) are projected to experience greater relative increases in temperature, such that areas that never before relied on air conditioning will experience new cooling demands.

Secondary impacts of energy shortages are most often felt by vulnerable populations. For example, those who rely on electric power for life-saving medical equipment, such as respirators, are extremely vulnerable to power outages. Also, during periods of extreme heat emergencies, the elderly and the very young are more vulnerable to the loss of cooling systems requiring power sources.

Probability of Future Occurrence of the Hazard

The probability of California experiencing a power outage can be difficult to quantify but is a hazard that occurs annually during the same seasonal periods of temperature variance throughout the calendar year. Long Beach and LA county experience such outages. As such, the probability ranking for the Long Beach area is Likely; although the campus has recorded fewer events than the surrounding area, it is prudent to assign this same ranking for the campus.

Climate models suggest summer global temperatures are likely to increase while changes between temperature extremes would be more pronounced. As such, it is expected that power outages will occur more frequently in the future.

Vulnerability to the Hazard

Based on the data available, and in consideration of the increasing effects of climate change, the campus remains vulnerable to power outages in terms of impacts to people, power infrastructure and campus operations. Nonetheless, as discussed campus leadership works to reduce vulnerabilities through consistent use of safety and operational protocols and emergency power sources to ensure it is able to mitigate an interruption to electrical power.

Although the campus has specific power outage protocols in place, an outage can impact the operations of the university depending on the severity of the outage. During daytime hours, the University may remain open and business and instructional operations will remain on-going at the maximum extent possible. It will be expected that the areas surrounding the campus, including streetlights, will have also experienced a blackout.

During dark hours, staff, students and faculty are to remain on campus for fifteen minutes in the event that power returns. In the event that the power returns business and instructional operations will resume. If power is not restored, instruction will stop, and business operations will stop for the remainder of the evening.
Classes and university operations and projects utilizing hazardous materials are required to immediately stop to avoid additional hazards.

**Estimate of Potential Losses**

The data provided by Cal State Long Beach State does not report any value for potential losses due to power outage.

**Vulnerability Assessment Conclusions**

The primary concern for campus leadership is that a loss of power can lead to potential hazards to students, faculty, and staff at Channel Islands. Safety and operations protocols center on the following “direct impact” set of concerns:

Elevators, entry ways, air filtration systems and lighting provide the campus community with the necessary infrastructure and systems to function and navigate through the campus and, to maintain a safe campus environment and visibility during nighttime hours. The vulnerable population (especially students with physical disabilities) may be the most heavily affected by loss of power as they rely on elevators, entry ways with automatic doors, and locks and lights may impede on a disabled student’s ability to travel and utilize the campus and its structures safely.

The use of communication devices, billing, records, and electrical tools may also become unusable due to a loss of electricity. Many records and billing items may have to revert to “by-hand” procedures and paper copies may be needed for continuity of operations. Additionally, classrooms may not be usable if lighting equipment is not functioning impacting a semester or quarter’s progress for the academic year.

**Identified Data Limitations**

Cal State Long Beach did not report any monetary or life losses due to a power outage. Also, the campus did not report any incidents involving a power outage directly affecting the campus community and operations.
Tsunami

Description of the Hazard

A tsunami is a wave triggered by any form of land displacement along the edge or bottom of an ocean or lake. Land displacement can be in the form of submarine landslides or submarine dip-slip faults. These types of faults cause ruptures that result in seafloor uplift or down-drop. This mass movement translates to a tsunami or gravity wave within the overlying water at the surface.

Tsunamis travel radially outward from the area of initiation. The size of a tsunami is proportional to the mass that moved to generate the tsunami. As a tsunami approaches the shore and the depth of the water column decreases, the energy in the wave pushes the wave crest above the water surface resulting in a larger wave height. Wave runup is the elevation above mean sea level on dry land that a tsunami reaches. Run-up is what causes inundation of coastal areas that are below the run-up height.

There are two types of source regions for tsunamis—resulting in local and distant source tsunamis as viewed from the affected shoreline. Local tsunamis are typically more threatening because they afford at-risk populations only a few minutes to find safety. California is vulnerable to, and must consider, both types. Identifying tsunami hazards requires 1) evaluating the potential for submarine mass movement, both locally and at great ocean distances, and 2) identifying coastal regions within the direct or indirect path of a potential tsunami wave that are below the run-up height.

Tsunamis can travel at speeds of over 600 miles per hour in the open ocean and can grow to over 50 feet in height when they approach a shallow shoreline, potentially causing severe damage to coastal development. At the shoreline, tsunamis may take the form of a fast-rising tide, a cresting wave, or a bore (a large, turbulent wall-like wave). The bore phenomenon resembles a step-like change in the water level that advances rapidly (from 10 to 60 miles per hour). The first wave is usually followed by several larger and more destructive waves.

Location of the Hazard:

CSU – Long Beach is located proximate to the tsunami inundation zone. See tsunami map (below) with campus location identified within the zone. Also, see the tsunami inundation zone map for the City of Long Beach for the larger geographic range of the coastal inundation area.

Note: According to the campus planning committee, the university leases a building that it believes lies in the tsunami zone. Although not mapped, the university may verify and map the property’s location in the future, only with the permission of the owner.
Figure 12-15: Tsunami Inundation Area at CSU Long Beach
Extent of the Hazard:

The factors shaping the extent or severity of the hazard are a combination of geophysical forces (the amount of vertical and horizontal motion of the sea floor, the area over which it occurs, and the efficiency with which energy is transferred from the earth’s crust to the ocean water) and the geographic range of coastal development to be impacted.

More specifically, as a tsunami approaches the shore, wave run-up is the elevation above mean sea level on dry land that a tsunami reaches. A tsunami’s potential severity can be forecasted as a function of the wave’s mass along with the difference between the wave’s run-up height and the ground elevation of the affected coastal location.
There are two types of source regions for tsunamis—resulting in local and distant source tsunamis as viewed from the affected shoreline. Local tsunamis are typically more threatening because they afford at-risk populations only a few minutes to find safety. California is vulnerable to, and must consider, both types. Identifying tsunami hazards requires 1) evaluating the potential for submarine mass movement both locally and at great ocean distances, and 2) identifying coastal regions within the direct or indirect path of a potential tsunami wave that are below the run-up height. Given the location of the campus proximate to the tsunami inundation zone, and the potential impacts to campus operations and local transportation/evacuation routes, the campus planning committee ranks the extent of the hazard as Moderate.

History of the Hazard:

The California Seismic Safety Commission report, the Tsunami Threat to California Findings and Recommendations on Tsunami Hazards Risks, published in December 2005, indicates that over 80 tsunamis have been observed or recorded along the coast of California in the past 150 years. That said, no tsunamis have impacted CSU campus locations.

According to the National Centers for Environmental Information (NCEI), have been eight tsunamis have caused damage to ports and harbors or coastal inundation in California since 1946. The most significant events are as follows:

- In 1964, a tsunami caused by a Magnitude 9.2 earthquake offshore from Alaska resulted in 13 deaths in California and destroyed portions of downtown Crescent City.
- A 2006 tsunami (originating in the Kuril Islands region north of Japan) caused approximately $20 million in damage to Crescent City harbor.
- A 2010 tsunami (originating offshore from Chile) caused millions of dollars in damage to ports and harbors in the state.
- A tsunami in 2011 (caused by a Magnitude 9.0 earthquake offshore of Japan) killed one person at the mouth of the Klamath River and caused up to $100 million of damage to 27 ports, harbors, and marinas throughout the State. The most damage occurred in Crescent City, Santa Cruz and Moss Landing harbors and a federal disaster was declared in Del Norte, Santa Cruz, and Monterey Counties. Both Crescent City and Santa Cruz harbors sustained damage to all docks, and oil spills and water/sediment contamination that resulted from sunk or damaged boats. Because recovery efforts in these two harbors took several years to complete, both harbors incurred business/economic losses that have been difficult to recapture.

In addition, the Worldwide Tsunami Database, www.ngdc.noaa.gov) provides information on tsunami run-up levels and earthquake magnitude factors. Although data for the most recent events is not available, additional (earlier) tsunami events are recorded.

Table 12-26: Tsunami Events in California 1930-2013

<table>
<thead>
<tr>
<th>Date</th>
<th>Location</th>
<th>Maximum Run-up (m)</th>
<th>Earthquake Magnitude</th>
</tr>
</thead>
<tbody>
<tr>
<td>08/31/1930</td>
<td>Redondo Beach</td>
<td>6.1</td>
<td>5.2</td>
</tr>
<tr>
<td>08/31/1930</td>
<td>Santa Monica</td>
<td>6.1</td>
<td>5.2</td>
</tr>
<tr>
<td>08/31/1930</td>
<td>Venice</td>
<td>6.1</td>
<td>5.2</td>
</tr>
<tr>
<td>03/11/1933</td>
<td>La Jolla</td>
<td>0.1</td>
<td>6.3</td>
</tr>
<tr>
<td>03/11/1933</td>
<td>Long Beach *</td>
<td>0.1</td>
<td>6.3</td>
</tr>
<tr>
<td>08/21/1934</td>
<td>Newport Beach</td>
<td>12.0</td>
<td>Unknown</td>
</tr>
<tr>
<td>02/09/1941</td>
<td>San Diego</td>
<td>Unknown</td>
<td>6.6</td>
</tr>
<tr>
<td>10/18/1989</td>
<td>Monterey</td>
<td>0.4</td>
<td>7.1</td>
</tr>
<tr>
<td>10/18/1989</td>
<td>Moss Landing</td>
<td>1.0</td>
<td>7.1</td>
</tr>
<tr>
<td>10/18/1989</td>
<td>Santa Cruz</td>
<td>0.1</td>
<td>7.1</td>
</tr>
<tr>
<td>04/25/1992</td>
<td>Arena Cove</td>
<td>0.1</td>
<td>7.1</td>
</tr>
<tr>
<td>04/25/1992</td>
<td>Monterey</td>
<td>0.1</td>
<td>7.1</td>
</tr>
<tr>
<td>09/01/1994</td>
<td>Crescent City</td>
<td>0.1</td>
<td>7.1</td>
</tr>
<tr>
<td>11/04/2000</td>
<td>Point Arguello</td>
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<td>Unknown</td>
</tr>
<tr>
<td>06/15/2005</td>
<td>N. California</td>
<td>0.1</td>
<td>7.2</td>
</tr>
</tbody>
</table>

* The City of Long Beach has not been impacted by a tsunami previously, according to the 2016 City of Long Beach Hazard Mitigation Plan. That said, a tsunami event is recorded (above) in 1933, though the run-up height of 0.1 meters or 4 inches, so it is understandable that no event was observed on the ground.

Potential Impacts of the Hazard:

Tsunamis can travel at speeds of over 600 miles per hour in the open ocean and can grow to over 50 feet in height when they approach a shallow shoreline, potentially causing total devastation to coastal development.

The configuration of the coastline, the shape of the ocean floor, and the characteristics of advancing waves play important roles in the destructiveness of the waves. Bays, sounds, inlets, rivers, streams, offshore canyons, islands, and flood control channels
may cause various effects that alter the level of damage. Offshore canyons can focus tsunami wave energy, and islands can filter the energy. It has been estimated that a tsunami wave entering a flood control channel could reach a mile or more inland, especially if it enters at high tide. The orientation of the coastline determines whether the waves strike head-on or are refracted from other parts of the coastline.

Potential impacts to the campus of the CSU – Chancellor’s Office in Long Beach include destruction of campus buildings and infrastructure, destruction of the natural environment, destruction of boats and coastal development, and loss of life in the area surrounding the campus. Tsunamis that impact both harbors and communities also can produce free-floating debris hazards and environmental contamination from chemical spills.

Probability of Future Occurrence of the Hazard:

The California Seismic Safety Commission report, the Tsunami Threat to California Findings and Recommendations on Tsunami Hazards Risks, published in December 2005, indicates that over 80 tsunamis have been observed or recorded along the coast of California in the past 150 years.72 If we consider historical occurrence as one data set for estimating future events, the average rate of occurrence over the past 150 years is 1 tsunami every 1.9 years statewide. Currently, no analysis is available which differentiates this statewide probability specifically for Long Beach, CA. Although 1 event is registered for Long Beach and 6 events for the Southern CA region, it is prudent to utilize the 1.9-year recurrence interval for planning purposes given extreme difficulties predicting tsunami points of origin.

That said, the rate of future occurrence may change and may be able to make target estimates for specific locations in the future; the California State Tsunami Program is trying to refine the accuracy of the data. In doing so, the State Tsunami Program is completing a set of Probabilistic Tsunami Hazard Analysis (PTHA) maps representing risk levels from 100-year to 3000-year average return periods. Analysis using these probabilistically based products will allow for a more common platform for comparison to other seismic and flood probabilistic analyses. 73

Vulnerability to the Hazard:

With regard to CSU campus locations, direct vulnerability of assets and people to tsunami only applies to the CSU Chancellor’s Office in Long Beach, CA, as this is the only campus located in a mapped tsunami zone. (Note: See section X for the Chancellor’s Office campus assets/tsunami zone mapping).


73 2018 State of California Hazard Mitigation Plan
Regarding the vulnerabilities for the CSU - Long Beach campus location, while it is not modeled to be at risk of direct impact from tsunami inundation, it lies adjacent to the inundation zone to the west and south of its facilities. The zone’s greatest vulnerabilities are properties located near Oceanfront and the Port of Long Beach. Tsunami “maximum run-up” projections were modeled by the University of Southern California and distributed by the California Office of Emergency Services for the purposes of identifying tsunami hazards. The tsunami model was the result of a combination of inundation modeling and onsite surveys and determined the maximum projected inundation levels from tsunamis along the entire coast of Los Angeles County. Given that inundation modeling changes over time and is not able to predict real world outcomes with 100% accuracy, it is conceivable that an actual worst case tsunami event could impact the campus.

The maximum run-up for is approximately 42 feet. This means that based on the worst-case scenario tsunami, the displaced water level would be approximately 42 feet above the normal tide for that day and time. As such, given that the campus is located close to the inundation zone, students, staff and visitors may be unable to evacuate with proper lead-time.  

Vulnerability of Populations

The populations most vulnerable to the tsunami hazard are the elderly, disabled and very young who reside near beaches, low-lying coastal areas, tidal flats and river deltas that empty into ocean going waters. In the event of a local tsunami generated near the coast, little warning time would exist, so more of the population would be vulnerable. While direct impacts to campus staff and students are not projected, the city’s evacuation capability could be exceeded by a worst-case event.

Property Vulnerability

While campus property is not directly vulnerable, the impact of tsunami waves and the scouring associated with debris that may be carried in the water could be damaging to surrounding structures. The most vulnerable structures are those in the front line of tsunami impact and those that are structurally unsound. According to the 2018 State of California Hazard Mitigation Plan, Long Beach exhibits among the state’s highest number and density of businesses located in the tsunami zone.

Critical Facilities and Infrastructure Vulnerabilities

While CSU – Long Beach is not projected to sustain direct impacts to infrastructure, the following (proximate) infrastructure is vulnerable to direct damage which could affect the campus:

74 2016 City of Long Beach Hazard Mitigation Plan.
Water Proximate Infrastructure—Breakwaters and piers collapse, sometimes because of scouring actions that sweep away their foundation material and sometimes because of the sheer impact of the tsunami waves.

Flood Control Systems—Floodwaters can back up drainage systems, causing localized flooding. Culverts can be blocked by debris from tsunami events, also causing localized urban flooding.

Utility Systems—Floodwaters can get into drinking water supplies, causing contamination. Sewer systems can be backed up, causing waste to spill into homes, neighborhoods, rivers and streams. Tsunami waves can knock down power lines and radio/cellular communication towers. Power generation facilities can be severely impacted by wave action and by inundation from floodwater.

Fuels—Destruction of fueling infrastructure and related environmental and potable water contamination can occur. In Humboldt County, the Chevron terminal is located in the tsunami inundation zone on Humboldt Bay and receives most of the vehicle fuel for the county by barge.

Estimate of Potential Losses

Estimates of potential losses specific to CSU campuses have not been conducted yet. In addition, no estimated loss data is currently available for the City of Long Beach, although the local mitigation plan indicates concern for losses related to fires from damaged ships in ports or from ruptured coastal oil storage tanks and refinery facilities in the port area. That said, according to the State plan, technological improvements have been made in the ability to estimate losses from tsunami impacts which can be brought to bear on loss estimation for CSU campuses in the future.

Vulnerability Assessment Conclusions:

According to the 2018 State of California Hazard Mitigation Plan, community exposure to tsunamis in California varies considerably—some communities may experience great losses that reflect only a small part of their community and others may experience relatively small losses that devastate them. Among the 94 incorporated communities and 83 unincorporated areas of the 20 coastal counties, the communities of Alameda, Oakland, Long Beach, Los Angeles, Huntington Beach, and San Diego have the highest number of people and businesses in the tsunami inundation zone.75

For improving assessments of vulnerability, FEMA has developed a new tsunami loss estimation module for HAZUS using existing numerical model results for tsunami inundation, flow depth, velocity, and force. This HAZUS module allows new capability for estimation of economic losses, and site-specific analysis of content losses,

casualties, infrastructure damage, and evacuation time. The module calibrates losses based on safe zones and community preparedness levels. Such technological improvements in assessment capability can be utilized for tsunami hazard analysis and planning purposes for the CSU Chancellor’s Office.

Along with new probability-based tsunami maps, the HAZUS module will improve the ability to compare tsunami impacts to those of other hazards. Moreover, the probability mapping will be used for numerous applications including identifying potential tsunami hazard “zones of required investigation” under the Seismic Hazards Mapping Act and will assist state and local agencies in making land use planning decisions. They will also help regional and state planners understand the flood potential from tsunamis representing different risk levels. The improved analysis and data will be utilized by the SU Chancellor’s Office through its partnerships with key stakeholder organizations.76

Identified Data Limitations:

As identified in the vulnerability conclusions (above), with regard to the current planning effort, the primary data limitations for assessing the tsunami hazard for CSU campuses mostly pertain to a complete set of valuations for the assets of the Chancellor’s Office campus lying within the tsunami inundation zone. In addition, the CSU system-wide effort would benefit from FEMA’s new probability mapping techniques and tsunami loss estimation module to the footprint of those campuses proximate to the inundation zone to ensure that the current “not at risk of direct impact” to staff, students and physical assets still holds true. That said, CSU leadership and planning teams intends to pursue such data in the future.

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**Volcano (Associated Air Quality)**

Description of the Hazard

The US Geological Service defines volcanoes as “openings or vents where lava, tephra (small rocks), and steam erupt on to the Earth’s surface. Through a series of cracks within and beneath the volcano, the vent connects to one or more linked storage areas of molten or partially molten rock (magma). This connection to fresh magma allows the volcano to erupt over and over again in the same location.”77

A volcanic eruption occurs when magma, lighter than surrounding rock, is driven upwards by its buoyancy and by pressure from the dissolved gases contained within

76 2018 State of California Hazard Mitigation Plan

it. Gases are released from magma as it reaches the surface and pressure decreases. Magma can be erupted in several ways and violent eruptions typically cause tiny pieces of tephra (ash) to be carried away by the wind. This ash is hard, does not dissolve in water, is extremely abrasive and mildly corrosive, and conducts electricity when wet. The gases released in an eruption include carbon dioxide, sulfur dioxide, hydrogen sulfide, and hydrogen halides. Depending on their concentration, these are potentially hazardous to people, animals, agriculture, and property.

Location of the Hazard

There are eight volcanic areas located throughout California. Seven of these - Medicine Lake Volcano, Mount Shasta, Lassen Volcanic Center, Clear Lake Volcanic Field, Long Valley Volcanic Region, Coso Volcanic Field, and Salton Buttes – are considered active volcanoes. No portion of CSU Long Beach or Los Angeles County is located within a volcano hazard zone.

Extent of the Hazard

Volcanic hazards are most severe within a few miles of the volcano vent and the severity generally decreases with distance. Ash impact zones can range from tens to hundreds of miles from the vent source. The US Geological Survey has estimated zones surrounding active volcanoes wherein 2 inches or more of ashfall following an eruption is possible. While CSU Long Beach does not fall within an estimated ashfall zone, lighter dustings of ash outside of those areas may directly or indirectly impact the campus. As such, the planning committee ranks the extent of the hazard for the campus as Low.

History of the Hazard

No historical eruption events in California have affected the campus. Over the last 1,000 years, there have been at least 12 eruptions in California. The most recent volcanic eruption in California occurred at Lassen Peak about 100 years ago, when a major explosion delivered windborne ash over 275 miles away.

Potential Impacts of the Hazard

The specific impacts vary widely and depend on which type of volcano erupts, the style of explosion, the volume of lava, the eruption duration, and the local water conditions. As CSU Long Beach is not proximal to an active volcano, only the potential impacts of ashfall and gases have been detailed. While both these hazards can be widespread, their most severe impacts are generally seen closer to the volcanic source.

Although ashfall is typically a nonlethal volcanic hazard, it is the most widespread and disruptive. Falling ash can damage crops, electronics, and machinery. It can also impact human health by irritating the respiratory tract, eyes, and skin. The particles may enter drinking water and structures and may cause structure failure if it is thick and heavy enough. Even a fine layer of ash can disrupt utilities. A portion of California’s major electric transmission lines, aerial telecommunication lifelines, transportation corridors, and water storage and conveyance lie within the state’s volcano hazard zones. Impacts to any of these can impact operations at CSU Long Beach.

The potential impacts of gases released during volcanic eruptions are as follows:

- Carbon dioxide typically becomes diluted very quickly and is not life threatening. However, it can become trapped in higher concentrations in low-lying areas and has the potential to be fatal.
- Sulfur dioxide can cause acid rain and air pollution downwind of a volcano.
- Hydrogen sulfide can cause irritation of the upper respiratory tract. At high concentrations it can cause unconsciousness and death.
- Hydrogen halides can coat ash particles and, once deposited, poison drinking water, agricultural crops, and grazing land.

Probability of Future Occurrence of the Hazard

The US Geological Survey, based on the record of volcanic activity in California, estimates that the probability of another small- to moderate-sized eruption in the next thirty years is about 16 percent. As such, the annual probability of future occurrence for the campus is ranked by the committee as Unlikely.

Vulnerability to the Hazard

Populations living near volcanoes are the most vulnerable to eruptions and lava flows. However, volcanic ash can travel and affect populations miles away. The location and thickness of ash in any given area is a function of the severity of the eruption and wind speed and direction. For CSU Long Beach, there is low vulnerability to the immediate impacts of volcanic eruptions due to the limited area affected and remote potential of an eruption. In the event of a widespread ashfall event, the elderly, infants, and populations with existing respiratory disease will be at higher risk.

Estimate of Potential Losses

Impacts to critical infrastructure, agriculture, and property from ashfall have the potential to cause widespread disruption, damage, and economic loss throughout the state. In the event of a widespread ashfall event, impacts will be immediate.

Current modeling is not precise enough to allow for an assessment of potential losses from ashfall to structures or infrastructure on or surrounding the campus.
Vulnerability Assessment Conclusions

CSU Long Beach is unlikely to experience the direct impacts of a volcanic event. While the campus may be indirectly impacted by ashfall elsewhere in the state, direct ashfall impacts are generally unlikely but possible in a widespread event. However, the likelihood of any volcanic eruption in the state impacting the campus is very low.

Identified Data Limitations

Not all active volcanoes in California have been zoned for hazards by the US Geological Survey. This, together with the infrequent occurrence of volcanic explosions and number of factors determining type and extent of impacts, make the quantification of potential loss difficult.

Wildfire

Description of the Hazard

While wildfires are a natural part of California’s ecosystem, wildfires in California represent a hazard that presents one of the greatest probabilities of destruction along with a demonstrated history of catastrophic fire events in recent years. The destructive fire seasons of 2017 to 2020 illustrated the destructive forces fire presents to communities across the state. Wildfires may result in the structural loss, infrastructure loss, dangerous air quality, environmental damages, economic impacts, injuries, and loss of life. In many communities throughout California, wildfire presents greatest risk to human life and property.

Wildfires have been defined as any free burning vegetation fire that initiates from an unplanned ignition, whether natural or human caused demanding fire suppression actions to contain. These fires are prone to become uncontrolled, spreading through vegetative fuels rapidly exposing people and structures to harm. Wildfires present a significant risk to communities across the state, as evidenced by increasing trends of structural losses from wildland fires. This risk is elevated in areas where development and community growth has intersected, also known as the wildland-urban interface (WUI). In the interface setting, development itself can provide additional fuel for large fires. Recent fires have also demonstrated the ability of fire to consume populated areas in extreme conditions.

California’s Mediterranean climate in combination with its geography and vast population create a combination of factors that promotes an optimal environment for large fire growth and consequences. As there is great diversity of geographic characteristics across the state, the risks and potential consequences of wildfire must be assessed locally. The physical location, weather patterns, local fuel types and

volume, extent of the WUI, topography, and additional factors will factor differently from part of the state to another.

The behavior of wildfires in California is significantly influenced by three distinct geographic factors. These factors will help shape the size, direction of spread, rate of combustion, fire intensity, and ability to pre-heat fuels. The physical factors contributing to wildfire behavior include:

- **Topography** – The rate in which wildfires spread increases with greater slopes in topography. The greater the slope will result in more pre-heating of fuel above the advancing fire. The direction that a slope faces will also influence fire behavior as south facing slopes receive greater solar radiation and thus drier vegetation that is more susceptible to combustion. Ridgetops often denote the end of fire spread as fire has greater difficulty spreading downhill.

- **Weather** – Weather factors substantially influence the behavior of wildfires. Wind, temperature, humidity, lightning, and lack of precipitation all contribute to a fire's ability or inability to spread and intensify. California routinely experiences conditions in which these factors are in alignment to contribute to extreme fire behavior during the summer and fall seasons. High winds, low humidity, and high temperatures provide an environment promoting extreme fire activity.

- **Fuels** – Certain types of vegetation are increasingly prone to igniting and promote more intense burning. Areas with greater “fuel loading” (amount of fuel present in terms of weight of fuel per unit of area) increases the amount of fuel to fuel a fire. Greater volumes of dead or dry vegetation compared to live plants is a critical factor. Vegetation during drought conditions will experience a decrease in moisture content increasing the conditions for combustion. Fuels close proximity to one another allows for rapid spread through contact or radiant exposures.

A risk assessment for wildfires should be implemented within a geospatial context focusing on the specific location features and incorporates the three components of the wildfire risk triangle – likelihood, intensity, and susceptibility.

**Location of the Hazard**

Substantial portions of the State of California are exceptionally vulnerable to wildfire activity or reside in a wildland-urban interface (WUI) area due to the vast open spaces, rangelands, forests and other lands with high susceptibility to fire occurring throughout the state. CSU Long Beach and the City of Long Beach are located in the southern end of the Los Angeles Basin along the coast. This area near the university is dominated by urban and suburban communities with limited direct exposures to wildland fire. CSU Long Beach has extensive residential neighborhoods surrounding the campus. Industrial land uses are located to the southeast of the campus.
The CSU Long Beach campus is located in the eastern side of Long Beach near the border of Orange County. The campus is 12 miles east of the closest area designated as having a high fire hazard in the Palos Verdes Peninsula where there is a mix of residential neighborhoods and hillsides with moderate vegetative fuels. The campus is not located next to areas with a fire hazard potential making direct impacts by fire on the campus unlikely.

However, the CSU Long Beach campus is surrounded by mountains and extensive areas of fire hazards further away. Surrounding the Los Angeles Basin are large mountain ranges including the San Gabriel, San Bernardino, and Santa Ana Mountains. These mountain ranges host three national forests with extensive history of large fire development. The fires that burn in these areas have the potential to develop vast quantities of smoke that can fill the basin in the right wind conditions. The geography of the Los Angeles Basin and San Gabriel, San Fernando, and San Bernardino valleys creates a topography that captures air pollutants including smoke within surrounding mountains and the development of inversion layers. The CSU Long Beach campus is located in a region in which wildfire smoke can saturate the air around the campus.

Figure 12-17: Fire Hazard Severity Zones\textsuperscript{80}

Extent of the Hazard

While the threat of fire directly affecting the campus is minimal, the direct effect of fire generated smoke has occurred on campus and might occur in the future. Fires are likely to occur in areas close enough to the campus that generate substantial amounts of smoke that could envelop the campus in the right atmospheric conditions. Fires that are large enough to generate volumes of smoke to cover great distances have the potential to affect the air quality of the Los Angeles County area including the campus. This will especially be the case in weather conditions creating strong offshore winds. The potential for this impact has been demonstrated during the summers of 2018, 2019, and 2020 as fires burned across the state and spread smoke over vast distances. Fires burning outside of the Los Angeles County region have the potential to distribute smoke onto the CSU Long Beach campus.

Given that the area immediately surrounding the CSU Long Beach campus is not in proximity to fire hazard zones designated as a High Fire Hazard Severity Zones, and the campus does not have a history of wildfire activity occurring within proximity to
the campus, it nevertheless has experienced impacts to air quality from smoke. Therefore, the planning committee ranks the extent of the hazard as Low to **Moderate**.

The National Fire Danger Rating System (NFDRS) is the current system in use for rating and classifying the potential danger of fire. The NFDRS tracks the effects of previous weather events on both dead and live fuel loads and adjusts accordingly based on future or predicted weather conditions. These complex relationships and equations are computed, and the outputs are expressed in terms that users can quickly and easily understand. The current NFDRS is used by all federal and most state agencies to assess fire danger conditions.

The following table depicts the NFDRS, from the US Forest Service’s Wildland Fire Assessment System.

Table 12-27: National Fire Danger Rating System

<table>
<thead>
<tr>
<th>Rating</th>
<th>Basic Description</th>
<th>Detailed Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>CLASS 1: Low Danger (L)</td>
<td>Fires not easily started</td>
<td>Fuels do not ignite readily from small firebrands. Fires in open or cured grassland may burn freely a few hours after rain, but wood fires spread slowly by creeping or smoldering and burn in irregular fingers. There is little danger of spotting.</td>
</tr>
<tr>
<td>COLOR CODE: Green</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CLASS 2: Moderate Danger (M)</td>
<td>Fires start easily and spread at a moderate rate</td>
<td>Fires can start from most accidental causes. Fires in open cured grassland will burn briskly and spread rapidly on windy days. Woods fires spread slowly to moderately fast. The average fire is of moderate intensity, although heavy concentrations of fuel – especially draped fuel -- may burn hot. Short-distance spotting may occur but is not persistent. Fires are not likely to become serious and control is relatively easy.</td>
</tr>
<tr>
<td>COLOR CODE: Blue</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CLASS 3: High Danger (H)</td>
<td>Fires start easily and spread at a rapid rate</td>
<td>All fine dead fuels ignite readily, and fires start easily from most causes. Unattended brush and campfires are likely to escape. Fires spread rapidly and short-distance spotting is common. High intensity burning may develop on slopes or in concentrations of fine fuel. Fires may become serious and their control difficult, unless they are hit hard and fast while small.</td>
</tr>
<tr>
<td>COLOR CODE: Yellow</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>CLASS 4: Very High Danger (VH)</th>
<th>Fires start very easily and spread at a very fast rate. Fires start easily from all causes and immediately after ignition, spread rapidly and increase quickly in intensity. Spot fires are a constant danger. Fires burning in light fuels may quickly develop high-intensity characteristics - such as long-distance spotting - and fire whirlwinds when they burn into heavier fuels. Direct attack at the head of such fires is rarely possible after they have been burning more than a few minutes.</th>
</tr>
</thead>
<tbody>
<tr>
<td>COLOR CODE: Orange</td>
<td></td>
</tr>
<tr>
<td>CLASS 5: Extreme (E)</td>
<td>Fire situation is explosive and can result in extensive property damage. Fires under extreme conditions start quickly, spread furiously, and burn intensely. All fires are potentially serious. Development into high intensity burning will usually be faster and occur from smaller fires than in the Very High Danger class (4). Direct attack is rarely possible and may be dangerous, except immediately after ignition. Fires that develop headway in heavy slash or in conifer stands may be unmanageable while the extreme burning condition lasts. Under these conditions, the only effective and safe control action is on the flanks, until the weather changes or the fuel supply lessens.</td>
</tr>
<tr>
<td>COLOR CODE: Red</td>
<td></td>
</tr>
</tbody>
</table>

Agencies across the nation have adopted the use of the Air Quality Index (AQI) to communicate and provide a consistent approach to air quality measurements and categorization. The AQI primarily focuses on the health effects caused by pollutants in the air such as smoke.

The goal of the AQI is to provide advisories to assist the public in determining when to reduce exposures to inhalation of air pollution as pollution levels rise.
History of the Hazard

The State of California has a long history of chronic and destructive wildfires throughout the state. On average, 8,300 wildfires have caused burnt 928,245 acres across the state over the 20-year period between 2000 and 2020. Los Angeles County also has a long history of wildfire activity primarily in the foothills and mountains of the San Gabriel and Santa Monica Mountains. Wildfires occurring in Los Angeles County have resulted in hundreds of thousands of acres burned and hundreds of millions of dollars in damages.

The area immediately surrounding the CSU Long Beach campus is not in proximity to fire hazard zones designated as a High Fire Hazard Severity Zones. The campus does not have a history of wildfire activity occurring within proximity to the campus. However, the County is surrounded by areas that are considered to be of high fire threat that would produce vast quantities of smoke and particulates into the air. The Long Beach campus has experienced multiple days of poor air quality due to fires burning in Los Angeles, Orange, Riverside, and San Bernardino Counties. The 2017, 2018, and 2020 fire seasons in particular illustrated the increase in wildfire generated smoke saturating the air of communities throughout the state including Los Angeles County. CSU Long Beach personnel reported the ongoing development of policies and procedures to address the response to poor air quality days.

83 California Department of Forestry and Fire Protection, Stats and Events, https://www.fire.ca.gov/stats-events/
Table 12-28: Historic Large-Scale Fires Near CSU Long Beach\textsuperscript{84}

<table>
<thead>
<tr>
<th>Date</th>
<th>Fire</th>
<th>Location</th>
<th>Declaration</th>
<th>Damages</th>
</tr>
</thead>
<tbody>
<tr>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
</tr>
</tbody>
</table>

**Potential Impacts of the Hazard**

The location of the CSU Long Beach campus surrounded by areas of urban development removed from areas with a fire hazard places a minimal direct threat from wildfire to the campus. The potential impacts to wildfire exist with members of the campus community who reside or work in these fire hazard zones.

Potential impacts to the campus community resulting from wildfires include:

- Injuries or loss of life
- Campus property destruction or damage
- Residential property destruction or damage
- Commercial property destruction or damage
- Loss of property contents
- Infrastructure damage
- Damaged or destroyed lifelines/supply routes
- Damaged or destroyed utilities
- Damaged or destroyed critical facilities supporting campus emergency support needs
- Loss of community economic base
- Employment losses
- Loss to ground supporting vegetation on hillsides resulting in erosion or landslides in future precipitation events
- Agricultural (crops and livestock) damages or destruction
- Environmental damage
- Societal and community impacts
- Damage to organizations and facilities providing support services to vulnerable populations
- Greater evacuation challenges for those most vulnerable

\textsuperscript{84} 2019 Los Angeles County All-Hazards Mitigation Plan, 2019
Psychological impacts of impacted populations
Disruptions to education delivery to community

Potential impacts resulting from wildfire generated smoke include:

- Dangerous levels of air pollution
- Human Health Effects
  - Similar health impacts to pets
- Air conditioning systems overwhelmed
- Greater demands on air filtration systems
- Greater demands on healthcare systems
- Reduced outdoor work productivity
- Closures of academic sessions

Additionally, there remains a number of secondary impacts from wildfires that could affect the campus community. Utilities feeding areas of Los Angeles County including the campus may be damaged resulting in power outages. Fire related damage in the watersheds will likely cause future landslides, degradation to plants supporting hillsides, and impact the hydroelectric power capabilities. Fires may present threats to areas of recreation, scenic value, and wildlife that are a part of the culture of the campus community.

Probability of Future Occurrence of the Hazard

Based on the minimal wildfire threat potential in the area surrounding the CSU Long Beach campus, including the distance to Fire Hazard Severity Zones and density of residential and commercial development, the probability of wildfire related damage is considered Unlikely.

Based on the wildfire threat potential in the area surrounding Southern California including the hills and mountains throughout the region, the volume of areas in elevated Fire Hazard Severity Zones throughout the southern portions of the state, and the historic occurrences of smoke, the probability of wildfire generated smoke impacts to air quality is considered Possible.

Vulnerability to the Hazard

The CSU Long Beach campus is not likely to be subject to direct impact from wildfire due to the campus location in an urban/suburban area of Long Beach. The vulnerabilities to the effects of wildfire would largely lie within the campus community who may reside or work in locations that are exposed to the Fire Hazard Severity Zones outside of Long Beach. Wildfires occurring in other areas of the region may result in the displacement of large numbers of people. These effects may spill onto the campus in the form of evacuees or facility support to emergency resources.
Fire directly threatening the campus would likely take the form of localized fires involving single structures or small areas. Smaller vegetation fires are possible surrounding the campus in the urban forest or fields surrounding the city. These incidents would likely have little impact to the campus.

The primary basis of vulnerability is based on the population affected and the built environment exposed. In general, newer construction will be more fire resistant than older buildings as building and fire codes and construction technology have improved. Density of buildings and proximity of fuels to buildings or equipment at risk of combustion would additionally influence the fire’s ability to spread to structures.

Some areas of particular vulnerability on the campus include:

- Students and staff engaging in outdoor activities when the air is determined to be unhealthy are vulnerable to adverse health effects.
- Buildings with ineffective HVAC or do not have HVAC will cause limitations in filtering of air during smoke filled days
- Power outages or brownouts during days with high levels of smoke will limit shelter in place options during heat events in summer.
- Santa Ana wind events may push large volumes of smoke into the Los Angeles Basin

The greater concerns regarding vulnerabilities to wildfire on CSU Long Beach are related to the smoke that fires in the area would produce. The recent summer seasons have clearly demonstrated the reality of large wildfires producing enough smoke to fill the Los Angeles Basin even from substantial distances away. These recent fires have displayed how the effects of this smoke impact the general population and especially vulnerable populations. CSU Long Beach students, faculty, and staff both on campus and off campus face these same vulnerabilities related to smoke filled air.

Individuals with existing health problems such as respiratory or cardiac illnesses are increasingly vulnerable to wildfire generated smoke. Staff who work in roles requiring outdoor activity will be increasingly exposed during days where the air quality index is considered unhealthy or worse. Student athletes participating in outdoor sports and engaging in aerobic activities are increasingly vulnerable to the effects of wildfire which will vary depending on when the air quality were to reach unhealthy levels. The risk to the campus population will be lessened during periods when classes are not in session or during periods of breaks. Conversely, during the days and hours that classes are in session and staff are at their workplaces, the human vulnerability increases. However, in region-wide events this vulnerability may be shared with the homes and workplaces of members of the campus community and their families.

Vulnerable populations will likely face disproportionate health safety issues from smoke filled air, experience increased stresses, may require the need to remain away from the campus enclosed at home, and may find difficulty in accessing equipment or supplies to aid in a specific need.
Estimate of Potential Losses

Estimates of potential losses will be influenced by a variety of factors. Costs would also be likely to include mitigation or repairs of HVAC systems, sealing of doors and windows, and other methods of keeping smoke from entering buildings. Secondary costs would include lost academic days during campus closures, lost staff on campus productivity, and health and medical interventions for affected members of the campus community.

Based on estimate replacement costs of facilities and structures on campus, the maximum total replacement costs due to wildfire are $453,426,848. Due to the lack of a complete inventory of building and facility costs, the total replacement estimate is likely much higher. However, the location of the campus in an urban/suburban setting removed from hazard prone areas makes wildfire related damages unlikely.

Table 12-29: Wildfire Hazard Potential (WHP) Zone Estimated Losses

<table>
<thead>
<tr>
<th>WHP Zone</th>
<th>No of Buildings</th>
<th>Maximum Replacement Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Extreme</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Very High</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>High</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Moderate</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Low</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Very Low</td>
<td>4</td>
<td>Unknown</td>
</tr>
<tr>
<td>Non-Burnable</td>
<td>87</td>
<td>$453,426,848</td>
</tr>
<tr>
<td>No Building Value Data Provided*</td>
<td>28</td>
<td>Unknown</td>
</tr>
</tbody>
</table>

*Buildings with no value defined are also included in the respective Zones they are found in.

The CSU Long Beach Lancaster University Center in Lancaster, CA is included in the non-burnable category. This location is within the developed desert community of Lancaster. The Southern California Marine Institute, located in San Pedro is included in the non-burnable category. This facility is located on Terminal Island in the Port of Los Angeles.

Vulnerability Assessment Conclusions

The occurrence of wildfires has been a frequent event in Los Angeles County; however, wildfire incidents do not pose a direct risk to the CSU Long Beach campus. The location of the CSU Long Beach campus surrounded by densely developed
residential, commercial, and industrial land uses mitigates any vulnerabilities of wildfire hazards to the campus community or facilities.

Communities located within or near the Wildland Urban Interface may be subject to damaging fires. These same communities may be home to members of the campus community. The students, faculty, and staff of CSU Long Beach who live or work in these hazard areas may experience vulnerabilities to the direct exposure to wildfire not likely at the campus. These effects may create tremendous challenges that could impact their ability to maintain engagement with university academic or professional activities. The potential for large-scale wildfires in the region further generates the added potential for a number of cascading effects such as disruptions to the local economy, utility failures, disruptions to providing for the needs of the community, and development of public health hazards.

Additionally, the topography of Southern California surrounded by mountains allows for smoke filled air to linger in the valleys of the Los Angeles Basin with the potential for unhealthy air quality depending on wind conditions. Fires in surrounding mountains generating tremendous quantities of smoke present tremendous health related vulnerabilities to members of the campus community. The campus community exposed to these unhealthy air conditions are vulnerable to a variety of potential health related effects.

**Identified Data Limitations**

Missing campus structural replacement costs and an inventory of building construction types to include status of earthquake retrofitting. HAZUS generated analysis is focused on the broader community level versus finetuning the analysis to the micro-level for facilities such as a university campus.

**Severe Weather (Wind, Tornado, Hail, and Lightning)**

**Description of the Hazard**

Severe weather can be described as a variety of weather or climate events that are beyond or near the ends of the range of observed weather patterns and behavior. These events can include high or extreme winds, storms, lightning, hail, tornadoes, heat waves, unusually cold temperatures, extreme rainfall, and flooding. According to the Intergovernmental Panel on Climate Change (IPCC), to be classified as severe (or extreme), the occurrence of each value of a climate or weather variable (e.g., wind, heat, rainfall)
hail, lightning, tornado, etc.) must be “above (or below) a threshold value near the upper (or lower) ends of the range of observed values of the variable.”

Severe weather in California can be generated by local, regional, and/or global weather and climate influences. From the individual thunderstorm to the Santa Ana wind event to the strong El Niño, damaging weather elements that are produced by and accompany severe weather and climate phenomena (e.g., damaging winds, hail, lightning, and tornadoes) occur throughout California and the California State University (CSU) system.

Global Scale Influences on Severe Weather in California: El Niño, La Niña, and ENSO

The El Niño-Southern Oscillation (ENSO) is a recurring climate pattern involving changes in the temperature of waters in the central and eastern tropical Pacific Ocean. On periods ranging from about three (3) to seven (7) years, the surface waters across a large swath of the tropical Pacific Ocean warm or cool by anywhere from 1°C to 3°C, compared to normal. This oscillating warming and cooling pattern, referred to as the ENSO cycle, directly affects rainfall distribution in the tropics and can have a strong influence on weather across the United States and other parts of the world.

El Niño and La Niña are extreme phases of the ENSO cycle, with a third phase occurring between them called the Neutral phase. The El Niño phase is characterized by unusually warm ocean temperatures and weaker-than-normal east winds in the Equatorial Pacific, while the La Niña phase is characterized by unusually cold ocean temperatures and stronger-than-normal east winds in the Equatorial Pacific. Both extreme ENSO phases lead to significant differences from the average ocean temperatures, winds, surface pressure, and rainfall across parts of the tropical Pacific. The Neutral phase indicates that conditions are near their long-term average.


87 Retrieved on 07.18.2021 from https://www.weather.gov/mhx/ensowhat


89 Retrieved on 07.17.2021 from https://www.climate.gov/news-features/understanding-climate/el-ni%C3%B1o-and-la-ni%C3%B1a-frequently-asked-questions
The extreme ENSO phases affect the frequency and intensity of weather events across the world, including in California. On average, areas across California experience exceptionally stormy winters with increased precipitation under El Niño conditions, but experience less stormy and drier winters under La Niña conditions. This variability in storminess and precipitation brought on by El Niño and La Niña events affects the both the frequency and intensity of severe weather conditions experienced by all CSU campuses, including CSU Long Beach.

Regional Climate Influences on Severe Weather across California

Most of the weather in California is influenced by the wet-winter/dry-summer Mediterranean climate pattern. In the summer months, Pacific storm tracks are deflected north due to the position of the Pacific High (i.e., a large-scale atmospheric circulation over the Northeast Pacific Ocean), preventing Pacific storms from reaching California. As a result, most summer storms are generated due to the incursion of moist air from the Gulf of Mexico or the Gulf of California, and occur as scattered, locally heavy showers in the desert and mountain regions of the state. In the winter months, the Pacific High decreases in intensity and moves south, permitting powerful Pacific storms to move into and across the state; these storms can produce extreme winds, heavy rains (including “atmospheric river” events), and widespread coastal and inland flooding. (Please see the Flood Hazard profile in this document for information on Floods.) As a result, storm events accompanied by precipitation in California are far more frequent in the winter months than they are in the summer months.

While the Mediterranean climate pattern influences the seasonal frequency, intensity, geographic spread, and type of some severe weather events CSU campuses experience (including CSU Long Beach), other severe weather phenomena may occur in California at any time of the year. For example, near the coast and over the Central Valley, there appears to be no defined seasonality to thunderstorms, and these storms are usually light and infrequent. Thunderstorms are more intense and more frequent in the intermediate and higher elevations of the Sierra Nevada, and occur with greater frequency during the summer months.

Types of Storms in California

The 2018 California State Hazard Mitigation Plan (SHMP) defines a storm as a violent atmospheric disturbance occurring over land and/or water that is distinguished by its

90 Retrieved on 07.16.2021 from https://www.pmel.noaa.gov/elnino/what-is-el-nino
92 Retrieved on 07.17.2021 from https://wrcc.dri.edu/Climate/narrative_ca.php
93 Retrieved on 07.17.2021 from https://wrcc.dri.edu/Climate/narrative_ca.php
strength, characteristics, and the scale of the resulting damage. The SHMP also lists the following types of storms that produce hazardous conditions and potential damage throughout the state of California. These storms affect (in varying degrees) all CSU campuses, including CSU Long Beach.

- **Thunderstorm**: A rain-bearing cloud that also produces lightning. Thunderstorms can produce some of nature’s most destructive and deadly weather including tornadoes, hail, strong winds, lightning and flooding. Thunderstorms are caused by an atmospheric imbalance from warm unstable air rising rapidly into the atmosphere. Lightning, which occurs during all thunderstorms, can strike anywhere. Thunderstorms can produce some of nature’s most destructive and deadly weather including tornadoes, hail, strong winds, lightning and flooding. *Severe thunderstorms* are more intense, violent, and dangerous thunderstorms. The National Oceanic and Atmospheric Administration (NOAA) defines a severe thunderstorm as any storm that produces one or more of the following elements: Damaging winds or speeds of 58 mph (50 knots) or greater, hail 1 inch in diameter or larger, and/or a tornado.

- **Hailstorm**: a type of storm that precipitates round chunks of ice. Hailstorms usually occur during regular thunderstorms.

- **Wind storm**: marked by high wind with little or no precipitation.
• **Winter storm**: A storm that can produce a combination of freezing rain, sleet, heavy snow, and/or strong winds.\(^{103}\)

• **Coastal storm**: Large wind-driven waves and/or storm surge that strike the coastal zone.\(^{104}\)

• **Ice storm**: Ice storms are one of the most dangerous forms of winter storms. When surface temperatures are below freezing, but a thick layer of above-freezing air remains aloft, rain can fall into the freezing layer and freeze upon impact into a glaze of ice. In general, 8 millimeters (0.31 inch) of accumulation is all that is required, especially in combination with breezy conditions, to start downing power lines as well as tree limbs. Ice storms also make unheated road surfaces too slick to drive on. Ice storms can vary in time range from hours to days and can cripple small towns and large urban centers alike.\(^{105}\)

• **Snowstorm**: A heavy fall of snow accumulating at a rate of more than 5 centimeters (2 inches) per hour that lasts several hours. Snowstorms, especially ones with a high liquid equivalent and breezy conditions, can down tree limbs, cut off power, and paralyze travel over a large region.\(^{106}\)

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**Severe Weather Hazard Elements: Wind Hazards, Hail, and Lightning**

This hazard profile concentrates on the following types of severe weather hazards: wind hazards (including tornadoes), hail, and lightning. These hazards are produced by a variety of weather phenomena, including thunderstorms, coastal storms, winter storms, and topographically-enhanced downslope winds. While storm and downslope wind hazards are responsible for severe weather events across the CSU system, only the wind, tornado, hail, and lightning elements generated by these hazards are covered in this profile. (Storm-related hazards such as flooding and extreme temperatures are covered in other sections of this document.)

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Wind Hazards

Wind is the horizontal movement of air past any given point. Wind begins with differences in air pressures; pressure that is higher at one point than another sets up a force, pushing the high towards the low pressure. Wind gusts are defined as “rapid fluctuations in the wind speed with a variation of 10 knots or more between peaks and lulls.”

Wind hazards in California take several forms: High Wind, Strong Winds, Thunderstorm Winds, Mountain-Valley (Downslope) Winds, and Tornadoes. These hazards are encountered across California, and have the potential to cause harm to or loss of life and/or property throughout California and the CSU system (including CSU Long Beach).

High Winds, Strong Winds, and Thunderstorm Winds

The National Weather Service reports three (3) types of wind events that occur areas over land: High Winds, Strong Winds, and Thunderstorm Winds. Collectively, these reports are used to determine the frequency with which wind hazard events have affected areas across the U.S., including California.

High Winds

High winds are defined as sustained non-convective winds of 35 knots (40 mph) or greater lasting for 1 hour or longer, or gusts of 50 knots (58 mph) or greater for any duration (or otherwise locally/regionally defined). In some mountainous areas, the above numerical values are 43 knots (50 mph) and 65 knots (75 mph), respectively.

Strong Winds

Strong winds are defined as non-convective winds gusting less than 50 knots (58 mph), or sustained winds less than 35 knots (40 mph), resulting in a fatality, injury, or damage.

Thunderstorm Winds

Thunderstorm winds are winds that arise from thunderstorm convection (occurring within 30 minutes of lightning being observed or detected), with speeds of at least 50 knots (58 mph). They can also be winds of any speed (non-severe thunderstorm winds below 50 knots (58 mph)) producing a fatality, injury, or damage.
Please note: **Straight-line wind** is a term used to define any thunderstorm wind that is not associated with rotation. It is used mainly to differentiate from the rotational winds found in tornado-producing storms.\(^{112}\) However, it is not a term used in the NCEI Storm Events Database, and therefore cannot be used to determine severe weather history of or potential impacts to CSU campuses.

**Tornadoes**

A tornado is an extreme severe weather wind hazard. A tornado is a rapidly rotating column of air extending from a thunderstorm to the surface of the Earth.\(^{113}\) This column extends between cloud and the Earth’s surface. The damage from tornadoes comes from the strong winds they contain and the flying debris they create. It is generally believed that rotational wind speeds can be as high as 300 mph in the most violent tornadoes.\(^{114}\) On a local scale, tornadoes are the most violent and most destructive of all atmospheric phenomena.\(^{115}\)

**Mountain-Valley (Downslope) Wind Systems: Santa Ana, Diablo, and Sundowner Winds.**

*Santa Ana Winds.* A type of wind hazard that is peculiar to Southern California is called a *Santa Ana Wind.* Santa Ana winds are strong, topographically-enhanced, extremely dry downslope winds that originate inland and affect coastal southern California and northern Baja California (Mexico).\(^{116}\) They occur when air from a region of high pressure over the dry, desert region of the southwestern U.S. flows westward towards low pressure located off the California coast. This creates dry winds that flow east to west through the mountain passages in Southern California. These winds have a strong seasonal component; they are most common during the cooler months of the year, occurring from September through May. Santa Ana winds typically feel warm (or even hot) because as the cool desert air moves down the side of the mountain, it is compressed, which causes the temperature of the air to rise. If strong enough, Santa Ana winds can cause major property damage, and may present difficulties for airborne and seagoing transportation. They also may increase wildfire risk because of the dryness of the winds and the speed at which they can spread a flame across the landscape.\(^{117}\) (Note: The Wildfire hazard is profiled elsewhere in this document.)

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\(^{112}\) Retrieved on 07.15.2021 from https://www.nssl.noaa.gov/education/svrwx101/wind/types/

\(^{113}\) Retrieved on 07.15.2021 from https://www.earthnetworks.com/tornado/

\(^{114}\) Retrieved on 07.15.2021 from https://www.nssl.noaa.gov/education/svrwx101/tornadoes/faq/

\(^{115}\) Retrieved on 07.15.2021 from https://www.weather.gov/bgm/severedefinitions


Figure below illustrates the mechanisms involved in the generation of Santa Ana winds across Southern California.

Figure 12-19: What Drives a Santa Ana Wind?\textsuperscript{118}

\textit{Diablo Winds}. The Diablo wind is another type of topographically-enhanced downslope wind phenomenon that occurs in the North-Central areas of California. Diablo winds are offshore wind events that flow northeasterly over Northern California’s Coast Ranges, often creating high wind speeds downwind of major canyons and over ridges, and extreme fire danger for the San Francisco Bay Area. Diablo winds are driven by a surface pressure gradient that forms in response to an inverted pressure trough that develops over California.\textsuperscript{119}

\textit{Sundowner Winds}. Sundowner winds are significant and potentially damaging downslope wind and warming events that periodically occur along a short segment of the southern California coast in the vicinity of Santa Barbara, CA. The unique

\textsuperscript{118} Retrieved on 07.14.2021 from https://twitter.com/nwslosangeles/status/933049473034579968

\textsuperscript{119} Retrieved on 07.13.2021 from https://www.fireweather.org/diablo-winds
topography of this coastal region promotes the development of Sundowner wind events: over a length of about 100 km, the coastline is oriented approximately west–east, with the adjoining narrow coastal plain bounded by a steeply rising (to elevations greater than 1200 m) and coast-parallel mountain range. Called Sundowner winds because they often begin in the late afternoon or early evening, their onset is typically associated with a rapid rise in temperature and decrease in relative humidity, and the winds tend to blow from the north from the Santa Ynez Mountains to the coast of Santa Barbara County, California. During the more intense Sundowner wind events, wind speeds can be of gale force (39-54 miles per hour) or higher, and can even reach hurricane force (≥ 74 miles per hour) in the most extreme cases. Temperatures over the coastal plain, and even at the coast itself, can rise significantly above 37.8°C (100°F). Seasonally, Sundowner winds peak in March, April, and May, with a minimum during summer and a secondary peak in winter that often corresponds with Santa Ana winds. In addition to causing a dramatic change from the more typical marine-influenced local weather conditions, Sundowner wind episodes have produced significant wind-related property and agricultural damage, as well as conditions of extreme fire danger.120 121 122

**Hail**

Hail is a form of precipitation consisting of solid ice that forms inside thunderstorm updrafts.123 It is roughly round in shape and at least 0.2’ in diameter. Hail develops in the upper atmosphere as ice crystals that are bounced about by high velocity updraft winds; the ice crystals accumulate frozen droplets and fall after developing enough weight. The size of hailstones varies and is a direct consequence of the severity and size of the storm that produces them – the higher the temperatures at the Earth’s surface, the greater the strength of the updrafts and the amount of time hailstones are suspended, and therefore the greater the size of the hailstone.124

**Lightning**

Lightning is an electrical discharge produced by a thunderstorm. Lightning rapidly heats the air in its immediate vicinity to about 50,000°F - about five times the temperature of the surface of the sun. This compresses the surrounding air and


creates a supersonic shock wave, which decays to an acoustic wave that is heard as thunder.\textsuperscript{125}

The discharge may occur within or between clouds, between the cloud and air, between a cloud and the ground, or between the ground and a cloud.\textsuperscript{126} Lightning that is produced from thunderstorms in which precipitation evaporates before reaching the ground is called “dry lightning.”

**Location of the Hazard**

Severe weather is a non-spatial hazard, and can occur anywhere in the CSU system, including on the CSU Long Beach campus. No one area of the campus – or of the surrounding community – is subject to experiencing severe weather more than any other area.

There is geographic variability among the different types of mountain and valley wind events (as a sub-category of the severe weather hazard). Santa Ana winds occur in Southern California, Diablo winds occur in North-Central California, and Sundowner winds occur almost exclusively in Santa Barbara County, California.

**Extent of the Hazard**

Severe weather hazards are non-spatial hazards that potentially affect all CSU Long Beach campus areas equally. However, the smallest geographic unit of measurement for almost all official severe weather event data is at the county level. Because the severe weather data used do not exist at the campus level, it is assumed that the same (or similar) severe weather risks to CSU Long Beach reflect those of the surrounding community and County. As a result, all assets and people at CSU Long Beach are at risk from the effects of severe weather and can expect to experience at least some (or the complete range of) endemic severe weather hazards. In consideration of the campus’ design, layout, and operations, the severe weather history and degree of severity in the Long Beach area, and the history and degree of severity of each severe weather sub-type identified by the extent scales (below), the campus planning committee ranks the overall extent of the Severe Weather hazard as **M od er ate**. See each sub-hazard below for the planning committee’s sub-type extent ranking.

**Wind Hazard: Non-Rotational**

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The Beaufort Scale is an empirical measure that relates wind speed to observed conditions at sea or on land. Its full name is the Beaufort wind force scale. First developed in 1805, it is still used today to estimate wind strengths.

Table 12-30: Beaufort Wind Force Scale

<table>
<thead>
<tr>
<th>Force</th>
<th>Speed (mph)</th>
<th>Speed (knots)</th>
<th>Description</th>
<th>Specifications for use at sea</th>
<th>Specifications for use on land</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0-1</td>
<td>0-1</td>
<td>Calm</td>
<td>Sea like a mirror.</td>
<td>Calm; smoke rises vertically.</td>
</tr>
<tr>
<td>1</td>
<td>1-3</td>
<td>1-3</td>
<td>Light Air</td>
<td>Ripples with the appearance of scales are formed, but without foam crests.</td>
<td>Direction of wind shown by smoke drift, but not by wind vanes.</td>
</tr>
<tr>
<td>2</td>
<td>4-7</td>
<td>4-6</td>
<td>Light Breeze</td>
<td>Small wavelets, still short, but more pronounced. Crests have a glassy appearance and do not break.</td>
<td>Wind felt on face; leaves rustle; ordinary vanes moved by wind.</td>
</tr>
<tr>
<td>3</td>
<td>8-12</td>
<td>7-10</td>
<td>Gentle Breeze</td>
<td>Large wavelets. Crests begin to break. Foam of glassy appearance. Perhaps scattered white horses.</td>
<td>Leaves and small twigs in constant motion; wind extends light flag.</td>
</tr>
<tr>
<td>4</td>
<td>13-18</td>
<td>11-16</td>
<td>Moderate Breeze</td>
<td>Small waves, becoming larger; fairly frequent white horses.</td>
<td>Raises dust and loose paper; small branches are moved.</td>
</tr>
</tbody>
</table>

---

127 Retrieved on 07.15.2021 from https://www.rmets.org/resource/beaufort-scale
<table>
<thead>
<tr>
<th>Wind Force</th>
<th>Beaufort Scale</th>
<th>Speed Range (knots)</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fresh Breeze</td>
<td>5</td>
<td>19-24</td>
<td>17-21</td>
</tr>
<tr>
<td>Strong Breeze</td>
<td>6</td>
<td>25-31</td>
<td>22-27</td>
</tr>
<tr>
<td>Near Gale</td>
<td>7</td>
<td>32-38</td>
<td>28-33</td>
</tr>
<tr>
<td>Gale</td>
<td>8</td>
<td>39-46</td>
<td>34-40</td>
</tr>
<tr>
<td>Severe Gale</td>
<td>9</td>
<td>47-54</td>
<td>41-47</td>
</tr>
<tr>
<td>Storm</td>
<td>10</td>
<td>55-63</td>
<td>48-55</td>
</tr>
</tbody>
</table>
whole the surface of the sea takes on a white appearance. The tumbling of the sea becomes heavy and shock-like. Visibility affected.

Seldom experienced inland; trees uprooted; considerable structural damage occurs.

<table>
<thead>
<tr>
<th></th>
<th>11</th>
<th>64-72</th>
<th>56-63</th>
<th>Violent Storm</th>
</tr>
</thead>
</table>

Exceptionally high waves (small and medium-size ships might be for a time lost to view behind the waves). The sea is completely covered with long white patches of foam lying along the direction of the wind. Everywhere the edges of the wave crests are blown into froth. Visibility affected.

Very rarely experienced; accompanied by wide-spread damage.

<table>
<thead>
<tr>
<th></th>
<th>12</th>
<th>73+</th>
<th>64+</th>
<th>Hurricane</th>
</tr>
</thead>
</table>

The air is filled with foam and spray. Sea completely white with driving spray; visibility very seriously affected.

Based on those extent ranking factors identified (above), the planning committee ranks the extent of non-rotational wind hazards as MODERATE.

**Extent: Tornado**

Tornadoes have their own severity/extent scale. Until 2007, tornadoes were measured and described according to the Fujita Scale.\(^\text{130}\)

In February 2007, use of the Fujita Scale was discontinued. In its place, the Enhanced Fujita (EF) Scale is used. The Enhanced Fujita scale considers how most structures are designed and is thought to be a much more accurate representation of the surface wind speeds in the most violent tornadoes. Like the original Fujita scale, the Enhanced Fujita scale is a set of wind estimates (not measurements) based on damage.

\(^{130}\) Retrieved on 07.19.2021 from https://www.weather.gov/tae/ef_scale
It is important to note the date that a tornado occurred. Tornadoes that occurred prior to February, 2007 are classified using the original Fujita scale and will not be converted to the Enhanced Fujita Scale.

Table below illustrates the Fujita Scale in use prior to February 2007.

Table 12-31: Fujita Tornado Scale (Pre-February 2007) ¹³¹

<table>
<thead>
<tr>
<th>F-Scale Number</th>
<th>Intensity Phrase</th>
<th>Wind Speed</th>
<th>Type of Damage</th>
</tr>
</thead>
<tbody>
<tr>
<td>F0</td>
<td>Gale tornado</td>
<td>40-72 mph</td>
<td>Some damage to chimneys; breaks branches off trees; pushes over shallow-rooted trees; damages sign boards.</td>
</tr>
<tr>
<td>F1</td>
<td>Moderate tornado</td>
<td>73-112 mph</td>
<td>The lower limit is the beginning of hurricane wind speed; peels surface off roofs; mobile homes pushed off foundations or overturned; moving autos pushed off the roads; attached garages may be destroyed.</td>
</tr>
<tr>
<td>F2</td>
<td>Significant tornado</td>
<td>113-157 mph</td>
<td>Considerable damage. Roofs torn off frame houses; mobile homes demolished; boxcars pushed over; large trees snapped or uprooted; light object missiles generated.</td>
</tr>
<tr>
<td>F3</td>
<td>Severe tornado</td>
<td>158-206 mph</td>
<td>Roof and some walls torn off well-constructed houses; trains overturned; most trees in forest uprooted.</td>
</tr>
<tr>
<td>F4</td>
<td>Devastating tornado</td>
<td>207-260 mph</td>
<td>Well-constructed houses leveled; structures with weak foundations blown off some distance; cars thrown and large missiles generated.</td>
</tr>
<tr>
<td>F5</td>
<td>Incredible tornado</td>
<td>261-318 mph</td>
<td>Strong frame houses lifted off foundations and carried considerable distances to disintegrate; automobile sized</td>
</tr>
</tbody>
</table>

missiles fly through the air in excess of 100 meters; trees debarked; steel reinforced concrete structures badly damaged.

<table>
<thead>
<tr>
<th>Enhanced Fujita Category</th>
<th>Wind Speed</th>
<th>Potential Damage</th>
</tr>
</thead>
<tbody>
<tr>
<td>EF0</td>
<td>65-85 mph</td>
<td>Light damage. Peels surface off some roofs; some damage to gutters or siding; branches broken off trees; shallow-rooted trees pushed over.</td>
</tr>
<tr>
<td>EF1</td>
<td>86-110 mph</td>
<td>Moderate damage. Roofs severely stripped; mobile homes overturned or badly damaged; loss of exterior doors; windows and other glass broken.</td>
</tr>
</tbody>
</table>

These winds are very unlikely. The small area of damage they might produce would probably not be recognizable along with the mess produced by F4 and F5 wind that would surround the F6 winds. Missiles, such as cars and refrigerators would do serious secondary damage that could not be directly identified as F6 damage. If this level is ever achieved, evidence for it might only be found in some manner of ground swirl pattern, for it may never be identifiable through engineering studies.

Table below illustrates the Enhanced Fujita (EF) Scale, currently in use. Tornadoes that have occurred since February, 2007 are classified using the Enhanced Fujita Scale.

Table 12-32: Enhanced Fujita Scale (February 2007 and Later) ¹³²


F6
Inconceivable tornado
319-379 mph
<table>
<thead>
<tr>
<th>EF2</th>
<th>111-135 mph</th>
<th>Considerable damage. Roofs torn off well-constructed houses; foundations of frame homes shifted; mobile homes completely destroyed; large trees snapped or uprooted; light-object missiles generated; cars lifted off ground.</th>
</tr>
</thead>
<tbody>
<tr>
<td>EF3</td>
<td>136-165 mph</td>
<td>Severe damage. Entire stories of well-constructed houses destroyed; severe damage to large buildings such as shopping malls; trains overturned; trees debarked; heavy cars lifted off the ground and thrown; structures with weak foundations blown away some distance.</td>
</tr>
<tr>
<td>EF4</td>
<td>166-200 mph</td>
<td>Devastating damage. Well-constructed houses and whole frame houses completely leveled; cars thrown and small missiles generated.</td>
</tr>
<tr>
<td>EF5</td>
<td>&gt;200 mph</td>
<td>Incredible damage. Strong frame houses leveled off foundations and swept away; automobile-sized missiles fly through the air in excess of 100 m (107 yd); high-rise buildings have significant structural deformation; incredible phenomena will occur.</td>
</tr>
</tbody>
</table>

Based on the extent ranking factors identified (above), the planning committee ranks the extent of tornados as **LOW**.

**Extent: Hail**

The National Oceanic and Atmospheric Administration and the Tornado and Storm Research Organization (TORRO) have combined efforts to create the Hailstorm Intensity Scale. Table below provides details of this scale.
Table 12-33: Combined NOAA/TORRO Hailstorm Intensity Scale\textsuperscript{133}

<table>
<thead>
<tr>
<th>Size Code</th>
<th>Intensity Category</th>
<th>Typical Hail Diameter</th>
<th>Approximate Size</th>
<th>Typical Damage Impacts</th>
</tr>
</thead>
<tbody>
<tr>
<td>H0</td>
<td>Hard Hail</td>
<td>Up to 0.33”</td>
<td>Pea</td>
<td>No damage</td>
</tr>
<tr>
<td>H1</td>
<td>Potentially Damaging</td>
<td>0.33” – 0.60”</td>
<td>Marble or Mothball</td>
<td>Slight damage to plants and crops</td>
</tr>
<tr>
<td>H2</td>
<td>Potentially Damaging</td>
<td>0.60” – 0.80”</td>
<td>Dime or grape</td>
<td>Significant damage to fruit, crops, and vegetation</td>
</tr>
<tr>
<td>H3</td>
<td>Severe</td>
<td>0.80” – 1.20”</td>
<td>Nickel to Quarter</td>
<td>Severe damage to fruit and crops, damage to glass and plastic structures, paint and wood scored</td>
</tr>
<tr>
<td>H4</td>
<td>Severe</td>
<td>1.20” – 1.60”</td>
<td>Half Dollar to Ping Pong Ball</td>
<td>Widespread glass damage, vehicle body damage</td>
</tr>
</tbody>
</table>

Based on those extent ranking factors identified (above), the planning committee ranks the extent of the hail hazard as **LOW**.

**Extent: Lightning**

The National Weather Service (NWS) uses a Lightning Activity Level (LAL) scale to indicate the frequency and character of cloud-to-ground (C/G) lightning. The scale uses a range of 1 – 6, with 6 being the high end of the scale. Table below provides details of the LAL scale.

<table>
<thead>
<tr>
<th>Extent</th>
<th>Size (in)</th>
<th>Description</th>
<th>Damage</th>
<th>Injuries</th>
</tr>
</thead>
<tbody>
<tr>
<td>H5 Destructive</td>
<td>1.60” – 2.0”</td>
<td>Silver Dollar to Golf Ball</td>
<td>Wholesale destruction of glass, damage to tiled roofs, significant risk of injuries</td>
<td></td>
</tr>
<tr>
<td>H6 Destructive</td>
<td>2.0” – 2.4”</td>
<td>Lime or Egg</td>
<td>Aircraft body dented; brick walls pitted</td>
<td></td>
</tr>
<tr>
<td>H7 Very Destructive</td>
<td>2.4” – 3.0”</td>
<td>Tennis Ball</td>
<td>Severe roof damage, risk of serious injuries</td>
<td></td>
</tr>
<tr>
<td>H8 Very Destructive</td>
<td>3.0” – 3.5”</td>
<td>Baseball to Orange</td>
<td>Severe damage to aircraft body</td>
<td></td>
</tr>
<tr>
<td>H9 Super Hailstorms</td>
<td>3.5” – 4.0”</td>
<td>Grapefruit</td>
<td>Extensive structural damage, risk of severe or fatal injuries to persons caught in the open</td>
<td></td>
</tr>
</tbody>
</table>
Table 12-34: Lightning Activity Level (LAL) Scale\textsuperscript{134}

<table>
<thead>
<tr>
<th>Rank</th>
<th>Cloud and Storm Development</th>
<th>Areal Coverage</th>
<th>Counts C/G per 5 Minutes</th>
<th>Counts C/G per 15 Minutes</th>
<th>Average C/G per Minute</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>No Thunderstorms</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>2</td>
<td>Cumulus clouds are common but only a few reaches the towering stage. A single thunderstorm must be confirmed in the rating area. The clouds mostly produce virga, but light rain will occasionally reach ground. Lightning is very infrequent.</td>
<td>&lt;15%</td>
<td>1-5</td>
<td>1-8</td>
<td>&lt;1</td>
</tr>
<tr>
<td>3</td>
<td>Cumulus clouds are common. Swelling and towering cumulus cover less than 2/10 of the sky. Thunderstorms are few, but 2 to 3 occur within the observation area. Light to moderate rain will reach the ground, and lightning is infrequent.</td>
<td>15% to 24%</td>
<td>6-10</td>
<td>9-15</td>
<td>1-2</td>
</tr>
</tbody>
</table>

\textsuperscript{134} Retrieved on 07.19.2021 from https://graphical.weather.gov/definitions/defineLAL.html
<table>
<thead>
<tr>
<th>Rank</th>
<th>Cloud and Storm Development</th>
<th>Areal Coverage</th>
<th>Counts C/G per 5 Minutes</th>
<th>Counts C/G per 15 Minutes</th>
<th>Average C/G per Minute</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>Swelling cumulus and towering cumulus cover 2-3/10 of the sky. Thunderstorms are scattered but more than three must occur within the observation area. Moderate rain is commonly produced, and lightning is frequent.</td>
<td>25% to 50%</td>
<td>11-15</td>
<td>16-25</td>
<td>2-3</td>
</tr>
<tr>
<td>5</td>
<td>Towering cumulus and thunderstorms are numerous. They cover more than 3/10 and occasionally obscure the sky. Rain is moderate to heavy, and lightning is frequent and intense.</td>
<td>&gt;50%</td>
<td>&gt;15</td>
<td>&gt;25</td>
<td>&gt;3</td>
</tr>
<tr>
<td>6</td>
<td>Dry lightning outbreak. (LAL of 3 or greater with majority of storms producing little or no rainfall.)</td>
<td>&gt;15%</td>
<td>None</td>
<td>None</td>
<td>None</td>
</tr>
</tbody>
</table>
Based on those extent ranking factors identified (above), the planning committee ranks the extent of the lightening hazard as **LOW**.

**Extent: Thunderstorms that Generate Wind, Tornado, Hail, and Lightning Hazard Events**

Thunderstorms are not explicitly identified as a severe weather category for this hazard profile. However, they are responsible for most tornado, lightning, and hail hazard events – as well as a significant number of wind hazard events – across California and the CSU system. While individual thunderstorms affect relatively small areas, there are many instances in which thunderstorms can cluster together and/or travel in a line over long distances, producing significant damage over large geographic areas.

A thunderstorm is classified as “severe” when certain meteorological parameters within the thunderstorm are reached (i.e., damaging winds or speeds of 58 mph (50 knots) or greater, hail 1 inch in diameter or larger, and/or a tornado). However, there is currently no established, objective severity scale for thunderstorms. That said, according to the *Glossary of Meteorology* published by the American Meteorological Society (AMS), a thunderstorm is reported as *light, medium, or heavy* according to following five (5) characteristics:

- the nature of the lightning and thunder;
- the type and intensity of the precipitation, if any;
- the speed and gustiness of the wind;
- the appearance of the clouds; and
- the effect upon surface temperature.

A thunderstorm may also be classified by the nature of the overall weather situation in which the thunderstorm is produced, including:

- **Airmass Thunderstorm**: A thunderstorm produced by local convection within an unstable air mass;  

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135 Retrieved on 07.15.2021 from https://www.noaa.gov/explainers/severe-storms

136 Retrieved on 07.15.2021 from https://www.weather.gov/safety/thunderstorm


• **Frontal Thunderstorm**: An individual thunderstorm the initiation of which results from rising motion associated with a front, or a thunderstorm within a convective system generated and organized by frontal rising motion;\(^\text{139}\) or

• **Squall-line Thunderstorm**: An individual thunderstorm included within a squall line (i.e., a continuous or broken line of active deep moist convection frequently associated with thunder).\(^\text{140} \, \text{141}\)

Based on the extent ranking factors identified (above) in relation to campus layout and operations, and past event low degree of severity, the planning committee ranks the extent of the thunderstorm hazard as **LOW**.

**History of the Hazard**

Severe weather hazards have been an annual occurrence in Los Angeles County and on the CSU Long Beach campus. Historical data for these hazards are presented below.

**Historical Storm Data Collection: NCEI Storm Events Database**

Historical information regarding severe weather hazards can be found using The National Centers for Environmental Information (NCEI) Storm Events Database. The Storm Events Database contains searchable, archived National Weather Service (NWS) storm data from January 1950 to April 2021, as entered by NOAA’s National Weather Service (NWS). Due to changes in the data collection and processing procedures over time, there are unique periods of record available depending on the event type.\(^\text{142}\) For example, from 1950 through 1954, only tornado events were recorded; from 1955 through 1995, only tornado, thunderstorm wind, and hail events were introduced into the database; from 1996 to present, 45 additional event types are recorded, including high wind, strong wind, and lightning events.\(^\text{143}\) To obtain the most accurate portrayal of severe weather event frequency, searches of the Storm Events Database are conducted using data collected since 01/01/1996. As a reminder, all official severe weather event data is at the county level. Severe weather data do not exist at the campus level. That said, it may be the case that the campus to some


degree experiences the severe weather events reported for the surrounding community and County.

Wind Hazards (excluding Tornadoes)

Information obtained from the NCEI Storm Event Database website shows the number of events (or occurrences) of wind hazard events in Los Angeles County since 1996. Here, wind hazard events include all “High Wind,” “Strong Wind,” and “Thunderstorm Wind” storm reports.

- **High Wind:** at least 387 events, or approximately 15.28 events per year
- **Strong Wind:** at least 3 events, or 0.12 events per year
- **Thunderstorm Wind:** at least 43 events, or approximately 1.70 events per year
- **All Wind Hazard events** (excluding Tornadoes): at least 427 events, or approximately 16.86 events per year. (Note: This was determined by conducting a simultaneous search of the component wind hazards of high wind, strong wind and thunderstorm wind.)

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146 National Climatic Data Center. Storm Events Database. Retrieved 07.29.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28Z%29+High+Wind&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=LOS%2BANGELES%3A37&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA

147 National Climatic Data Center. Storm Events Database. Retrieved 07.29.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28Z%29+Strong+Wind&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=LOS%2BANGELES%3A37&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA

148 National Climatic Data Center. Storm Events Database. Retrieved 07.29.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Thunderstorm+Wind&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=LOS%2BANGELES%3A37&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA

149 National Climatic Data Center. Storm Events Database. Retrieved 07.29.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28Z%29+High+Wind&eventType=%28Z%29+Strong+Wind&eventType=%28C%29+Thunderstorm+Wind&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=LOS%2BANGELES%3A37&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA
Overall, in Los Angeles County, there have been at least 427 wind hazard events since 1996, excluding tornadoes.¹⁵⁰ That translates to an approximate average historical frequency of occurrence of 16.86 wind hazard events per year.

Please note: Differences between the sums of individual component severe weather hazard event Database searches (i.e., 433 events) and simultaneous Database searches of all severe weather hazard events (i.e., 427 events) may be due to the following factors: (1) multiple event types are in the same record (e.g., "Thunderstorm Wind/Hail" or "Hail/Tornado;" and/or (2) severe weather hazard events such as “Thunderstorm Wind” or “Hail” that are reported for Los Angeles County have actually taken place hundreds of miles away, but are erroneously recorded as events that have occurred in the County.¹⁵¹ When such a discrepancy arises, the more conservative aggregate hazard wind event value (i.e., 427 events) is used to determine the historical frequency of occurrence for the severe weather hazard. The origin of this discrepancy is unknown at this time.

**Historical Wind Hazard Losses for Los Angeles County since 1996**

According to the NCEI Storm Events Database, the wind hazard events that Los Angeles County has experienced since 1996 have been costly. There have been 2 deaths and 4 injuries reported from wind hazard events (excluding tornadoes) in Los Angeles County; no property or crop damage has been reported.¹⁵²

**Tornado Wind Hazards**

Information from the NCEI Storm Events Database indicates that since 1996, there have been 12 reported events of tornadoes in Los Angeles County, which translates to approximately 0.47 tornado events per year.¹⁵³

¹⁵⁰ National Climatic Data Center. Storm Events Database. Retrieved 07.29.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28Z%29+High+Wind&eventType=%28Z%29+Strong+Wind&eventType=%28C%29+Thunderstorm+Wind&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=LOS%2BANGELES%3A37&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitButton=Search&statefips=6%2CCALIFORNIA


¹⁵² National Climatic Data Center. Storm Events Database. Retrieved 07.29.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28Z%29+High+Wind&eventType=%28Z%29+Strong+Wind&eventType=%28C%29+Thunderstorm+Wind&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=LOS%2BANGELES%3A37&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitButton=Search&statefips=6%2CCALIFORNIA

¹⁵³ National Climatic Data Center. Storm Events Database. Retrieved 07.29.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28Z%29+Strong+Wind&eventtype=%28C%29+Tornado&beginDate_mm=0
The vast majority of tornado reports in Los Angeles County since 1996 have been of tornadoes with a severity rating of F0/EF0. Only one (1) of the 12 reported tornadoes has been rated F1/EF1 or higher (it was an F1 tornado that occurred in 1998); that translates to approximately 0.04 events of F1/EF1 tornadoes have occurred per year in Los Angeles County.\(^{154}\)

**Historical Tornado Hazard Losses for Los Angeles County since 1996**

According to the NCEI Storm Events Database, the tornado hazard events that Los Angeles County has experienced since 1996 have been minimal. There have been no deaths, or property or crop damage reported; however, 1 injury has been reported.\(^{155}\) (Note: The F1/EF1 tornado that occurred in Los Angeles County in 1998 caused the one (1) reported injury.)

**Hail**

Information from the NCEI Storm Events Database indicates that since 1996, there have been 18 reported events of hail in Los Angeles County, which translates to approximately 0.71 hail events per year.\(^{156}\) (Note: The NCEI Storm Event Database search results for hail indicate that there has been a total of 19 reports of hail since 1996. However, one (1) entry is for a hail event in San Diego County, over 100 miles away from Los Angeles County. The origin of this discrepancy is unknown at this time.)

**Historical Hail Hazard Losses for Los Angeles County since 1996**

According to the NCEI Storm Events Database, the hail hazard events that Los Angeles County has experienced since 1996 have been costly. While there have been 0 deaths and 0 injuries, property damage estimates have totaled approximately $3,500,000; no crop damage estimates have been reported; the property damage estimate reflects

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1\(^{154}\) National Climatic Data Center. Storm Events Database. Retrieved 07.29.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Tornado&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=LOS%2BANGELES%3A37&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA

1\(^{155}\) National Climatic Data Center. Storm Events Database. Retrieved 07.29.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Tornado&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=LOS%2BANGELES%3A37&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA

1\(^{156}\) National Climatic Data Center. Storm Events Database. Retrieved 07.29.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Hail&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=LOS%2BANGELES%3A37&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA
one hail hazard event that occurred in 2003.\textsuperscript{157} (Note: The San Diego County hail event that was included erroneously in the search results for hail events in Los Angeles County accounted for all injuries (i.e., 5) and crop damage estimates (i.e., $300,000) presented in the search results.)

**Lightning**

Information from the NCEI Storm Events Database indicates that since 1996, there have been 9 reported events of lightning in Los Angeles County, which translates to approximately 0.36 lightning events per year.\textsuperscript{158}

**Historical Lightning Hazard Losses for Los Angeles County since 1996**

According to the NCEI Storm Events Database, the lightning hazard events that Los Angeles County has experienced since 1996 have been costly. While no property or crop damages have been reported, there have been 2 deaths and 13 injuries attributed to lightning hazard events.\textsuperscript{159}

**All Severe Weather Hazard Events Recorded by the NCEI Storm Events Database**

Information obtained from the NCEI Storm Events Database indicates that there have been 466 occurrences of the severe weather hazard in Los Angeles County. This translates to 18.39 severe weather hazard occurrences per year.\textsuperscript{160}

Please note: Differences between the sums of individual component severe weather hazard event Database searches (i.e., 472 events) and simultaneous Database

\textsuperscript{157} National Climatic Data Center. Storm Events Database. Retrieved 07.29.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Hail&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&eventtype=%28C%29+Hail&hailfilter=0.00&tornfilter=0&windfilter=0&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA

\textsuperscript{158} National Climatic Data Center. Storm Events Database. Retrieved 07.29.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Lightning&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=LOS%2BANGELES%3A37&hailfilter=0.00&tornfilter=0&windfilter=0&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA

\textsuperscript{159} National Climatic Data Center. Storm Events Database. Retrieved 07.29.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Lightning&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=LOS%2BANGELES%3A37&hailfilter=0.00&tornfilter=0&windfilter=0&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA

\textsuperscript{160} National Climatic Data Center. Storm Events Database. Retrieved 07.29.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Hail&eventtype=%28Z%29+High+Wind&eventtype=%28C%29+Lightning&eventtype=%28Z%29+Strong+Wind&eventtype=%28C%29+Thunderstorm+Wind&eventtype=%28C%29+Tornado&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=LOS%2BANGELES%3A37&hailfilter=0.00&tornfilter=0&windfilter=0&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA
searches of all severe weather hazard events (i.e., 466 events) may be due to the following factors: (1) multiple event types are in the same record (e.g., "Thunderstorm Wind/Hail" or "Hail/Tornado;" and/or (2) severe weather hazard events such as "Thunderstorm Wind" or "Hail" that are reported for Los Angeles County have actually taken place hundreds of miles away, but are erroneously recorded as events that have occurred in the County. When such a discrepancy arises, the more conservative aggregate hazard wind event value (i.e., 466 events) is used to determine the historical frequency of occurrence for the severe weather hazard. The origin of this discrepancy is unknown at this time.

**Historical, Aggregated Severe Hazard Losses for Los Angeles County since 1996**

According to the NCEI Storm Events Database, the severe weather events that Los Angeles County has experienced since 1996 have been costly. There have been 4 deaths and 18 injuries, and property damage estimates have totaled approximately $3,500,000; no crop damage has been reported. It *is important to note that for all Los Angeles County severe weather hazard events recorded on the Storm Events Database, lightning has accounted for half of the deaths, and 13 out of 14 (92.9%) injuries reported. However, hail has accounted for all estimated property damages.*

**Wind Hazards Not Included in the NCEI Storm Events Database**

**Santa Ana Winds**

Santa Ana wind events occur at least twice per month from October through April. From 1948 to 2012, total of 2056 events on the 65-year record were recorded in the Southern California region, yielding an average of 32 occurrences per year. Typical Santa Ana wind events last 1–2 days and represent 27% of the occurrences, with events lasting up to 6 days accounting for 90% of all occurrences. The remaining 10% are made up almost entirely of events lasting between 7 and 12 days.

Figure below shows the mean monthly frequency per season of Santa Ana Wind events detected from 1948 to 2012. Extreme Santa Ana wind events are shown in dark red, and are defined as those events that are above the 90th percentile of all events on record.

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Diablo Winds

Diablo wind events occur approximately **2.5 events per year**. These events are most frequent during the fall and early winter seasons, with the highest frequency of events occurring in October. As a result, the highest risk of Diablo-wind-related damage is in the fall and early winter.\textsuperscript{167}


Figure below shows the monthly frequency of Diablo winds (along with average live fuel moisture content). The Diablo Wind data are derived from a 17-year climatology of San Francisco Bay Area regional surface weather stations.\(^{168}\)

Figure 12-21: Monthly Frequency of Diablo Winds and Average Live Fuel Moisture Content (Dashed Line)\(^{169}\)

### Sundowner Winds

Strong sundowner wind events occur approximately **2-3 times per year.** These events can create sharp temperature rises, local gale force winds, and significant weather-related problems. Rare, “explosive” types of sundowner wind events occur about 6 times per century that present dangerous weather situations, generating extremely strong and hot winds that can reach gale force or higher speeds.\(^{170}\)

### Historical Frequency of All Severe Weather Hazards

Table below shows the average historical frequency of severe weather hazard events for Los Angeles County since 1996.)

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\(^{168}\) Retrieved on 07.15.2021 from https://www.fireweather.org/diablo-winds

\(^{169}\) Retrieved on 07.13.2021 from https://www.fireweather.org/diablo-winds

Table 12-35: Severe Weather Hazard Event

Frequencies for Los Angeles County since 1996.

<table>
<thead>
<tr>
<th>Severe Weather Hazard Category</th>
<th>Average Number of Hazard Events Per Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wind (Includes High, Strong and Thunderstorm Winds ONLY)</td>
<td>16.86</td>
</tr>
<tr>
<td>Tornado</td>
<td>0.47</td>
</tr>
<tr>
<td>Hail</td>
<td>0.71</td>
</tr>
<tr>
<td>Lightning</td>
<td>0.36</td>
</tr>
<tr>
<td>Diablo Wind*</td>
<td>2.5</td>
</tr>
<tr>
<td>Santa Ana Wind</td>
<td>32</td>
</tr>
<tr>
<td>Sundowner Wind*</td>
<td>2 to 3</td>
</tr>
</tbody>
</table>

* Note: The Diablo and Sundowner wind hazards are not present in Los Angeles County. They are included here for information purposes only.

Potential Impacts of the Hazard

The significance (or priority) of a hazard’s potential impacts is based primarily on the frequency and resulting damage caused by the hazard, including deaths/injuries and property, crop, and economic damage. All assets and people within CSU Long Beach campus areas are at risk from the effects of severe weather.

**Wind Hazards (Including Tornadoes)**

Wind hazard events have the potential to impact people, property, and operations on campuses across the CSU system. People caught in the open during an extreme wind event are exposed to high winds and debris, and could be injured or killed.

The habitability of buildings can be compromised (by damaging roofs, windows, or other weak points in the building envelope), leading to long-term operational issues for the campus. As with most university campuses, space is always at a premium at the CSU Long Beach campus, and the loss of any currently utilized space due to building or structural damage would likely disrupt operations and the University’s mission.
Extreme wind events can result in power failure, which would impact the operation of the campus. Fallen tree limbs and other potential transportation hazards may also cause disruption to the surrounding community and limit ingress/egress to the campus.

According to the 2017 City of Long Beach Hazard Mitigation Plan Local Hazard, the “Windstorm” hazard (i.e., high wind, including tornado, that is primarily caused by Santa Ana winds) is a hazard that poses enough of a “significant” threat to the city that it could result in the declaration of a local disaster. On a scale of 1 (lowest) to 4 (highest), it is rated as a 2.95 (out of 4) in terms of significance. As a result, the wind hazard is considered to be of medium to high significance, and therefore to have a moderate to high potential impact on both the city and (by extension) the CSU Long Beach campus.\textsuperscript{171}

**Hail**

Hail typically impacts property by damaging structures, cars, and utilities as it falls. Dents in cars, broken glass, and holes in roofs are common impacts of hail. Injuries to people from hail are less common, though they can happen, as hail is a hard object falling in an unpredictable manner at a fairly high rate of speed.

According to the 2017 City of Long Beach Hazard Mitigation Plan Local Hazard, hail hazards are not considered to be significant hazards, and are therefore not included in the hazards profiled by the Plan. As a result, the hail hazard is deemed to have low significance, and therefore to have a minimal potential impact on both the city and (by extension) the CSU Long Beach campus.\textsuperscript{172}

**Lightning**

Lightning strikes the United States about 20-25 million times a year.\textsuperscript{173} Although most lightning occurs in the summer months, people can be struck at any time of year. Since 1990, lightning has killed an average of 39 people each year in the United States, and hundreds more have been injured.\textsuperscript{174} Property losses due to lightning have been very costly across the U.S. For example, from 2005 through 2020, U.S. homeowner’s insurance claim payouts for lightning losses totaled approximately

$15,334,600,000, or $958,412,500 worth of payouts per year.\(^{175}\) (Commercial claim payouts for lightning losses for the U.S. were not available.)

According to the 2017 City of Long Beach Hazard Mitigation Plan Local Hazard, lightning hazards are not considered to be significant hazards, and are therefore are not included in the hazards profiled by the Plan. As a result, the lightning hail hazard is deemed to have low significance, and therefore have a minimal potential impact on both the city and (by extension) the CSU Long Beach campus.\(^{176}\)

Probability of Future Occurrence of the Hazard

Areas throughout California, including all California State University (CSU) campuses, experience severe weather events every year, and future occurrences of such events are projected to increase in both their frequency and intensity. The 2017 City of Long Beach Hazard Mitigation Plan states that the probability of “Windstorm” events (i.e., high wind events – including tornadoes – caused primarily by Santa Ana winds) occurring in Long Beach is “Highly Likely;” that is, they are frequent events with a well-documented history of occurrence and an annual probability of greater than 1 in 10 (>10%).\(^{177}\) Also, according to the NCEI Storm Events Database, severe weather wind hazard events (excluding tornadoes) have occurred in Los Angeles County 427 times since 1996, or an average of 16.86 times per year.\(^{178}\) Furthermore, while the severe weather hazard is a non-spatial hazard that affects all areas of the CSU Long Beach campus equally, the smallest geographic unit of measurement for almost all official severe weather event data is at the county level. Because the severe weather data used in this assessment do not exist at the campus level, it is assumed that the severe weather probabilities for the CSU Long Beach campus reflect those of the surrounding community and County identified in Table 12-XX below.

Based on the data available from both the 2017 City of Long Beach Hazard Mitigation Plan and the NCEI Storm Events Database, the severe weather hazard is expected to occur on (or otherwise impact) the CSU Long Beach campus at least once on an annual basis. Therefore, the probability of future occurrence of the severe weather hazard for CSU Long Beach is HIGHLY LIKELY. See Table 12-XX for probabilities of

\(^{175}\) Retrieved on 07.21.2021 from https://www.iii.org/table-archive/20504


\(^{178}\) National Climatic Data Center. Storm Events Database. Retrieved 08.07.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28Z%29+High+Wind&eventType=%28Z%29+Strong+Wind&eventType=%28C%29+Thunderstorm+Wind&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=LOS%2BANG ELES%3A37&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA
future occurrence for component severe weather hazards for the Los Angeles County and the campus.

Table 12-36: Severe Weather Hazard Probabilities of Future Occurrence for Los Angeles County and CSU Long Beach

<table>
<thead>
<tr>
<th>Severe Weather Hazard Category</th>
<th>Average Number of Hazard Events Per Year</th>
<th>Probability of Future Occurrence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wind (Includes High, Strong and Thunderstorm Winds ONLY)</td>
<td>16.86</td>
<td>Highly Likely</td>
</tr>
<tr>
<td>Tornado</td>
<td>0.47</td>
<td>Possible</td>
</tr>
<tr>
<td>Hail</td>
<td>0.71</td>
<td>Likely</td>
</tr>
<tr>
<td>Lightning</td>
<td>0.36</td>
<td>Possible</td>
</tr>
<tr>
<td>Diablo Wind**</td>
<td>2.5</td>
<td>Not Rated</td>
</tr>
<tr>
<td>Santa Ana Wind</td>
<td>32</td>
<td>Highly Likely</td>
</tr>
<tr>
<td>Sundowner Wind**</td>
<td>2 to 3</td>
<td>Not Rated</td>
</tr>
</tbody>
</table>

** Note: The Diablo and Sundowner wind hazards are not present in Los Angeles County, and therefore are not rated for probability of future occurrence. They are included here for information purposes only.

Vulnerability to the Hazard

People, structures, and assets on the CSU Long Beach campus are all vulnerable to the impacts associated with severe weather. Infrastructure can be damaged or destroyed by hail, wind, tornadoes, thunderstorms, and lightning, which can result in service interruptions and outages. Structures can be damaged or destroyed by hail, wind, tornadoes, thunderstorms, and lightning. People can be injured or killed by lightning, flying debris, hail, or extreme wind events. The CSU Long Beach campus also has vehicles, as well as off-campus conference and recreational facilities, that are all vulnerable to a severe weather event.

Estimate of Potential Losses

Severe weather is a non-spatial hazard that affects the entire CSU Long Beach campus. Each of the hazards associated with severe weather can result in losses throughout the planning area.
All structures within the CSU Long Beach campus are at risk from severe weather. There are approximately 119 buildings on the main campus that could be damaged by wind, hail, and/or lightning. If even a fraction of these assets were to be damaged, the resulting estimated losses would still be in the millions of dollars. The total replacement costs due to severe weather hazard are $453,426,848 for 87 of the buildings, and unknown for the remaining 32 buildings. An analysis of projected dollar losses to campus buildings from severe weather as a percentage of building replacement costs is not currently available, though CSU leadership may pursue such data in the future.

The population at the CSU Long Beach campus varies throughout the day. As of Fall, 2019, CSU Long Beach had 38,074 students and 4,004 faculty and staff. All are at risk from severe weather events, with 42,078 being directly vulnerable in this scenario.

**Vulnerability Assessment Conclusions**

Severe weather presents a variety of hazards to the CSU Long Beach campus. People, assets, infrastructure, and vehicles can all be damaged by this hazard, and losses can quickly begin to rise. In the aggregate, severe weather is a frequently occurring hazard (mostly in the form of wind hazard events) that presents a variety of risks to CSU Long Beach.

It is evident that the CSU Long Beach campus has vulnerabilities to and risks from severe weather hazard incidents, and that pre-event planning, communication, and mitigation efforts should be implemented. Public education and outreach regarding areas of shelter that could be used by campus populations during severe weather events is considered by campus leadership to be one viable mitigation option. The campus planning committee will continue to look for feasible and cost-effective options for the mitigation of severe weather risks going forward.

**Identified Data Limitations**

Numerous federal agencies maintain a variety of records regarding losses associated with hazards. Unfortunately, no single source is considered to offer a definitive accounting of all losses. The Federal Emergency Management Agency (FEMA) maintains records on federal expenditures associated with declared major disasters. The US Army Corps of Engineers (USACE) and the Natural Resources Conservation Service (NRCS) collect data on losses during the course of some of their ongoing projects and studies. Additionally, the National Oceanic and Atmospheric Administration’s (NOAA) National Centers for Environmental Information (NCEI)

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collects and maintains data about natural hazards in summary format, as well as occurrences, dates, injuries, deaths, and estimated costs for individual storm events. Many of these databases and other data collection services, including the NCEI, have inherent data limitations when searching for information at a scale as small as a single campus.

The best available data and records have been used throughout this section. Where no data or records exist or could be located, that deficiency is noted.
12.4 Social Resilience Assessment

Overview

While every person is vulnerable to risk, individuals from diverse populations such as those with access and functional needs are disproportionately more vulnerable and may be at a higher risk to harm in a disaster event. In addition to physical vulnerabilities, the intersectionality between physical hazard risks and population social vulnerabilities must be considered to holistically address overall campus risk.

As inclusivity is a high priority for CSU, addressing campus risk and resilience must be done through the lens of inclusion and equity. Addressing social vulnerability is an increasingly critical requirement of state and national doctrines and described in Section 4.4 of the HVRA Base Plan. Every individual of the campus’s richly diverse population group needs to have the capacity, skills, and knowledge in order to understand, access, and participate in risk reduction and disaster response in ways that are meaningful to their own unique situation. In a campus community, having strong social support networks and active involvement in community disaster responses may negatively or positively impact these opportunities and reduce the resilience-building process. This section offers a glimpse into the CSU Long Beach campus’s unique social construct, population demographics, strengths and concerns and presents a high-level assessment of the resilience, coping capacities and potential social vulnerabilities of students, staff and faculty. The research variables that were asked are often considered sensitive subjects, and few are traditionally included in emergency management/hazard mitigation planning.

This social resilience assessment of college campuses is the first of its kind in the nation. The research methodology unfolded as the interviews with campuses progressed. The assessment data presented are not definitive or authoritative. The answers, analysis, and suggested trends are strictly indicators for potential social risk. They do not represent an accurate data capture as limitations on the data gathering process influenced an ability to provide accuracy. This assessment provides indications of increased risk, not accuracy of response or a true reflection of the situation of the campus. The information presented is to be considered in the context of the more detailed system-wide CSU social vulnerability assessment that is included in the baseline HVRA.

Campus-Identified Populations of Concern

During the campus interview, the following responses were provided when asked, “In considering the diverse population group(s) amongst student body, faculty and staff, which are of the most concern in your emergency management planning?”
### Question

Which population groups amongst the student body, faculty, and staff, are of the most concern for physical and social vulnerabilities in emergency management planning?

- Students experiencing homelessness
- Populations who are housing and food insecure
- Populations with access and functional needs

Which population groups are most difficult to reach in an event?

- International students
- Commuter students and employees
- Populations with access and functional needs

Which population groups have little/limited support networks if impacted by an event?

N/A

### Resilience Variables Related to Campus Emergency Management

The interviewees were asked to reflect on a set of 12 variables for the campus populations of student, faculty and staff: homelessness (*housing insecurity*), food security, health and wellness, disability/access and functional needs (AFN), racial equity, digital equity, communications, international students, immigrants/immigration status issues (*undocumented, DACA, etc.*), LGBTQI (Lesbian Gay Bisexual Transgender Questioning (or queer) Intersex), and transportation dependency. They were also offered an opportunity to add any other factor they wanted to include. The following two questions were asked:

- Is this factor a particular issue of concern for emergency management on your campus? Responses were summarized as *Very High, High, Medium, Low*
- Is this factor reflected in the emergency plans and processes for your campus? Responses were summarized as *Yes, No, In Progress, NA*
In order to provide a high-level qualitative response for the answers, the approach of averaging response was taken. If conflicting answers were expressed by the interviewees, the answer (code) was averaged out. A detailed explanation of the response averaging approach is included in the base HVRA.

Table 12-38: campus-specific emergency management issues of concern and inclusion in emergency management plans and processes

<table>
<thead>
<tr>
<th>Issue of Concern</th>
<th>Plans &amp; Processes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Homelessness (Housing Insecurity)</td>
<td>Low</td>
</tr>
<tr>
<td>Food Security</td>
<td>Low</td>
</tr>
<tr>
<td>Health &amp; Wellness</td>
<td>Medium</td>
</tr>
<tr>
<td>AFN</td>
<td>Low</td>
</tr>
<tr>
<td>Digital Equity</td>
<td>Low</td>
</tr>
<tr>
<td>Comms.</td>
<td>Low</td>
</tr>
<tr>
<td>International Students / Immigrants / Immigration Status</td>
<td>Low</td>
</tr>
<tr>
<td>LGBTQI</td>
<td>Low</td>
</tr>
</tbody>
</table>

![Color scale legend](image)
Qualitative Narrative: Campus Overview of Potential Resilience Vulnerabilities

The following are interview notes of interest:

- EOP is reviewed by the health center before finalized.
- CARES referrals: anyone can refer to CARES, [referrals] gone through the roof; absolute increase, seeing referrals coming in.
- Access Center, head of the dept, is involved with the committees and plans and review everything; separate plans on issues such as; have an ongoing partnership
- Town hall and press conference having ASL interpreters.

Campus High Hazards and Potentially Vulnerable Populations

This section provides a brief introduction to the link between socially vulnerable populations and a particular hazard type. While extensive research has been conducted on the impacts of hazards, not all linkages have been documented or published, and detail for finding them are beyond the scope of this assessment. It’s important to note, the intersectional nature of what makes an individual’s personal experience and resilience to an event is played out by unique factors for that individual or population. The nuanced social vulnerabilities often come from the social and physical environment in which a person is embedded.

In order to aid in further assessing campus resilience, below is a general description of the known impacts. From some hazards, the descriptions are robust, while others are only brief introductions.

Table 12-39: CSU Long Beach *Highly Likely, Likely and Possible* Hazards

<table>
<thead>
<tr>
<th>Hazard</th>
<th>Future Occurrence Probability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Communicable Disease</td>
<td>Highly Likely</td>
</tr>
<tr>
<td>Drought</td>
<td>Highly Likely</td>
</tr>
<tr>
<td>Earthquake</td>
<td>Possible</td>
</tr>
<tr>
<td>Erosion</td>
<td>Likely</td>
</tr>
<tr>
<td>Extreme Temperature</td>
<td>Possible (Heat Only)</td>
</tr>
<tr>
<td>Flood</td>
<td>Possible</td>
</tr>
<tr>
<td>Hazardous Materials</td>
<td>Possible</td>
</tr>
<tr>
<td>Power Outage</td>
<td>Likely</td>
</tr>
<tr>
<td>Sea Level Rise</td>
<td>Highly Likely</td>
</tr>
<tr>
<td>Tsunami</td>
<td>Likely</td>
</tr>
</tbody>
</table>
Drought

The 2012-2016 drought had severe effects on two vulnerable sectors of our population: those in low-income brackets, and those, especially Native Americans, who rely on subsistence fishing for their livelihoods.\footnote{News Deeply. “Study finds two groups hardest hit by California’s drought.” Accessed January 8, 2020. https://www.newsdeeply.com/water/community/2017/01/25/study-finds-two-groups-hardest-hit-by-californias-drought.} Water bills increased throughout the state. Due to rising water prices, for the working poor, many have paid four to five percent of their income for water. Since many CSU students are commuters, and many living with families, future drought impacts may potentially affect a percentage of non-resident students. NASA’s modeling shows that future droughts are likely to last longer and be more intense, even leading to “megadroughts” in the western states.\footnote{NASA. “Earth’s Freshwater Future: Extremes of Flood and Drought.” June 13, 2019. https://climate.nasa.gov/news/2881/earths-freshwater-future-extremes-of-flood-and-drought/.} Fresh water supplies are predicted to be full of extremes, with both droughts and extreme precipitation events being more severe. The interrelationship between drought and other hazard conditions may lead to a set of secondary impacts. Drought conditions lead to water quality issues due to loss of drinking water, increased fire danger that leads to drought-induced fires and elevated AQI levels, as well as extreme heat or prolonged heat events.

Earthquake

Impacts on populations from earthquakes are complex, with long-term implications on social stability for all populations. In addition to the physical impact exposure during a no-notice earthquake event and the social and logistical challenges of a recovering community, an earthquake can have lasting impacts long afterwards due to post traumatic stress disorder (PTSD).

Socioeconomic vulnerabilities of populations at risk were analyzed in the hypothetical yet scientifically realistic earthquake sequence that is being used to better understand hazards for the San Francisco Bay region during and after a magnitude-7 earthquake (mainshock) on the Hayward Fault and its aftershocks. In this study, the at-risk populations located in areas of concentrated damage are anticipated to experience longer recovery trajectories, increased long term housing displacement, and transportation impacts due to dependencies on transit dependencies. When neighborhood schools close, families with school age children may move to other areas to keep their children in schools. Persons with access and functions needs are likely to be more dependent on access to functioning medical, social and personal health care services that would be overwhelmed by the event and therefore increasing their vulnerabilities. For the homeless populations, the loss of social community
services and damages to shelters could add to protracted relocations. For the young and mobile populations who rent, the major disruption to housing, jobs and transit will also drive relocation. Widespread housing damage and preexisting housing market constraints will make it “extremely challenging” for the socially and economically vulnerable populations to find alternative housing near their home communities. Those who utilize interim and irregular housing for months and years after a disaster are more vulnerable to physical, social, and mental disorders, including suicide, substance abuse, and physical and verbal abuse. Aftershocks and post disaster conditions delay population return and increase outmigration.\textsuperscript{183}

\textit{Erosion}

Risk from erosion relates to earthen and infrastructural losses. The degree of vulnerability to these events and their impacts depends on human behavior and the traditional social factors such as situational awareness, prior knowledge of hazards, social capital and decision-making capabilities, as well as increased vulnerability due to social factors, such as racial and economic disparities.

\textit{Extreme Temps}

People susceptible to respiratory ailments (asthma, lower and upper respiratory disease) disproportionately suffer from the effects of fire, smoke, air pollutions, allergens, heat and PSPS. Those with limited income or without resources are affected disproportionately due to the inability to provide safe shelter, air conditioning, cooling, air purification, medical care, and quality foods, and are also least able to obtain information related to climate risks and adaptation strategies.

\textit{Heat}

Heatstroke, cardiovascular disease, respiratory disease and cerebrovascular disease are related to extreme heat events. Increased number of heat waves creates heat-related physical stress on populations and is exacerbated in the metropolitan areas where greater amounts of heat-absorbing surfaces (e.g., asphalt and concrete) trap heat and emit higher temperatures throughout the night.

The heat also extends the geographic range and the distribution of disease-carrying insects and pests. Health professionals are concerned that California’s warming climate will allow species to acclimate. Such vectors include such pests as ticks that carry Lyme disease, and mosquitos that transmit Zika, dengue fever, West Nile,

plague and tularemia. Some others, such as chikungunya, Chagas disease, and Rift Valley fever virus, are threats as well.

Some communities of color and some low-income, homeless, and immigrant populations are more exposed to heat waves, as these groups often reside in urban areas affected by heat island effects. In addition, these populations are likely to have limited adaptive capacity due to a lack of adequately insulated housing, inability to afford or to use air conditioning, inadequate access to public shelters such as cooling centers, and inadequate access to both routine and emergency health care. These social, economic, and health risk factors give rise to the observed increase in deaths and disease from extreme heat in some immigrant and impoverished communities.

Heat stroke, the most serious heat-related illness, occurs when the body is unable to control its temperature. Body temperature rises rapidly, the sweating mechanism fails, and the body cannot cool down. In extreme causes, heat stroke can cause confusion and unconsciousness, so the victim is unable to seek treatment without assistance.

There are several groups of people who are uniquely vulnerable to the effects of extreme heat, such as infants and children, older adults aged 65 and up, athletes and outdoor workers, low-income households, and individuals with certain chronic medical conditions.

When dealing with an extreme heat event, the most common impacts are those generally felt by the people living in the targeted area. For people in particular, heat can kill when the body is pushed beyond its limits. Most heat disorders occur because the victim has been overexposed to heat. As discussed, the major human risks associated with extreme heat include dehydration, sunburn, fatigue, heat exhaustion, heat stroke, and in severe cases, death.

Some portions of the population are more at risk to the effects of extreme heat. The very young, the elderly, and certain groups with chronic medical conditions (such as asthma or other pulmonary illnesses, heart disease, poor blood circulation, neurological illnesses, and obesity) are generally more vulnerable to the effects of extreme heat, and are more likely to suffer illness or death as a result.

This is especially true if exposure is extended for a period of time and preventative measures are not taken immediately. Distributional implications of impacts, and even less on distributional implications of adaptation actions.” 184

**Flood**

Risk from floods relates to community risk, exposure and infrastructural losses. The degree of vulnerability to these events and their impacts depends on human behavior

and the traditional social factors such as situational awareness, prior knowledge of hazards, social capital and decision-making capabilities. The exposure of humans to floods continues to increase, driven by changes in hydrology and land use. The adverse impacts on socially vulnerable populations are amplified because a disproportionately high number live in flood-prone areas. Research has shown that places of social vulnerabilities are places characterized by housing and racial disparities, such as mobile home parks, structural fragility and poverty, and higher percentages of populations such as Black and Native Americans, and others with shared histories of discrimination, marginalization and exclusion. 185

Health impacts from flooding are well recognized due to the extensive history of flooding in California and around the nation. The impacts range from waterborne illnesses from contaminated waters, respiratory illnesses that impact the lungs, throat, and airways from airborne particles, mold on flooded buildings that can trigger asthma, allergies and other illnesses—all which are particularly impactful to older, younger and individuals with pre-existing health condition. Foodborne illnesses can increase if there are issues with power outages or sewer overflows. Individuals with increased mental health concerns can be impacted by the stress or anxiety from the impacts of the flood. Poor quality housing can increase vulnerability to many flood risks, including flood inundation, power outages, mold growth, rodent vectors, and serious health impacts. For those with limited finances, flood inundation and impacts to infrastructure or farmlands may lead to extensive income losses.

The poorest residents suffer disproportionately to flood situations, especially those who have been less able to fund homeowner’s insurance to protect against flood losses. Loss of life is not unusual in flooding situations, as is loss of property, livestock, pets, workplaces, and tourist industries. There is a strong interrelationship between water events and other hazards. Flooding, storms and water quality are related to each other. Drought conditions can exacerbate floods as the surface soils are hardened and not as ready to allow surface water absorption. Extreme heat events can cause snowmelt, inundating waterways and causing flood and water quality issues. Flooding and storm events can have impacts on public health, environmental health, agricultural health and economic system health. Mental health issues are reported for all people who have experience flood losses, including anxiety, fear, anger, anger, sadness and grief. 186 Additionally, waterborne disease outbreaks are reported weeks after the flood events. Mold contamination leads to indoor air issues.


Damp indoor environments lead to increased prevalence of asthma, and also upper and lower respiratory symptoms.

These issues may influence the diverse CSU populations, both on and off campus, in a number of ways long after a flood event, or the related hazards impacts, has concluded.

**Hazardous Materials**

The severity of a hazardous materials release depends upon the type of material released, the amount of the release, and the proximity to populations or environmentally sensitive areas such as wetlands or waterways. The release of materials can lead to injuries or evacuation of nearby residents. Wind direction at the time of the release can also have a bearing on the severity (as well as the location and extent) of a hazardous materials release.

The primary threat from the hazardous materials incident hazard is to the structures located along transmission lines and transportation routes or near facilities that use or store hazardous materials. Minor incidents would likely cause no damage and little disruption, assuming they could be contained quickly. Major incidents could have fatal and disastrous consequences. The severity of a hazardous material release relates primarily to its impact on human safety and welfare and on the threat to the environment. Threats to human safety and welfare include:

- Poisoning of water or food sources and/or supply
- Presence of toxic fumes or explosive conditions
- Damage to personal property
- Need for the evacuation of people
- Interference with public or commercial transportation

Environmental risks are not uniformly distributed across groups of people. Age, poverty, and minority status place some groups at a disproportionately high risk for environmental disease.\(^{187}\) Poor access to health information and health care means less health promotion, less risk avoidance, a less healthy diet, and more adverse conditions that increase susceptibility to exposure. Delayed recognition of exposure, diagnosis, and treatment allows effects to accumulate.\(^{188}\)

\(^{187}\) [https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3222496/](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3222496/)

**Power Outage/Public Safety Power Shutdowns (PSPS)**

Loss of power creates economic hardship to a region experiencing regular PSPS events, such as those experienced throughout the state over the recent years. Many businesses close, including gas stations, grocery stores, and local retail establishments. These impacts may deeply impact students dependent on support jobs, as well impacting family members of campus staff and faculty. PSPS increases risks to the public due to inability to use medical devices, spoilage of food and medicines, and disruption to infrastructure, such as supply of clean water and electricity used to run home medical equipment, such as lift chairs and ventilators.

**Sea Level Rise**

TBD

**Tsunami**

TBD

**Hazard Mitigation and Emergency Management Planning**

The goal of this high-level assessment is to provide a starting point to encourage further exploring campus social risks and vulnerabilities, as well as to inform and to enhance holistic emergency management and hazard mitigation decision making, planning processes and future adaptive risk management strategies. By including the social resilience factors, mitigation investments may move beyond standardized planning and regulations, structure and infrastructure projects, and natural systems protections to embrace a more expanded, customized emergency operations plan and an education and outreach program unique to the campus.

A more robust social resilience inquiry is strongly encouraged to develop an accurate picture, based on methodical and scientific research-based data. Such an effort would be envisioned through both nuanced discussions with a variety of campus stakeholders and the invitation of nontraditional stakeholders to join in a collaborative resilience partnership. Such a forward-leaning effort would be directly in keeping with CSU’s commitment to inclusion and equity in risk reduction.
Section 13
California State University, Los Angeles

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13.1 University Profile

University History

California State University, Los Angeles (Cal State LA) is located on the site of one of California’s 36 original adobes, built in 1779 by Franciscan missionaries and destroyed by fire in 1908. These lands were once known as Rancho Rosa Castilla, given to Juan Batista Batz, a Basque rancher from Northern Spain who settled here in the 1850s.

Founded by an Act of the California legislature in 1947, Los Angeles State College opened for classes on the campus of L.A. City College. In 1949, Los Angeles State College became Los Angeles State College of Applied Arts & Sciences, with 2,187 students. Six (6) years later, in 1955, groundbreaking began for a new Los Angeles State College of Applied Arts & Sciences campus, and in 1958, the first classes were held on the newly built (and current) campus site. In 1964, Los Angeles State College was officially renamed California State College at Los Angeles and became part of the California State College system. The college then received University status and was officially renamed California State University, Los Angeles (Cal State LA) in 1972. Notable achievements include the establishment of the nation’s first Chicano Studies program in 1968, as well as the development of Cal State LA’s Charter College of Education, the first such college of higher education in the nation in 1993. Today, Cal State LA is designated as both a Hispanic-Serving Institution (HSI) and an Asian American and Native American Pacific Islander-Serving Institution (AANAPISI).

University Governance

The campus president is the chief executive officer who oversees the administration of the entire university. The president manages campus operations and fundraising, sets campus priorities, and oversees the hiring and support of staff and faculty. The president also maintains a close working relationship with the CSU’s systemwide office, reporting to the chancellor and participating in the systemwide Executive Council.

The provost is the chief academic officer of the university, overseeing all academic affairs and programs of the university. The provost reports directly to the president.

The Executive Committee operates in an advisory capacity for the university president. The Cabinet is comprised of senior leaders on campus who provide advice to the president in addressing strategic and operational issues and in pursuing new initiatives.

University Mission

“Cal State LA transforms lives and fosters thriving communities across greater Los Angeles. We cultivate and amplify our students’ unique talents, diverse life experiences, and intellect through engaged teaching, learning, scholarship, research, and public service that support their overall success, well-being, and the greater good.”

Cal State LA highlights twelve core values fundamental to their success by prioritizing the students of Cal State LA, pushing the limits of their goals and challenges, engaging the
public through service, valuing diversity, equity and inclusion, engaging the student population at Cal State LA, engaged learning, pursuing academic distinction, creating and growing a community of scholars, practicing a culture of excellence, transparency, mutual respect within the CAL STATE LA community, and inspiring academic freedom.

University Location

Cal State LA’s main campus is located in the University Hills district of Los Angeles, CA, about five (5) miles east of Downtown Los Angeles. A satellite campus, Cal State LA Downtown, is located in Downtown Los Angeles.

University Population

Cal State LA has a total enrollment of 28,531 students. The full-time enrollment at Cal State LA is 23,319 students and the part-time enrollment is 5,212. This means that 81.7% of students enrolled at Cal State LA are enrolled full-time.

The enrolled student population at Cal State LA, both undergraduate and graduate, is 63% Hispanic or Latino, 13.6% Asian, 7.19% White, 3.76% Black or African American, 1.82% Two or More Races, 0.109% American Indian or Alaska Native, and 0.0841% Native Hawaiian or Other Pacific Islanders.

The most popular Bachelor’s Degree concentrations at Cal State LA are General Business Administration & Management, Sociology, and General Psychology. Cal State LA is predominantly a commuter campus.

13.2 Interim Final Rule for Hazard Vulnerability and Risk Assessment

Requirement §201.6(c)(2): The plan shall include a risk assessment that provides the factual basis for activities proposed in the strategy to reduce losses from identified hazards. Local risk assessments must provide sufficient information to enable the jurisdiction to identify and prioritize appropriate mitigation actions to reduce losses from identified hazards.

Requirement §201.6(c)(2)(i): [The risk assessment shall include a] description of the type...location and extent of all natural hazards that can affect the jurisdiction. The plan shall include information on previous occurrences of hazard events and on the probability of future hazard events.

Requirement §201.6(c)(2)(ii): [The risk assessment shall include a] description of the jurisdiction’s vulnerability to the hazards described in paragraph (c)(2)(i) of this section. This description shall include an overall summary of each hazard and its impact on the community.
Requirement §201.6(c)(2)(ii): [The risk assessment] must also address National Flood Insurance Program (NFIP) insured structures that have been repetitively damaged floods.

Requirement §201.6(c)(2)(ii)(A): The plan should describe vulnerability in terms of the types and numbers of existing and future buildings, infrastructure, and critical facilities located in the identified hazard area.

Requirement §201.6(c)(2)(ii)(B): [The plan should describe vulnerability in terms of an] estimate of the potential dollar losses to vulnerable structures identified in paragraph (c)(2)(ii)(A) of this section and a description of the methodology used to prepare the estimate..

Requirement §201.6(c)(2)(ii)(C): [The plan should describe vulnerability in terms of] providing a general description of land uses and development trends within the community so that mitigation options can be considered in future land use decisions.

Requirement §201.6(c)(2)(iii): For multi-jurisdictional plans, the risk assessment must assess each jurisdiction’s risks where they vary from the risks facing the entire planning area.

13.3 Hazard Identification and Risk Assessment

Overview of California State University, Los Angeles History of Hazards

Numerous federal agencies maintain a variety of records regarding losses associated with hazards. Unfortunately, no single source is considered to offer a definitive accounting of all losses. The Federal Emergency Management Agency (FEMA) maintains records on federal expenditures associated with declared major disasters. The US Army Corps of Engineers (USACE) and the Natural Resources Conservation Service (NRCS) collect data on losses during the course of some of their ongoing projects and studies. Additionally, the National Oceanic and Atmospheric Administration’s (NOAA) National Centers for Environmental Information (NCEI) database collects and maintains data about natural hazards in summary format. The data includes occurrences, dates, injuries, deaths, and estimated costs. Many of these databases and other data collection services, including the NCEI, have inherent data limitations when searching for information at a university scale.

The best available data and records were used throughout this assessment.

Hazard Identification

As part of the initial hazard identification process, the Campus Assessment Team considered potential hazards with the most chance to significantly affect the planning area. The hazards include those that have occurred in the past and may occur in the future. A variety of sources were used to develop the list of hazards considered including national, regional, and local sources such as emergency operations plans, FEMA’s How-
To Series, websites, published documents, databases, and maps, as well as discussion among the Campus Assessment Team members.

In the initial phase of the planning process, the Campus Assessment Team considered 14 hazards and the risks they create for the University and its material assets, population, and operations. The hazards initially considered, and the determinations as to the treatment of those hazards, are shown in Table 13-1 (following).

Table 13-1: Hazard Identification Determinations

<table>
<thead>
<tr>
<th>Hazard</th>
<th>Determination (Yes/No)</th>
<th>Reason for Determination</th>
<th>Future Occurrence Probability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Communicable Disease</td>
<td>Yes</td>
<td>Hazard of concern for campus</td>
<td>Highly Likely</td>
</tr>
<tr>
<td>Dam and Levee Failure</td>
<td>No</td>
<td>Not a hazard of concern for campus</td>
<td>N/A</td>
</tr>
<tr>
<td>Drought</td>
<td>Yes</td>
<td>Hazard of concern for campus</td>
<td>Highly Likely</td>
</tr>
<tr>
<td>Earthquake</td>
<td>Yes</td>
<td>Hazard of concern for campus</td>
<td>Possible</td>
</tr>
<tr>
<td>Erosion</td>
<td>Yes</td>
<td>Hazard of concern for campus</td>
<td>Unlikely</td>
</tr>
<tr>
<td>Extreme Temperature</td>
<td>Yes</td>
<td>Hazard of concern for campus</td>
<td>Possible (Heat); Unlikely (Cold)</td>
</tr>
<tr>
<td>Flood</td>
<td>Yes</td>
<td>Hazard of concern for campus</td>
<td>Unlikely</td>
</tr>
<tr>
<td>Hazardous Materials</td>
<td>Yes</td>
<td>Hazard of concern for campus</td>
<td>Likely</td>
</tr>
<tr>
<td>Landslide</td>
<td>Yes</td>
<td>Hazard of concern for campus</td>
<td>Unlikely</td>
</tr>
<tr>
<td>Power Outage</td>
<td>Yes</td>
<td>Hazard of concern for campus</td>
<td>Likely</td>
</tr>
<tr>
<td>Sea Level Rise</td>
<td>No</td>
<td>Not a hazard of concern for campus</td>
<td>N/A</td>
</tr>
<tr>
<td>Tsunami</td>
<td>No</td>
<td>Not a hazard of concern for campus</td>
<td>N/A</td>
</tr>
<tr>
<td>Volcano</td>
<td>Yes</td>
<td>Hazard of concern for campus</td>
<td>Unlikely</td>
</tr>
<tr>
<td>Wildfire</td>
<td>Yes</td>
<td>Hazard of concern for campus</td>
<td>Unlikely (Fire); Possible (Smoke)</td>
</tr>
</tbody>
</table>
Future Occurrence Probability

In order to determine the probability of future occurrences of each hazard profiled, the following scale was developed:

- Highly Likely- 76%-100% that the hazard would occur annually.
- Likely- 50%-75% that the hazard would occur annually.
- Possible- 11%-49% that the hazard would occur each annually.
- Unlikely- 0%-10% that the hazard would occur each annually.
Communicable Disease

Description of the Hazard

Communicable diseases are illnesses that occur due to infectious agents or their toxic products and are infectious due to their potential of transmission from one person or species to another by a replicating agent.¹ They may be transmitted from a reservoir to a susceptible host either directly as from an infected person or animal or indirectly through the agency of an intermediate plant or animal host, vector, or the inanimate environment. Communicable diseases are clinically evident illness resulting from the presence of pathogenic microbial agents, including pathogenic viruses, pathogenic bacteria, fungi, protozoa, multi-cellular parasites, and aberrant proteins known as prions.² The degree of spread of a communicable disease depends on both the ability of an organism to enter, survive and multiply in the host and the comparative ease with which the disease is transmitted to other hosts.³

Some ways in which communicable diseases spread are by:

- Travel through the air, such as tuberculosis, measles, or COVID-19;
- Physical contact with an infected person, such as through touch (staphylococcus), sexual intercourse (gonorrhea, HIV), fecal/oral transmission (hepatitis A), or droplets (influenza, TB, COVID-19);
- Contact with a contaminated surface or object (Norwalk virus), food (salmonella, E. coli), blood (HIV, hepatitis B), or water (cholera); and
- Bites from insects or animals capable of transmitting the disease (mosquito: malaria and yellow fever; flea: plague)⁴

Collectively, the twenty-three (23) campuses and Chancellor’s Office of the California State University (CSU) system have identified nine (9) communicable disease hazards that that have had significant impacts on their respective student, faculty, and staff populations. Of these communicable diseases, COVID-19 is considered to be the most prominent and widespread agent across all CSU campuses. (See Table 13-2 below.)

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Table 13-2: Communicable Diseases at Identified CSU Campuses

<table>
<thead>
<tr>
<th>Collective List of Communicable Diseases Identified by All CSU Campuses</th>
<th>Number of CSU Campuses (Including Chancellor’s Office) Identifying Communicable Disease Having Significant Impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>COVID-19 (SARS-CoV-2)</td>
<td>24</td>
</tr>
<tr>
<td>Meningitis</td>
<td>7</td>
</tr>
<tr>
<td>Measles</td>
<td>6</td>
</tr>
<tr>
<td>Influenza (Including H1N1/ Swine Flu)</td>
<td>6</td>
</tr>
<tr>
<td>Tuberculosis</td>
<td>5</td>
</tr>
<tr>
<td>Norovirus</td>
<td>4</td>
</tr>
<tr>
<td>Mumps</td>
<td>2</td>
</tr>
<tr>
<td>E. Coli</td>
<td>2</td>
</tr>
<tr>
<td>Sexually Transmitted Diseases (STDs)</td>
<td>2</td>
</tr>
</tbody>
</table>

(Source: Interviews with CSU campus staff at CSU campuses and at CSU Chancellor’s Office.)

With the exception of COVID-19, there is variability among CSU campuses regarding which communicable diseases have had the greatest impact on individual campus communities. Table 13-3 shows the communicable disease hazards that have had the greatest impact on each CSU campus.

Table 13-3: Communicable Disease Hazards at CSU Campuses with Greatest Impact

<table>
<thead>
<tr>
<th>CSU Campus</th>
<th>Identified Communicable Disease Hazards with the Greatest Impact on CSU Campus</th>
</tr>
</thead>
<tbody>
<tr>
<td>CSU Bakersfield</td>
<td>COVID-19, Meningitis</td>
</tr>
<tr>
<td>CSU Channel Islands</td>
<td>COVID-19, Measles</td>
</tr>
<tr>
<td>Chico State</td>
<td>COVID-19, Tuberculosis</td>
</tr>
<tr>
<td>CSU Dominguez Hills</td>
<td>COVID-19</td>
</tr>
<tr>
<td>Cal State East Bay</td>
<td>COVID-19, Meningitis</td>
</tr>
<tr>
<td>Fresno State</td>
<td>COVID-19, Meningitis, Tuberculosis</td>
</tr>
<tr>
<td>Cal State Fullerton</td>
<td>COVID-19, Influenza</td>
</tr>
<tr>
<td>Humboldt State</td>
<td>COVID-19, Measles, Norovirus, Influenza, STDs</td>
</tr>
<tr>
<td>Cal State Long Beach</td>
<td>COVID-19</td>
</tr>
<tr>
<td>Cal State LA</td>
<td>COVID-19, E. coli, Measles</td>
</tr>
<tr>
<td>-----------------------------------</td>
<td>-----------------------------</td>
</tr>
<tr>
<td>Cal Maritime</td>
<td>COVID-19</td>
</tr>
<tr>
<td>CSU Monterey Bay</td>
<td>COVID-19</td>
</tr>
<tr>
<td>CSUN (Northridge)</td>
<td>COVID-19, Measles</td>
</tr>
<tr>
<td>Cal Poly Pomona</td>
<td>COVID-19, Influenza (Swine Flu - H1N1)</td>
</tr>
<tr>
<td>Sacramento State</td>
<td>COVID-19</td>
</tr>
<tr>
<td>Cal State San Bernardino</td>
<td>COVID-19, Tuberculosis</td>
</tr>
<tr>
<td>San Diego State</td>
<td>COVID-19, Meningitis, Mumps</td>
</tr>
<tr>
<td>San Francisco State</td>
<td>COVID-19</td>
</tr>
<tr>
<td>San José State</td>
<td>COVID-19, H1N1</td>
</tr>
<tr>
<td>Cal Poly San Luis Obispo</td>
<td>COVID-19, Meningitis, Norovirus</td>
</tr>
<tr>
<td>CSU San Marcos</td>
<td>COVID-19</td>
</tr>
<tr>
<td>Sonoma State</td>
<td>COVID-19, H1N1, Norovirus</td>
</tr>
<tr>
<td>Stanislaus State</td>
<td>COVID-19, Tuberculosis</td>
</tr>
<tr>
<td>Office of the Chancellor</td>
<td>COVID-19</td>
</tr>
<tr>
<td>CSU System-Wide</td>
<td>COVID-19, Meningitis, Measles, Tuberculosis, Influenza-Swine Flu-H1N1, Mumps, Norovirus, E. coli, STDs</td>
</tr>
</tbody>
</table>

(Source: Interviews with CSU campus staff at CSU campuses and at CSU Chancellor’s Office.)

**Descriptions of Identified Communicable Disease Hazards at Cal State LA**

Cal State LA has identified three (3) communicable disease hazards that have had the greatest impact on campus – COVID-19, E. coli, and Measles. The following are brief descriptions of the communicable disease hazards at Cal State LA.

**COVID-19 (SARS-CoV-2)**

Coronaviruses are a family of viruses that can cause illnesses such as the common cold, severe acute respiratory syndrome (SARS) and Middle East respiratory syndrome (MERS). In 2019, a new coronavirus was identified as the cause of a disease outbreak that originated in China. This virus is now known as the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2). The disease it causes is called Coronavirus Disease 2019 (COVID-19). In March 2020, the World Health Organization (WHO) declared the COVID-19 outbreak a pandemic.
Signs and symptoms of coronavirus disease 2019 (i.e., COVID-19) may appear two to 14 days after exposure. Common signs and symptoms can include fever, cough, and tiredness. Early symptoms of COVID-19 may also include a loss of taste or smell.

The virus that causes COVID-19 spreads easily among people, and more continues to be discovered over time about how it spreads. Data has shown that the COVID-19 virus spreads mainly from person to person among those in close contact (within about 6 feet, or 2 meters). The virus is transmitted by respiratory droplets being released when someone with the virus coughs, sneezes, breathes, sings or talks. These droplets can be inhaled or land in the mouth, nose or eyes of a person nearby. In some situations, the COVID-19 virus can spread by a person being exposed to small droplets or aerosols that stay in the air for several minutes or hours (i.e., airborne transmission). It’s not yet known how common it is for the virus to spread this way. The COVID-19 virus can also spread if a person touches a surface or object with the virus on it and then touches his or her mouth, nose or eyes; however, this is not considered to be a main way it spreads.

The severity of COVID-19 symptoms can range from very mild to severe. Some people may have only a few symptoms, and some people may have no symptoms at all. However, some people may experience worsened symptoms, such as worsened shortness of breath and pneumonia. People who are older have a higher risk of serious illness from COVID-19, and the risk increases with age. People who have existing medical conditions also may have a higher risk of serious illness from COVID-19. In some cases, the disease can cause severe medical complications and may even lead to death.  

**Measles**

Measles (also known as rubeola) is a highly contagious childhood infection caused by a virus. The measles virus replicates in the nose and throat of an infected child or adult. Then, when someone with measles coughs, sneezes or talks, infected droplets spray into the air, where other people can inhale them. The infected droplets may also land on a surface, where they remain active and contagious for several hours. The virus is contracted by putting touching one’s nose, mouth, or eyes after touching the infected surface.

Measles can be serious and even fatal for small children. The disease still kills more than 100,000 people a year worldwide, most under the age of 5. However, as a result of high vaccination rates in general, measles hasn't been widespread in the United States for more than a decade.  

**E. Coli**

Escherichia coli (E. coli) bacteria normally live in the intestines of healthy people and animals. Most types of E. coli are harmless or cause relatively brief diarrhea. But a few

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strains, such as E. coli O157:H7, can cause severe stomach cramps, bloody diarrhea and vomiting. The E. coli O157:H7 strain belongs to a group of E. coli that produces a powerful toxin that damages the lining of the small intestine. Potential sources of exposure to E. coli O157:H7 include contaminated food or water – especially raw vegetables and undercooked ground beef – and person-to-person contact.

Signs and symptoms of E. coli O157:H7 include diarrhea (which may range from mild and watery to severe and bloody), stomach cramping, pain or tenderness, and nausea and vomiting. Infection can occur anytime from one day to one week after exposure to the bacteria, but usually begin three or four days after exposure.7

Location of the Hazard

Communicable diseases have the potential to affect the entire Cal State LA planning area equally. As a result, the communicable disease hazard can be found at the Cal State LA campus located in Los Angeles, CA (Los Angeles County). Because of the ubiquitous nature of many communicable diseases, students, faculty, staff at (and visitors to) at Cal State LA are at risk of exposure to the communicable disease hazard.8

CSU Student Housing Locations and Populations

Although CSU-campus-owned student housing opportunities have been severely limited due to the COVID-19 pandemic, this situation is temporary. Eventually, students will be allowed back on campus at full capacity, and many of these students will be living in campus-owned housing. When this occurs, over 53,000 students (i.e., just over 11% of the CSU total enrollment) will be at increased risk of exposure to communicable disease hazards, owing to the “close-quarters” living arrangements in student housing. For CSU – Los Angeles, approximately 4% of its 26,361 enrolled students or 1,054 students reside in student housing.9,10 In the fall of 2021, a new student housing facility is opening adding 1,500 beds to the existing 1,054 beds for a total of 2,554 students (9.7%) residing in on-campus housing.

8 California State University. About CSU. Retrieved 4.29.2021 from: https://www2.calstate.edu/csu-system/about-the-csu
10 California State University. CSU Campus Match. Retrieved 04.30.2021 from: https://www2.calstate.edu/attend/campuses/campus-match/Pages/campus-match.aspx
Extent of the Hazard

Various communicable diseases are categorized by the Center for Disease Control and Prevention (CDC) by levels of containment called Biosafety Levels (or BSLs). The higher the BSL, the greater the level of containment and level of effort necessary to prevent transmission of the disease, and therefore the greater the hazard. Biosafety Levels prescribe procedures and levels of containment for a particular microorganism or material (including research involving recombinant or synthetic nucleic acid molecules) and procedures associated with that containment. BSLs also consider primary barriers (e.g., biosafety cabinets), secondary barriers, facility design, air handling, laboratory security, etc. BSLs are graded from 1 to 4; as the BSL increases so does the relative risk of the agent/procedures as well the stringency of procedures and facility design.

Figure 13-1 describes the different BSLs, and provides examples of communicable diseases that would typically fall into these classifications, as well as the typical protections that would be necessary to prevent transmission of each of the diseases.

Figure 13-1: Biosafety Levels (BSLs)¹¹

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The Extent of Cal State LA Communicable Disease Hazards Except COVID-19:

Before the COVID-19 pandemic, there were cases of Measles and E. coli at Cal State LA. Measles would be classified at the BSL-2 containment level, and E. coli would be also classified at the BSL-2 containment level.  

The Extent of Cal State LA COVID-19 Communicable Disease Hazard:

As a microorganism, the SARS-CoV-2 (COVID-19) virus requires a high level of containment. It is therefore classified at BSL-3.

History of the Hazard

Over an approximately one-year period, from mid-March, 2020 to March 23, 2021, there were a reported 198 cases of COVID-19 at Cal State LA. CSU-campus-specific COVID-19 case data for Cal State LA can be found in the “History of the Hazard” section below.

Most communicable disease data are maintained by the state and at the county levels, and are not generally available at the municipal or campus levels unless (a) the CSU campus falls under the jurisdiction of a city-level health department, or (b) a geographically specific outbreak occurs on campus or in the local community. The exception to this is the current COVID-19 pandemic, where both campus and County-level case data have been collected. As a result, it is important to provide COVID-19 case statistics for both CSU campuses and the counties where CSU campus assets are located.

Following Tables show County-level COVID-19 Case data for Cal State LA. These case data are updated on at least a weekly basis. (Please note that the COVID-19 case numbers here may not reflect the most recent updates.)

Since March 2020, there have been 198 COVID-19 cases among students and employees reported to Cal State LA: 86 students, 74 employees and 38 contractors. These data reflect the number of individuals who have notified the university of their diagnosis.

Of the 86 students, 8 had the virus during a period of time when they were on campus or in instructional activity. Of the 74 employees with a diagnosis, 49 were on campus. The contractors were working at construction sites on campus when they were diagnosed.

Table 13-4: Total COVID-19 cases recorded on and off campus as of 3/22/2021

<table>
<thead>
<tr>
<th>Population</th>
<th>Confirmed Cases</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total On-Campus</td>
<td>95</td>
</tr>
<tr>
<td>Total Off-Campus</td>
<td>103</td>
</tr>
</tbody>
</table>


Potential Impacts of the Hazard

Communicable disease outbreaks and pandemics potentially have (and will continue to have) direct impact on life, health, and safety across the CSU system, including the CSU – Los Angeles campus. The extent of this impact is contingent on the type of infection or contagion, the severity of the outbreak, and the speed at which it is transmitted. Property and infrastructure integrity may be affected if large portions of the campus population contracts communicable diseases at the same time and are therefore unable to perform maintenance, operations, and educational tasks. This would be particularly disruptive if those impacted are first responders or other essential personnel. Long-term outbreaks affecting large numbers of CSU – Los Angeles students could result in cancelled classes, delayed matriculation, or other disruptions to the CSU System’s mission. This has already occurred with the current COVID-19 pandemic and could occur again with more virulent strains of communicable diseases, including COVID-19.

Communicable disease hazards found across the CSU system (including CSU – Los Angeles) vary both by level of containment (BSL) (described previously) and by level of individual/public health risk, or Risk Group (RG) level. While BSLs describe the procedures and required levels of containment in a laboratory setting, Risk Groups (RGs) reflect the potential effects of disease exposure on humans or animals. Like BSLs, RGs range from Level 1 (RG1) to Level 4 (RG4), with Level 1 (RG1) posing minimal risk to healthy individuals and public health and Level 4 (RG4) posing a very serious or extreme risks to individuals and public. BSLs generally correlate with Risk Group (RG) Levels (e.g., a RG2 agent is worked with at BSL-2), but there are exceptions (e.g., production volumes, high-risk procedures, etc.).

The World Health Organization’s (WHO) Laboratory Biosafety Manual, 3rd ed., NIH Guidelines, categorizes Risk Groups (RGs) in the following way:

Table 13-6: WHO Risk Group Categorization

<table>
<thead>
<tr>
<th>Risk Group (RG)</th>
<th>Definition</th>
</tr>
</thead>
</table>


<table>
<thead>
<tr>
<th></th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>RG1</td>
<td>Rarely associated with disease in healthy adult humans or animals and pose no-to-little public health risk (e.g., Saccharomyces cerevisiae, E. coli K-12 strain derivatives often used for recombinant/molecular biology, many environmental organisms)</td>
</tr>
<tr>
<td>RG2</td>
<td>Associated with mild to moderate disease for which preventative measures or post exposure treatments are often available; public health impact is limited (e.g., Streptococcus pyogenes, Salmonella, hepatitis B virus)</td>
</tr>
<tr>
<td>RG3</td>
<td>Associated with serious to lethal human disease for which preventative vaccines or post-exposure therapies may be scarce. Public health impact is limited-to-moderate (e.g., Mycobacterium tuberculosis, hantaviruses, West Nile virus, SARS)</td>
</tr>
<tr>
<td>RG4</td>
<td>Associated with serious to lethal human disease for which preventative vaccines or post exposure therapies are not usually available. Public health impact is high (e.g., Ebola virus, Marburg virus, smallpox virus, etc.)</td>
</tr>
</tbody>
</table>

Table 13-8 describes the four (4) Risk Group Levels (RGs), and provides examples of communicable diseases that would typically fall in to these classifications, and the typical protections that would be necessary to prevent transmission of the disease. It is important to note that all but two (2) communicable disease hazards identified by CSU campuses fall under either the lower-risk RG1 or RG2 categories. COVID-19 and tuberculosis are the two (2) communicable diseases fall under the higher-risk RG3 category. However, with the advent of the recently-developed COVID-19 vaccine, and with the expectation of an increasingly robust vaccine supply, it is possible that the RG level for COVID-19 could be lowered in the future, thereby reducing both the extent and the potential impact of COVID-19.
<table>
<thead>
<tr>
<th>Level</th>
<th>Examples</th>
<th>Typical Protection to Prevent Transmission</th>
</tr>
</thead>
<tbody>
<tr>
<td>RG 1</td>
<td>E. Coli</td>
<td>Precautions are minimal, most likely involving gloves and some sort of facial protection. Usually, contaminated materials are left in open (but separately indicated) waste receptacles. Decontamination procedures for this level are similar in most respects to modern precautions against everyday viruses (i.e.: washing one’s hands with anti-bacterial soap, washing all exposed surfaces of the lab with disinfectants, etc.).</td>
</tr>
<tr>
<td>RG 2</td>
<td>Chicken Pox, Hepatitis A, B, C, Lyme disease, Salmonella, Mumps, Measles, Malaria, Scrapie, Dengue Fever, HIV</td>
<td>These bacteria and viruses cause mild disease in humans or are difficult to contract via aerosol. Routine diagnostic work with clinical specimens can be done safely at BSL-2, using BSL-2 practices and procedures.</td>
</tr>
</tbody>
</table>

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18 CDC/National Institutes of Health. *Biosafety in Microbiological and Biomedical Laboratories, 6th Ed.* Print. Retrieved 05.03.2021 from: [https://www.cdc.gov/labs/BMBL.html](https://www.cdc.gov/labs/BMBL.html)
These bacteria and viruses cause severe to fatal disease in human, but vaccines or other treatments do exist to combat them. Laboratory personnel have specific training in handling pathogenic and potentially lethal agents and are supervised by competent scientists who are experienced in working with these agents. This is considered a neutral or warm zone.

These viruses and bacteria cause severe to fatal disease in humans, for which vaccines or other treatments are not available. When dealing with biological hazards at this level the use of a Hazmat suit and a self-contained oxygen supply is mandatory. The entrance and exit of a BSL-4 lab will contain multiple showers, a vacuum room, an ultraviolet light room, autonomous detection system, and other safety precautions designed to destroy all traces of the biohazard. Multiple airlocks are employed and are electronically secured to prevent both doors opening at the same time. All air and water service going to and coming from a BSL-4 lab will undergo similar decontamination procedures to eliminate the possibility of an accidental release.

### Probability of Future Occurrence of the Hazard

There are significant data limitations regarding non-COVID-19 communicable disease cases, as the information thereof is outdated, anecdotal, and/or inadequate. As a result, it is not feasible to provide quantitative probabilities of future occurrence for non-COVID-19 communicable disease hazards. However, based on the limited data, it is feasible to present qualitative probabilities of future occurrence based on ranges of communicable disease frequency.

Table 13-9 shows a probability scale of future occurrence for the nine (9) communicable disease hazards profiled in this assessment. This scale is divided into four (4) levels of probability:
Table 13-8: Likelihood of Future Hazard Occurrence

<table>
<thead>
<tr>
<th>Likelihood</th>
<th>Parameters for Determining Likelihood</th>
</tr>
</thead>
<tbody>
<tr>
<td>Highly Likely</td>
<td>76 – 100% probability that hazard will occur annually (high to very high frequency)</td>
</tr>
<tr>
<td>Likely</td>
<td>50 – 75% probability that hazard will occur annually (moderate to high frequency)</td>
</tr>
<tr>
<td>Possible</td>
<td>11 – 49% probability that hazard will occur annually (low to moderate frequency)</td>
</tr>
<tr>
<td>Unlikely</td>
<td>0 – 10% probability that hazard will occur annually (very low to low frequency)</td>
</tr>
</tbody>
</table>

Due to significant data limitations surrounding non-COVID communicable diseases, the probability of future occurrence of CSU-system-wide communicable disease is measured by the proportion of campuses that have identified a particular communicable disease as having an impact on the campus community. In this measure, the more frequent a communicable disease is seen as impactful CSU-wide, the greater the probability of future occurrence.

Note: Each communicable disease’s system-wide probability ranking (below) reflects the ranking at the individual CSU campus level unless noted otherwise.

Table 13-9: Probability of Future Occurrence of Communicable Disease Hazard for CSU System

<table>
<thead>
<tr>
<th>Collective List of Communicable Diseases Identified by All CSU Campuses</th>
<th>Number of CSU Campuses (Including Chancellor’s Office) Identifying Communicable Disease Having Significant Impact</th>
<th>Proportion of CSU Campuses Identifying Communicable Disease as Having Significant Impact System-Wide</th>
<th>CSU System-Wide Probability Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>COVID-19 (SARS-CoV-2)</td>
<td>24</td>
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<td>Meningitis</td>
<td>7</td>
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<tr>
<td>Measles</td>
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<td>0.25</td>
<td>Possible</td>
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<tr>
<td>Influenza (Including H1N1/ Swine Flu)</td>
<td>6</td>
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<td>Tuberculosis</td>
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<td>Norovirus</td>
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<tr>
<td>Mumps</td>
<td>2</td>
<td>0.08</td>
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</tr>
<tr>
<td>E. Coli</td>
<td>2</td>
<td>0.08</td>
<td>Unlikely</td>
</tr>
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</table>
Sexually Transmitted Diseases (STDs) | 2 | 0.08 | Unlikely

(Source: Interviews with staff at CSU campuses and at the CSU Chancellor’s Office.)

Vulnerability to the Hazard

Vulnerability to a communicable diseases hazard resides in the population of a given area – both human and animal – not in the infrastructure or physical assets. While CSU assets and infrastructure could be impacted indirectly by the communicable disease hazard, these impacts would be secondary to the impact that the communicable disease hazard would have on students, faculty, staff, and visitors at CSU campuses.

CSU campus settings are geographically diverse, with locations ranging from small towns to medium-sized cities to densely populated urban areas. Hundreds of thousands of people work, study, and/or pass through CSU campuses on any given day. As of Fall 2019, the CSU – Los Angeles had 26,361 students as well as additional faculty and staff. Each of these persons is vulnerable to communicable disease, particularly if it is a pathogen that individual has not been immunized against, or for which no immunization exists. Prolonged outbreaks could result in a loss of services, failure of infrastructure (from lack of operators or maintenance), and closure of facilities. This exact scenario has played out to some degree in the current COVID-19 pandemic on the CSU-Los Angeles campus.19,20

Estimate of Potential Losses

COVID-19 Pandemic Health Impact on CSU Campuses and Surrounding Communities

The most prescient metric for estimating losses from COVID-19 is loss of life. The nationwide campus-related COVID-19 death rate of 0.02% remains well below the average COVID-19 death rate in the U.S. However, due to data limitations, there is no information on CSU-campus-specific deaths by COVID-19 or by any other communicable diseases. In fact, COVID-19 is the only communicable disease for which case reports have been readily available for CSU campuses.

At some point in the future, CSU campuses will return to full capacity. Without adequate surveillance regarding campus access and student and employee interaction, CSU campuses (including CSU-Los Angeles) are at risk of developing an extreme incidence of COVID-19 and may become “super-spreaders” for adjacent communities.21

19 The California State University. Enrollment. Retrieved 05.03.2021 from: https://www2.calstate.edu/csu-system/about-the-csu/facts-about-the-csu/enrollment/Pages/default.aspx
20 The California State University. Employee Head Count by Campus. Retrieved 05.03.2021 from: https://www2.calstate.edu/csu-system/faculty-staff/employee-profile/csu-workforce/Pages/employee-headcount-by-campus.aspx
emergence of more virulent COVID-19 variants would only add to the potential for high negative impacts on life safety, operations, and service delivery across the CSU system. (Other communicable diseases would also re-emerge, but with low to moderate negative impacts on life safety, operations, and service delivery.)

**Economic Impact of COVID-19 Pandemic on CSU Financial Health**

During the first few months of the COVID-19 pandemic in 2020, the CSU system suffered tremendous negative fiscal impacts. From March through July of 2020 alone, over $146 million worth of revenue losses were sustained across the CSU system due to refunds to students for parking, housing and dining service fees during Spring Semester, 2020. Several CSU campuses saw refund losses surpass $10 million. (See Figure13-2. below for the economic impact to the CSU – Channel Islands campus)

Figure 13-2: CSU COVID-19 Cost Tracking Showing Revenue Refund Losses and Increased Costs  

<table>
<thead>
<tr>
<th>Campus</th>
<th>State Agency Code</th>
<th>Total Estimated Cost (within department operations)</th>
<th>Non-Absorbable</th>
<th>Total Estimated Extraordinary Cost</th>
<th>Total Costs</th>
<th>Total Refunds</th>
<th>Grand Total</th>
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<tr>
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</table>

CSU System Total: 3,461, 8,397, 3,013, 30,826, 47,521, 134,149, 294,679

**Mitigative Relief from Federal Assistance**

The $1.5 billion in total federal assistance sent to the CSU system will help relieve the losses of revenues from services like dorms, parking and dining services during a year of mainly empty campuses. (See Table 13-11) However, because of staggering COVID-related revenue losses, the CSU system is planning for three (3) years of fiscal duress.

---

<table>
<thead>
<tr>
<th>Institution</th>
<th>December 2020 Stimulus</th>
<th>CARES Act</th>
<th>APLU Projection of HEERF Total ARP Act Funding Allocation</th>
<th>Total Estimated Federal COVID Relief Funding</th>
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<table>
<thead>
<tr>
<th>Institution</th>
<th>Amount</th>
<th>Amount</th>
<th>Amount</th>
<th>Amount</th>
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<tbody>
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<td>$14,394,000</td>
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<td>$81,566,860</td>
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<td>California State University, Fresno</td>
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<td>$41,088,000</td>
<td>$120,859,884</td>
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<td>California State University, Long Beach</td>
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<td><strong>$40,067,000</strong></td>
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Vulnerability Assessment Conclusions

Before the COVID-19 pandemic, populations at all CSU campuses and CSU-affiliated facilities were substantial. Collectively, as of Fall 2019, CSU campuses had 480,541 students and 53,763 faculty and staff. All were at risk from the communicable disease events, with 534,304 people being directly vulnerable. The COVID-19 pandemic has caused campus population numbers to plummet to a small fraction of full capacity.

At some point in the future, campus population numbers will return to their pre-pandemic levels, and students, faculty, and staff will again be vulnerable to the communicable disease hazard. If just 10% of the total CSU population were to become ill with a highly infective communicable disease like influenza or another strain of SARS, this would mean that approximately 53,430 people would be sick at the same time. This scenario would likely overwhelm available on-campus medical services could even overwhelm portions of the larger community’s medical resources – especially if there were large numbers of infected people with immune system compromises or other underlying health problems.

See Table 13-12 below for the “10% outbreak scenario” projections for the CSU-Los Angeles campus and for the entire CSU system.

Table 13-11: Scenario of Communicable Disease Hazard Affecting 10% of the CSU Population

<table>
<thead>
<tr>
<th>CSU Campus</th>
<th>Approximate Enrollment Population (Fall 2019)26</th>
<th>Approximate Total FT/PT Faculty/Staff Population (Fall 2019)27</th>
<th>Total Combined Approximate Student and Faculty/Staff Population</th>
<th>10% Outbreak Scenario (Students and Faculty/Staff Combined)</th>
</tr>
</thead>
<tbody>
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<td>11,199</td>
<td>1,277</td>
<td>12,476</td>
<td>1,248</td>
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<td>CSU Channel Islands</td>
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<td>994</td>
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<td>18,988</td>
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26 The California State University. *Enrollment*. Retrieved 05.04.2021 from: [https://www2.calstate.edu/csu-system/about-the-csu/facts-about-the-csu/enrollment/Pages/default.aspx](https://www2.calstate.edu/csu-system/about-the-csu/facts-about-the-csu/enrollment/Pages/default.aspx)

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<th>LA</th>
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<th>San Diego</th>
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<th>San José</th>
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</tr>
<tr>
<td>Sonoma State</td>
<td>8,649</td>
<td>1,338</td>
<td>9,987</td>
<td>999</td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Stanislaus State</td>
<td>10,614</td>
<td>1,276</td>
<td>11,890</td>
<td>1,189</td>
<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Office of the Chancellor</td>
<td>0</td>
<td>673</td>
<td>673</td>
<td>67</td>
<td></td>
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<td></td>
<td></td>
<td></td>
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<tr>
<td>CSU System-Wide</td>
<td>480,541</td>
<td>53,763</td>
<td>534,304</td>
<td>53,430</td>
<td></td>
<td></td>
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</table>

*Note: Enrollment figures do not include non-specific CSU campus International Programs (455 students) or CALStateTEACH Program (933 students).*

While the case numbers of COVID-19 have been significantly lower (about 1% of the total CSU population) than those in the 10% scenario, the degree of virulence and resultant morbidity and mortality caused by COVID-19 have led to widespread campus shutdowns, educational disruption, and economic harm to the CSU system. In short, the real-time COVID-19 communicable disease outbreak scenario has proven far more devastating than the 10% simulated scenario.

**Identified Data Limitations**

There is a wealth of technical information available for communicable disease. However, there is also limited non-COVID-19 communicable disease data available regarding risk or vulnerability of specific populations throughout the CSU. Much of the data that does exist...
is protected by privacy policies, and therefore cannot be obtained for more specific populations. As a result, performing a detailed quantitative assessment for this hazard is difficult.

Data that could be collected prior to the next update in order to improve this methodology includes:

- Data regarding infection rates at the campus level and for specific populations;
- Data regarding communicable disease case numbers and outcomes, by CSU campus;
- Data regarding projected population changes;
- Data regarding absenteeism; and
- Data regarding increased operating costs as a result of absenteeism (i.e., temporary shifting of duties resulting in business interruption).

**Drought**

**Description of the Hazard**

Drought is defined as a condition where moisture levels fall significantly below normal for an extended period of time over a large area that adversely affects plants, animal life, and humans. Drought is a gradual phenomenon. Although droughts are sometimes characterized as emergencies, they differ from typical emergency events. Most natural disasters, such as floods or forest fires, occur relatively rapidly and afford little time for preparing for disaster response. Droughts occur slowly, over a multi-year period, and it is often not obvious or easy to quantify when a drought begins and ends.

Throughout California, one dry year does not normally constitute a drought. California’s extensive system of water supply infrastructure (reservoirs, groundwater basins, and conveyance assets) mitigates the effect of short-term dry periods for most water users. Defining when a drought begins is a function of drought impacts to water users. Drought in one location may not constitute a drought for all water users, as some users in relative proximity may have a different water supply. For example, individual water suppliers may use a combination of sources such as rainfall/runoff, water in storage, or expected supply from a water wholesaler to define their water supply conditions.

Drought can be characterized as one or more of the following types:

- **Meteorological drought** is defined on the basis of the degree of dryness (in comparison to some “normal” or average amount) and the duration of the dry period. A meteorological drought must be considered as region-specific since the atmospheric conditions that result in deficiencies of precipitation are highly variable from region to region.

- **Hydrological drought** is associated with the effects of periods of precipitation (including snowfall) shortfalls on surface or subsurface water supply (e.g., streamflow, reservoir and lake levels, ground water). The frequency and severity of hydrological drought is often defined on a watershed or river basin scale. Although all droughts originate with a deficiency of precipitation, hydrologists are
more concerned with how this deficiency plays out through the hydrologic system. Hydrological droughts are usually out of phase with or lag the occurrence of meteorological and agricultural droughts. It takes longer for precipitation deficiencies to show up in components of the hydrological system such as soil moisture, streamflow, and ground water and reservoir levels. As a result, these impacts are out of phase with impacts in other economic sectors.

- **Agricultural drought** focus is on soil moisture deficiencies, differences between actual and potential evaporation, reduced ground water or reservoir levels, and so forth. Plant water demand depends on prevailing weather conditions, biological characteristics of the specific plant, its stage of growth, and the physical and biological properties of the soil.

- **Socioeconomic drought** refers to when physical water shortage begins to affect health, well-being, and quality of life of people, or when the drought starts to affect the supply and demand of an economic product that relies on water.

The drought issue in California is further compounded by water rights. The central challenge is how to prioritize water usage among a broad variety of contexts. It is for this reason that water is a commodity possessed and utilized under a variety of legal doctrines. As such, many competing sets of interests create a dynamic prioritization process between, for example, farming and federally protected fish habitats and water supply for municipal/public use (including usage for CSU - Los Angeles) versus water usage for wildfire abatement or natural resource protection.

**Location of the Hazard**

Drought conditions have been identified in Los Angeles where the campus is located. Drought is not a location-specific hazard and affects the entire planning area equally. Drought location is not isolated to each campus footprint but occurs as a geographic subset of drought conditions occurring at larger scales. From 2000-2020, drought conditions existed continuously somewhere in the state, with 80-100% of the state impacted for 12 of the last 20 years. 28

**Extent of the Hazard**

Given the historical occurrence of severe drought impacts throughout the state (including Los Angeles) and the potential future impact exacerbated by climate change, the CSU Planning Committee recognizes that drought will continue to pose a risk to the geographic regions where CSU campuses are located, potentially impacting crops, livestock, water resources, the natural environment at large, buildings and infrastructure (from land subsidence), and local economies.

Although drought affects the entire CSU system wide planning area, the potential impacts may be variable and specific to each campus/jurisdiction, depending on contextual

factors such as the degree of assets and activities, historically impacted by drought within each jurisdiction.

Also, land subsidence has occurred and will continue in areas where the groundwater basin has been subject to overdraft and long-term recharge is inadequate to maintain the water table elevation, leaving underground voids. Subsidence levels in California have been measured up to 30-feet with subsidence bowls covering hundreds of square miles. As such, drought-related subsidence may result in serious structural damage to buildings, roads, irrigation ditches, underground utilities, and pipelines. These effects have not been reported on campus, but remain applicable concerns over the long term.

For CSU – Los Angeles, the extent of the hazard is Low (corresponding to D0-D1 on the extent scale below) and addressed through water conservation and conversion to drought resistant landscaping. However, the campus planning committee recognizes that the potential for more severe conditions exists and is tied to regional water resource vulnerabilities.

The U.S. Drought Monitor developed tables of impacts reported during past droughts in California in order to depict the extent of drought risk for each level of drought on the U.S. These possible extent conditions for California complement the general impacts column of the U.S. Drought Monitor Classification Scheme.

Table 13-12: Impacts of Drought Levels as Determined by US Drought Monitor

<table>
<thead>
<tr>
<th>Category</th>
<th>Impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>D0</td>
<td>Soil is dry; irrigation delivery begins early</td>
</tr>
<tr>
<td></td>
<td>Dryland crop germination is stunted</td>
</tr>
<tr>
<td></td>
<td>Active fire season begins</td>
</tr>
<tr>
<td></td>
<td>Winter resort visitation is low; snowpack is minimal</td>
</tr>
<tr>
<td>D1</td>
<td>Dryland pasture growth is stunted; producers give supplemental feed to cattle</td>
</tr>
<tr>
<td></td>
<td>Landscaping and gardens need irrigation earlier; wildlife patterns begin to change</td>
</tr>
<tr>
<td></td>
<td>Stock ponds and creeks are lower than usual</td>
</tr>
<tr>
<td>D2</td>
<td>Grazing land is inadequate</td>
</tr>
<tr>
<td></td>
<td>Producers increase water efficiency methods and drought-resistant crops</td>
</tr>
<tr>
<td></td>
<td>Fire season is longer, with high burn intensity, dry fuels, and large fire spatial extent; more fire crews are on staff</td>
</tr>
</tbody>
</table>

29 United States Drought Monitor. *Drought Classification*. Retrieved 05.04.2021 from: [https://droughtmonitor.unl.edu/About/AbouttheData/DroughtClassification.aspx](https://droughtmonitor.unl.edu/About/AbouttheData/DroughtClassification.aspx)
<table>
<thead>
<tr>
<th>D3</th>
<th>Wine country tourism increases; lake- and river-based tourism declines; boat ramps close</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Trees are stressed; plants increase reproductive mechanisms; wildlife diseases increase</td>
</tr>
<tr>
<td></td>
<td>Water temperature increases; programs to divert water to protect fish begin</td>
</tr>
<tr>
<td></td>
<td>River flows decrease; reservoir levels are low and banks are exposed</td>
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<tr>
<td></td>
<td>Livestock need expensive supplemental feed, cattle and horses are sold; little pasture remains, producers find it difficult to maintain organic meat requirements</td>
</tr>
<tr>
<td></td>
<td>Fruit trees bud early; producers begin irrigating in the winter</td>
</tr>
<tr>
<td></td>
<td>Federal water is not adequate to meet irrigation contracts; extracting supplemental groundwater is expensive</td>
</tr>
<tr>
<td></td>
<td>Dairy operations close</td>
</tr>
<tr>
<td></td>
<td>Marijuana growers illegally tap water out of rivers</td>
</tr>
<tr>
<td></td>
<td>Fire season lasts year-round; fires occur in typically wet parts of state; burn bans are implemented</td>
</tr>
<tr>
<td></td>
<td>Ski and rafting business is low, mountain communities suffer</td>
</tr>
<tr>
<td></td>
<td>Orchard removal and well drilling company business increase; panning for gold increases</td>
</tr>
<tr>
<td></td>
<td>Low river levels impede fish migration and cause lower survival rates</td>
</tr>
<tr>
<td></td>
<td>Wildlife encroach on developed areas; little native food and water is available for bears, which hibernate less</td>
</tr>
<tr>
<td></td>
<td>Water sanitation is a concern, reservoir levels drop significantly, surface water is nearly dry, flows are very low; water theft occurs</td>
</tr>
<tr>
<td></td>
<td>Wells and aquifer levels decrease; homeowners drill new wells</td>
</tr>
<tr>
<td></td>
<td>Water conservation rebate programs increase; water use restrictions are implemented; water transfers increase</td>
</tr>
<tr>
<td></td>
<td>Water is inadequate for agriculture, wildlife, and urban needs; reservoirs are extremely low; hydropower is restricted</td>
</tr>
<tr>
<td></td>
<td>Fields are left fallow; orchards are removed; vegetable yields are low; honey harvest is small</td>
</tr>
<tr>
<td></td>
<td>Fire season is very costly; number of fires and area burned are extensive</td>
</tr>
<tr>
<td></td>
<td>Many recreational activities are affected</td>
</tr>
<tr>
<td></td>
<td>Fish rescue and relocation begins; pine beetle infestation occurs; forest mortality is high; wetlands dry up; survival of native plants and animals is low; fewer wildflowers bloom; wildlife death is widespread; algae blooms appear</td>
</tr>
</tbody>
</table>
Policy change; agriculture unemployment is high, food aid is needed

Poor air quality affects health; greenhouse gas emissions increase as hydropower production decreases; West Nile Virus outbreaks rise

Water shortages are widespread; surface water is depleted; federal irrigation water deliveries are extremely low; junior water rights are curtailed; water prices are extremely high; wells are dry, more and deeper wells are drilled; water quality is poor;

History of the Hazard

Historically, drought has been so prevalent in California that its presence is almost continuous. According to the US Drought Monitor, Time Series data, Los Angeles County has experienced five or more periods of drought covering 12 years over the past 20 years, and it includes the CSU - Los Angeles footprint.

Figure 13-3: Periods of Drought in Los Angeles County, California, 2000 – 2021

According to the National Drought Mitigation Center, over 3,500 reports and publications covering 370 drought-related events took place across the state (many of which were statewide events) between 2000-2020. In addition, the National Center for Environmental Information (NCEI) reports more than 500 events statewide during this same time period. These events produced a comprehensive range of impacts to water supply, regulations and allocations to businesses and municipalities, budgets and resources for firefighting, water law and policy, and physical impacts to built and natural environments. As such, data records of previous occurrences can be viewed as separate time and event demarcations for a hazard almost continuously in effect across the state with cascading impact potential.

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According to the Department of Water Resources, droughts exceeding three years are relatively common in Southern California, but relatively rare in Northern California - the region is the geographic source of much of the state’s developed water supply. The 1929-34 drought established the criteria commonly used in designing storage capacity and yield of large Northern California reservoirs. 31

According to the US Drought Monitor’s time series data, from 2000-2021 (with the exception of a 2–3-month period in 2000 and 2011), some degree of drought conditions have been continuously in effect somewhere in California. In fact, 80% - 100% of the state has been subjected to drought conditions for 12 of the last 20 years, with the most severe drought being the 100% state-wide event from 2012-2017.

Figure 13-4: Periods of Drought in State of California, 2001 – 2021 32

Given the extent of the drought risk in California, the following drought event was selected as an exemplar due to its broad and significant impacts on the state and on the metropolitan area surrounding the CSU - Los Angeles campus:

2012 – 2017 – Drought produced severe impacts to water wells throughout the state of California, with a high number of wells running dry. Land subsidence due to increased groundwater pumping also occurred in numerous areas of the state such as the San Joaquin and Central Valleys. Crop damage was widespread as well. Water allotments were drastically reduced in many towns and water agencies, with extremely high costs for procuring water. In addition, job loss occurred with many families requiring food supply assistance, and water supply assistance provided to home-owners with dry wells. According to a report released by UC Davis Center for Watershed Sciences, the 2014–2017 period of the California drought cost the state's agriculture industry about $1 billion in lost revenue, with a total statewide economic cost of the drought calculated to be $2.2 billion. The report says, “it is responsible for the greatest water loss ever seen in California agriculture - about one third less than normal”. The report calls the

groundwater situation in California "a slow-moving train wreck." Spring snowpack at Donner Summit reached record low levels in 2014, exceeded in 2015 by a remarkable April 1 snow-water-equivalent value of only 5% of average. Decreased precipitation since contributed to near-record low levels in the Shasta Reservoir. The ongoing drought has contributed to declines in crop values across the state. For example, crops including cotton, corn silage and barley (the field crop category) fell by 42 percent. 33

Potential Impacts of the Hazard

Drought impacts are wide-reaching and may be economic, environmental, and/or societal. This assessment of its impact recognizes that historic occurrences of drought throughout the planning area are a sub-set of larger and inter-connected local and regional droughts, and that the (related) historic impacts provide a sound basis for understanding potential (future) impacts.

The most significant potential impact associated with drought across the CSU - Los Angeles campus planning area is a reduction in water availability for the municipal area tied to each campus. Other impacts include crop loss and damage to trees and other natural resources (See Tree Mortality below). Though the campus does not have “Ag” programs or resources, the campus landscape (trees) is potentially impacted.

As a secondary impact of drought, wildfire is directly attributable to dry atmospheric conditions. Wildfires almost always coincide with drought in California, though not limited to such. 34 However, the wildfire hazard is analyzed separately in this plan. (See wildfire hazard).

In reviewing the occurrences of drought for CSU - Los Angeles, the US Drought Monitor and the National Drought Mitigation Center report that tens of millions of trees died during the (2014-2017) state-wide drought disaster. Though data sources do not provide data for tree mortality specific to CSU - Los Angeles, the broad geographic extent of the impact makes it likely that tree mortality occurred to some degree on the campuses. Due to the lasting and ongoing effects of drought on the landscape, trees will continue to be impacted within the municipalities, counties and regions wherein lies the CSU campus system as long as drought conditions continue to occur in the future.

Given the absence of campus level drought data, in order for the CSU Committee to assess the impact of tree mortality, it is useful to view it as a risk sub-set to the probability, location, extent, severity and duration of the drought hazard within each campus=located municipality, county and region. Regarding potential impacts, standing dead trees could fall, posing a risk to people, buildings, power lines, roads and other infrastructure. In addition, drought-impacted trees become susceptible to diseases and insect infestations (bark beetle) further adding to the risk of tree mortality and related

potential impacts. No data is currently available for tree mortality on campus, however, the CSU Planning Team will pursue data on this issue in the future.

As a potential tertiary impact, prolonged and repeated drought conditions over time can produce land subsidence and the risk of damage to building foundations and infrastructure on campus resulting from ground instability and collapse. Land subsidence is defined as the vertical sinking of the land over manmade or natural underground voids. Subsidence is often the direct result of groundwater over-extraction in response to drought conditions, as well as oil and gas extraction. Weight can accelerate the process of subsidence resulting from surface development and infrastructure such as roads and buildings, vibrations from construction blasting and heavy truck or train traffic. For example, the State Water Project’s 444-mile-long California Aqueduct has required repairs such as the raising of canal linings, bridges, and water control structures on the Aqueduct – in the Central Valley a five-mile reach of the Eastside Bypass was impacted by subsidence, and the Department of Water Resources estimated that it may cost in the range of $250 million to acquire flowage easements and levee improvements to restore the design capacity of the subsided area. 35

At present, drought related damage to campus buildings and infrastructure at CSU - Los Angeles has not been reported, but the potential for such impacts is possible. With regard to overall potential impact, water supply/availability for CSU - Los Angeles is ultimately tied to broader inter-dependent, and more intensive modes of water use at local and regional scales such as agriculture and ranching, wildfire protection, larger metropolitan/municipal usage, manufacturing and commerce, tourism, recreation, and wildlife preservation. During drought periods, the State of California’s regulated water allocations are modified and often reduced, which can result in reduced water availability for all usage contexts, including CSU - Los Angeles. A reduction of electric power generation and water quality deterioration are also potential impact factors.

Table 13-13: Summary of Drought Impacts on Water Resources36

<table>
<thead>
<tr>
<th>Resource</th>
<th>Type of Impact</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sea Level</td>
<td>Direct</td>
<td>Sea level is rising and will likely impact coastal areas</td>
</tr>
<tr>
<td>Soil Moisture</td>
<td>Direct</td>
<td>Prolonged dry seasons can lead to decreases in soil moisture; drier vegetation</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Vegetation</th>
<th>Indirect</th>
<th>Longer and more intense fire season with increased extent of area burned</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stream Conditions</td>
<td>Direct</td>
<td>Increases in water temperature; potential effects on fish</td>
</tr>
<tr>
<td>Snowpack</td>
<td>Indirect</td>
<td>Increases in temperature will lead to decreases in snowpack</td>
</tr>
<tr>
<td>Runoff</td>
<td>Direct</td>
<td>Warmer temperatures are likely to lead to a shift in peak runoff from spring to winter and a likely decrease in summer base flow</td>
</tr>
<tr>
<td>Hydropower</td>
<td>Indirect</td>
<td>Decreased summer flows resulting from earlier snowmelt and a shift in peak runoff could affect hydropower generation during summer months</td>
</tr>
<tr>
<td>Precipitation</td>
<td>Direct</td>
<td>Warmer winter temperatures will result in a greater percentage of precipitation falling as rain rather than as snow</td>
</tr>
<tr>
<td>Groundwater</td>
<td>Indirect</td>
<td>Reduction in snowpack and extended periods of drought are likely to increase dependency on groundwater</td>
</tr>
</tbody>
</table>

**Probability of Future Occurrence of the Hazard**

**Highly Likely** — The US Drought Monitor’s time series data (2000-2020) indicates that some degree of drought has nearly a 100% probability of occurrence somewhere in the state in any given year. Given that CSU - Los Angeles lies within a drought impacted region, it is prudent to extend this likelihood of occurrence to the planning area. Although the probably of occurrence is highly likely, the impacts of drought to the campus are low.

**Vulnerability to the Hazard**

In California, rising temperatures are projected to increase the average lowest elevation at which snow falls, reducing water storage in the snowpack, particularly at those lower mountain elevations which are now on the margins of reliable snowpack accumulation. Higher spring temperatures will also result in earlier melting of the snowpack. The shift in snow melt to earlier in the season is critical for California’s water supply because flood control rules require that water be allowed to flow downstream and that water cannot be stored in reservoirs for use in the dry season. As such, state-level drought risk factors that have led to drought’s state-wide severity and extent, and potential impacts also create drought vulnerabilities at the level of the CSU - Los Angeles campus.

Moreover, climate change will likely adversely impact the vulnerability of watersheds and ecosystems in their ability to deliver important ecosystem services. These changes may limit the natural capacity of healthy forests to capture water and regulate stream flows.
Sierra Nevada mountain winters and springs are warming, and on average, precipitation as snowfall relative to rain is decreasing. A warming climate with reduced snowpack will result in earlier snowmelt and will subsequently reduce downstream water availability during summer and early fall.

As such, the state and the CSU - Los Angeles planning area stakeholders potentially have less capacity to address future drought risks due to projected temperature increases and shortages in water; ground-water withdrawals have been occurring at a deficit rate of 1 – 2-million-acre feet per year, where the impacts of drought include decreased availability of water for agriculture and environmental uses. In forested and other vegetated areas, prolonged drought decreases the moisture content of forest fuels and increases the risk of high severity wildfires.

It should be pointed out that California is the single most productive agricultural state and its agricultural industry relies heavily on reservoir water supplied by snowmelt and rainfall runoff. Yearly variations in snowpack depths have implications for water availability as snowmelt from the winter snowpack feeds a network of reservoirs. Spring snowpack at Donner Summit reached record low levels in 2014, exceeded in 2015 by a remarkable April 1 snow-water-equivalent value of only 5% of average. Decreased precipitation since 2011 has contributed to near-record low levels in the Shasta Reservoir.

Vulnerability of Populations

Drought vulnerabilities on California’s population include agricultural sector job loss, secondary economic losses to local businesses and public recreational resources, increased cost to local and state government for large-scale water acquisition and delivery, and water rationing and water wells running dry for individuals and families. As drought is often accompanied by prolonged periods of extreme heat, negative health impacts such as dehydration can also occur, where children and elderly are most susceptible. Air quality often declines in times of drought which can affect those with respiratory ailments. These same vulnerability measures apply to the students, faculty and staff of the CSU - Los Angeles campus.

Property Vulnerability

Drought vulnerabilities include crop loss, injury and death of livestock and pets, and damage to infrastructure, homes and other buildings resulting from the secondary drought impact of land subsidence. The related drought impacts of tree mortality and land subsidence pose risks to vulnerable critical infrastructure and property. Though property is not considered vulnerable currently, these same vulnerabilities may apply to the properties of the CSU - Los Angeles campus in the future.

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**Natural Environment Vulnerability**

Natural environment vulnerabilities are widespread throughout public and private lands within the state, including tree mortality, impacts to all flora and fauna, and destabilization (subsidence) of land along streams and rivers, and within watersheds.

The core issue shaping drought vulnerabilities throughout California is water supply and demand. Several factors play into the issue including groundwater basins, surface water run-off, public and agricultural demand, and surface water storage water sheds. A USGS led analysis was first conducted in 2010 through the Forest and Rangeland Assessment and ongoing through the USGS Forest and Rangeland Ecosystem Science Center to identify threats and assets where water supply would benefit from environmental management designed to protect or enhance water resources, the key effort which, in part, both defines and mitigates the severity of drought risk and vulnerabilities.

With regard to overall threat and asset findings shaping the potential severity of drought, the watersheds in the Sierra region contribute most greatly to the state’s water supply, but are under threat from climate change, wildfire and development. In addition, groundwater basins in the San Joaquin Valley and Sacramento Valley bioregions are an abundant resource that is heavily threatened by over pumping.39

**Critical Facilities Vulnerability**

Drought vulnerabilities for CSU - Los Angeles’ critical facilities include water shortfalls for facility operations and critical functions, and potential structural destabilization and damage resulting from land subsidence.

**Estimate of Potential Losses**

An estimate of potential losses from drought has not been calculated for the campus or the CSU system as a whole. However, drought related losses to the city and county of Los Angeles, and the surrounding region such as crop loss and cost increases for water resources have re-occurred over time. Please consult city and county level government, and/or state agricultural agencies for data on the financial impacts from drought.

**Vulnerability Conclusions**

The CSU Planning Committee understands that the high degree of vulnerability posed by drought will be exacerbated by greater climate variation in the future and therefore greater variation and uncertainty regarding the availability of water supplies which are already under tremendous stress. In response to such vulnerability, state legislation passed in 2014 requires local governments to regulate pumping and recharge to better manage groundwater supplies, and groundwater-dependent regions are required to halt overdraft and bring basins into sustainable levels of pumping and recharge by the early

2040s. That said, the Committee will continue to work with local, regional and state partners and stakeholders to explore solutions for mitigating the drought hazard on its campuses by accessing the best available data and resources on climate change and its relationship to drought.

**Identified Data Limitations**

Data is limited concerning campus-related agricultural assets as well as data on campus tree mortality.

**Earthquake**

**Description of the Hazard**

An earthquake is a sudden motion or shaking caused by the release of pressure accumulated along the edge of tectonic plates covering the earth. These huge plates are constantly moving and move ever so slowly under, over, or by passing one another. This movement is gradual however the plates may lock together accumulating enormous amounts of energy. When this energy builds, stress develops, and the adjoining plates will eventually break free and result in ground shaking — an earthquake.

Large earthquakes may result in fissuring, ground settlement, and/or vertical or horizontal displacement. Earthquakes occur without warning and can result in extensive damages and human casualties. Damages associated to earthquake generated ground shaking is normally confined to a narrow area along fault trend from the earthquake epicenter. However, seismic waves may generate ground shaking resulting in damages in areas outside of the fault trend.

**Fault Rupture** — The rupture of faults is the differential movement of the two sides of the earth’s plates at the point of the fault. Horizontal or vertical displacement may be significant and occur over great distances. The movement and energy that occurs along a fault is released in waves resulting in ground shaking. The intensity of ground shaking varies based on the magnitude of the earthquake, the proximity to the earthquake epicenter, the composition of the ground sediment or rock the waves travel through, and the depth of the earthquake.

**Liquefaction** — In addition to the primary fault rupture that occurs right along a fault during an earthquake, the ground many miles away can also fail during intense shaking. As seismic waves travel through saturated granular soil; the soil begins to liquefy and act as a fluid. Soil strength and stability is lost causing the effects of ground shaking to intensify and for ground deformation to occur. These water saturated soils when shaken quickly lose the ability to support buildings, bridges, utilities, and other structures. Areas susceptible to liquefaction include places where sandy sediments have been deposited by rivers along their course or by wave action along beaches. The greater the magnitude of an earthquake and longer duration of strong ground shaking will result in an enhanced potential for liquefaction to occur. Settlement can cause damage when the amount
settlement varies significantly across the length of a structure. Lateral spreading occurs when liquefaction occurs on gently sloping ground and the liquefied material at depth allows the area to slide, often toward a vertical discontinuity or “free face” such as a creek or stream channel. Liquefaction can occur in susceptible soils below bodies of water, and settlement and lateral spreading can damage structures built on or adjacent to these areas. Transportation bridges across water bodies, wharves, piers and other structures at ports and harbors, and underwater utility lines can be severely damaged by this hidden hazard.

**Subsidence** - Changes in the local environment that cause subsidence or sinkholes are called triggering mechanisms. Water is the primary factor that affects the local environment and causes subsidence. Water level decline, changes in groundwater flow, increased loading, and deterioration (such as abandoned mines) are all triggering mechanisms. Water level decline may occur naturally, or it may be the result of human action. Factors that lead to water decline are pumping (from wells), localized drainage (for construction activities), dewatering, or drought. Changes in groundwater flow can result from an increase in the velocity of groundwater movement, and increase in the frequency of water table fluctuations, and changes in discharge (either increase or decrease). Increased loading can cause pressure in the soil, leading to the failure of underground cavities and space, such as caves. Vibrations from earthquakes, heavy machinery, and blasting may result in structural collapse, followed by surface resettlement.

**Location of the Hazard**

The State of California is particularly vulnerable to earthquake activity due to California’s location residing between two large tectonic plates. Cal State LA is located in the eastern portion of the Los Angeles Basin. In general, fault systems surround and traverse through Los Angeles and Orange Counties including the area of Cal State LA. Throughout the basin the ground is saturated with sediment eroded from the mountains and foothills via multiple stream and river channels and resulting in liquefaction zones scattered across the region.

The Pacific Plate and the North American Plate come together at the San Andreas Fault 30-35 miles northeast of the Cal State LA campus. In addition to the San Andreas Fault, Los Angeles County is home to or near additional fault systems with the potential to generate strong ground shaking. The Elysian Park Fault extends across the southern boundary of the campus in an east to west direction. The Hollywood-Raymond Fault is another east to west fault 3 ½ miles north of the campus connecting Arcadia and Beverly Hills. The Puente Hills Fault extends from the southern base of the Puente Hills to downtown Los Angeles approximately 5 miles southwest of the campus. The Newport-Inglewood Fault traverses south to north paralleling the Orange County coastline extending 12 miles southwest of the Cal State LA campus. The Verdugo Fault extends from South Pasadena northwest to San Fernando 5 miles to the north of the campus. There are numerous additional faults in the area on all sides of the campus.
Figure 13-5: Faults located near Cal State LA

The Cal State LA campus reside outside of areas designated to be liquefaction zones. No campus facilities are located within the liquefaction zone. However, Substantial areas of the community surrounding the campus do reside within the liquefaction zone. This also includes major transportation corridors including Interstate 10, Interstate 710, Valley Blvd., and the Southern Pacific Railroad. The liquefaction zone generally follows the path of the Fullerton Creek.

Figure 13-6: Liquefaction Zones in Proximity to Cal State LA

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Extent of the Hazard

The extent or severity of earthquake damage is expressed in terms of magnitude, intensity and duration. The amount of energy released during an earthquake is normally conveyed as a magnitude measured from a seismogram. Magnitude is expressed in numbers and decimals representing the physical size of the earthquake. The strength and effect of the shaking on the surface of the earth is classified as the intensity. Intensity is further defined from the effects the earthquake has on people, structures, and the natural environment. The intensity of an earthquake in terms of measuring magnitude and evaluating its effects is generally expressed using the Modified Mercalli (MM) Intensity Scale. Duration is the length of time the earthquake’s energy is released.

The Richter magnitude scale was developed in 1935 by Charles F. Richter of the California Institute of Technology as a mathematical device to compare the size of earthquakes. The Richter Scale is the best-known scale for measuring the magnitude of earthquakes. The magnitude value is proportional to the logarithm of the amplitude of the strongest wave during an earthquake. A recording of 7, for example, indicates a disturbance with ground...
motion 10 times as large as a recording of 6. The energy released by an earthquake increases by a factor of 31 for every unit increase in the Richter scale.

Table 13-14: Earthquake Intensity and Frequency Comparisons

<table>
<thead>
<tr>
<th>Magnitude</th>
<th>Mercalli Intensity</th>
<th>Potential Damage</th>
<th>Global Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 2.0</td>
<td>I</td>
<td>None</td>
<td>Continually</td>
</tr>
<tr>
<td>2.0 - 2.9</td>
<td>I to II</td>
<td>None</td>
<td>&gt; IM per year</td>
</tr>
<tr>
<td>3.0 - 3.9</td>
<td>II to IV</td>
<td>None</td>
<td>&gt; 100,000 per year</td>
</tr>
<tr>
<td>4.0 - 4.9</td>
<td>IV to VII</td>
<td>Light</td>
<td>10K to 15 K per year</td>
</tr>
<tr>
<td>5.0 - 5.9</td>
<td>VI to VII</td>
<td>Moderate</td>
<td>1K to 1,500 per year</td>
</tr>
<tr>
<td>6.0 - 6.9</td>
<td>VII to X</td>
<td>Heavy</td>
<td>100 to 150 per year</td>
</tr>
<tr>
<td>7.0 - 7.9</td>
<td>VII &lt;</td>
<td>Very Heavy</td>
<td>10 - 20 per year</td>
</tr>
<tr>
<td>8.0 - 8.9</td>
<td>VII &lt;</td>
<td>Very Heavy</td>
<td>1 per year</td>
</tr>
<tr>
<td>&gt; 9.0</td>
<td>VII &lt;</td>
<td>Very Heavy</td>
<td>1 per 10-50 years</td>
</tr>
</tbody>
</table>

The Modified Mercalli Intensity Scale provides descriptive values of earthquake intensity that may provide greater meaning to the broader population as the description of intensity refers to the effects actually experienced. This scale uses an arbitrary ranking based on observed earthquake effects. The scale is composed of increasing levels of intensity ranging from shaking that is not recognizable to intense shaking resulting in catastrophic damages and casualties. The Modified Mercalli Intensity Scale is demonstrated below:

Table 13-15: Modified Mercalli Intensity Scale

<table>
<thead>
<tr>
<th>Intensity</th>
<th>Shaking</th>
<th>Description / Damage</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Not felt</td>
<td>Not felt except by a very few under especially favorable conditions.</td>
</tr>
<tr>
<td>II</td>
<td>Weak</td>
<td>Felt only by a few persons at rest, especially on upper floors of buildings.</td>
</tr>
<tr>
<td>III</td>
<td>Weak</td>
<td>Felt quite noticeably by persons indoors, especially on upper floors of buildings. Many people do not recognize it as an earthquake. Standing motor cars may rock slightly.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Magnitude</th>
<th>Intensity</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>IV</td>
<td>Light</td>
<td>Vibrations similar to the passing of a truck. Duration estimated. Felt indoors by many, outdoors by few during the day. At night, some awakened. Dishes, windows, doors disturbed; walls make cracking sound. Sensation like heavy truck striking building. Standing motor cars rocked noticeably.</td>
</tr>
<tr>
<td>V</td>
<td>Moderate</td>
<td>Felt by nearly everyone; many awakened. Some dishes, windows broken. Unstable objects overturned. Pendulum clocks may stop.</td>
</tr>
<tr>
<td>VI</td>
<td>Strong</td>
<td>Felt by all, many frightened. Some heavy furniture moved; a few instances of fallen plaster. Damage slight.</td>
</tr>
<tr>
<td>VII</td>
<td>Very strong</td>
<td>Damage negligible in buildings of good design and construction; slight to moderate in well-built ordinary structures; considerable damage in poorly built or badly designed structures; some chimneys broken.</td>
</tr>
<tr>
<td>VIII</td>
<td>Severe</td>
<td>Damage slight in specially designed structures; considerable damage in ordinary substantial buildings with partial collapse. Damage great in poorly built structures. Fall of chimneys, factory stacks, columns, monuments, walls. Heavy furniture overturned.</td>
</tr>
<tr>
<td>IX</td>
<td>Violent</td>
<td>Damage considerable in specially designed structures; well-designed frame structures thrown out of plumb. Damage great in substantial buildings, with partial collapse. Buildings shifted off foundations.</td>
</tr>
<tr>
<td>X</td>
<td>Extreme</td>
<td>Some well-built wooden structures destroyed; most masonry and frame structures destroyed with foundations. Rails bent.</td>
</tr>
</tbody>
</table>

The graph below illustrates the increasing intensity of energy that is released and as the measured magnitude increases. While each whole number increases in magnitude represents a tenfold increase in the measured amplitude, it represents an increasing rate of 32 times more energy released in the same increase in magnitude. As the magnitude
of an earthquake is measured higher, the intensity of the earthquake worsens progressively from one category to the next.

Figure 13-7: Earthquake Magnitude and Equivalent Energy Release\(^{42}\)

![Diagram of Earthquake Magnitude and Equivalent Energy Release](https://www.usgs.gov/media/images/graph-showing-earthquake-magnitudes-and-equivalent-energy-release)

Extreme earthquake shaking potential exists in the Los Angeles County area, however, the Cal State LA campus resides outside of areas designated to be liquefaction zones. Also, no campus facilities are located within the liquefaction zone. That said, substantial areas of the community surrounding the campus do reside within the liquefaction zone. Based on the above factors, the campus planning committee ranks the extent of the earthquake risk to be Moderate.

**History of the Hazard**

The State of California has a long history of chronic and destructive earthquakes throughout the state. On average, earthquakes strong enough to result in structural damages occur three to four times a year in California, while earthquakes Magnitude 6.0 to 6.9 occur once every two to three years. Los Angeles County also has a long history of earthquake activity. The entire area of Los Angeles County is at risk to seismic activity and has a history of significant earthquakes resulting in damages.

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Table 13-16: Historic Earthquakes Near Los Angeles, CA

<table>
<thead>
<tr>
<th>Date</th>
<th>Location</th>
<th>Magnitude</th>
<th>Damages</th>
</tr>
</thead>
<tbody>
<tr>
<td>12/8/1812</td>
<td>San Juan Capistrano</td>
<td>7.5</td>
<td></td>
</tr>
<tr>
<td>3/10/1933</td>
<td>Long Beach</td>
<td>6.4</td>
<td>120 fatalities, $40 million</td>
</tr>
<tr>
<td>2/9/1971</td>
<td>San Fernando</td>
<td>6.6</td>
<td>58-65 fatalities, $553 million</td>
</tr>
<tr>
<td>10/1/1987</td>
<td>Whittier</td>
<td>5.9</td>
<td>8 fatalities, $358 million</td>
</tr>
<tr>
<td>2/28/1990</td>
<td>Upland</td>
<td>5.7</td>
<td>30 injuries, $12.7 million</td>
</tr>
<tr>
<td>6/28/1991</td>
<td>Sierra Madre</td>
<td>5.6</td>
<td>1 fatality, $40 million</td>
</tr>
<tr>
<td>1/17/1994</td>
<td>Northridge</td>
<td>6.7</td>
<td>57 fatalities, $40 billion</td>
</tr>
<tr>
<td>7/29/2008</td>
<td>Chino Hills</td>
<td>5.5</td>
<td>Minor</td>
</tr>
<tr>
<td>3/28/2014</td>
<td>La Habra</td>
<td>5.1</td>
<td>$10 million</td>
</tr>
</tbody>
</table>

The January 9, 1994 Northridge Earthquake became the costliest seismic event in California history. The earthquake caused extensive damage to structures, the transportation infrastructure, utility systems, water storage, communications, and critical facilities. This level of damage due to the fault that ruptured was directly underneath a densely populated urban area. The Northridge Earthquake was found to raise the nearby mountains by as much as 70 centimeters. The earthquake was provided a federal disaster declaration (DR-1008).

The October 1, 1987 Whittier Narrows Earthquake shook a large part of southern California. The earthquake caused $358 million in damages, especially in the Alhambra, Pasadena, and Whittier areas. The earthquake resulted in extensive infrastructure damages, multiple injuries, and 8 fatalities. The earthquake was provided a federal disaster declaration (DR-799).

The February 9, 1971 Magnitude 6.5 San Fernando Earthquake struck the San Fernando Valley in Los Angeles just after 6am. The intense shaking caused the collapse of freeway overpasses, hospitals, and other infrastructure. It damaged thousands of homes and businesses, a reservoir, and critical infrastructure. 65 people were killed and 2,000 more were injured. The shaking was felt for 300 miles including in Las Vegas, Nevada. The earthquake was provided a federal disaster declaration (DR-299).

The March 10, 1933 Long Beach Earthquake registered at a Magnitude 6.4 occurred along the Newport-Inglewood Fault. The earthquake resulted in over $50 million in damages, 500 injuries, and 120 fatalities. Unreinforced masonry structures were the source of most of the casualties. 70 schools were destroyed and 120 were damaged. This earthquake

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43 2019 County of Los Angeles All-Hazards Mitigation Plan, 2019
promoted statewide standards in building design and construction for schools and other structures to better withstand seismic events.

Potential Impacts of the Hazard

The shaking of the ground from earthquakes can result in building collapse, bridge failure, utility disruptions and other structural collapse. Large earthquakes can additionally cause natural gas lines to break resulting in structure fires. The proximity to the unstable soils surrounding the campus presents a potential for liquefaction creating greater ground instability during seismic events. A major earthquake in the Los Angeles area would likely result in region-wide social disruptions in addition to structural damages. The region-wide structural damages may disrupt lifelines and supply chain routes limiting the campus from effective evacuation routes and receiving necessary supplies or equipment.

Most injuries resulting from earthquakes are from collapsing walls, flying glass, or other objects moved by ground shaking. The lack of warning allows individuals minimal time to react and find areas of safety. A moderate earthquake occurring near Hayward could cause injuries or fatalities to members of the campus community or support networks the campus relies on. These earthquake effects might be aggravated by collateral incidents such as fire, flooding, hazardous material spills, dam/levee compromises, and other cascading events. A catastrophic earthquake near Los Angeles could result in extensive casualties, expansive structural damages, panic, widespread utility outages, communication failures, and secondary emergencies such as fire. A catastrophic earthquake would certainly affect the broader Los Angeles County region limiting immediate assistance that the campus may normally expect.

Local impacts to Cal State LA campus caused by an earthquake could include:

- Damage and secondary fires to industrial buildings to the west of campus
- Potential hazardous material releases on and off campus
- Potential liquefaction-based effects to areas of the surrounding neighborhoods to the west
- Infrastructure damage to freeway system
- Structural damage to bridges
- Potential isolation of campus from community
- Potential isolation among on-campus residents
- Structural damage to flood control and drainage systems
- Structural damage to campus academic and support buildings
- Structural damage to residence halls resulting in displaced student populations
- Structural damage to nearby residences
- Community members arriving on campus for refuge from damaged homes
- Damaged university communications, computer systems, and networks
- Considerable stress and fear among community
- Closure or reduction of service to campus operations
Probability of Future Occurrence of the Hazard

The Working Group on California Earthquake Probabilities (WGCEP), a collaboration between the United States Geological Survey (USGS), the Southern California Earthquake Center (SCEC), and the California Geological Survey (CGS) develops Uniform California Earthquake Forecasts (UCERFs) using the best currently available science and technology. The UCERF version 3 provides a three-dimensional view of the likelihood a region in California will experience a Magnitude 6.7 or greater earthquake in the next 30 years. The likelihood for the Los Angeles County fault systems surrounding Los Angeles is included in the following table.

Table 13-17: Major Potentially Active Faults in Proximity to Cal State LA

<table>
<thead>
<tr>
<th>Fault Zone</th>
<th>Recurrence</th>
<th>Maximum Magnitude</th>
<th>UCERF Likelihood</th>
</tr>
</thead>
<tbody>
<tr>
<td>Elysian Park</td>
<td>Historic: Unknown</td>
<td>5.8 to 6.5</td>
<td>1%</td>
</tr>
<tr>
<td>Hollywood</td>
<td>Historic: 1,600 years</td>
<td>5.8 to 6.5</td>
<td>1-2%</td>
</tr>
<tr>
<td>Newport-Inglewood</td>
<td>Historic: Unknown</td>
<td>6.0 to 7.4</td>
<td>1%</td>
</tr>
<tr>
<td>Palos Verdes</td>
<td>Historic: Unknown</td>
<td>6.0 to 7.0</td>
<td>3%</td>
</tr>
<tr>
<td>San Andreas</td>
<td>Varies: 100-300 years</td>
<td>6.8 to 8.0</td>
<td>18-20%</td>
</tr>
<tr>
<td>Santa Monica</td>
<td>Historic: Unknown</td>
<td>6.0 to 7.0</td>
<td>1%</td>
</tr>
<tr>
<td>Santa Susana</td>
<td>Historic: 138 years</td>
<td>6.6</td>
<td>2-3%</td>
</tr>
<tr>
<td>Sierra Madre</td>
<td>Historic: 1,000-3,000 years</td>
<td>6.0 to 7.0</td>
<td>1-2%</td>
</tr>
<tr>
<td>Verdugo</td>
<td>Historic: Unknown</td>
<td>6.0 to 6.8</td>
<td>1%</td>
</tr>
<tr>
<td>Whittier</td>
<td>Historic: Unknown</td>
<td>6.0 to 7.2</td>
<td>1%</td>
</tr>
</tbody>
</table>

Based on the earthquake shaking potential in the Los Angeles Basin, the history of occurrence, the proximity to the above listed fault systems, and the probability of seismic ground shaking generating damage is considered Possible.

Vulnerability to the Hazard

A considerable challenge regarding earthquakes is they generally occur without warning. The fault systems surrounding the region all cross major transportation routes potentially reducing the availability of access and the supply chain. The geographic location of Cal State LA places the campus in an urban/suburban community near residential,

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44 2019 County of Los Angeles All-Hazards Mitigation Plan, 2019
45 Southern California Earthquake Center, Earthquake Information,
commercial, and industrial areas that is moderately populated. Earthquake effects experienced in the neighboring local community will likely spill over onto the campus.

The known fault systems generating the threat to Los Angeles generally surround the city and some cross into the city including near the Cal State LA campus. The Elysian Park Fault traverses the southern edge of the campus. The proximity and potential for large earthquake development from these surrounding systems expose significant vulnerabilities. The potential for earthquake damaged structures being left uninhabitable including campus residence halls will result in numerous displaced individuals and households. The lack of earthquake insurance will cause extreme financial burdens on those affected.

Elements of the vulnerability to a major earthquake on the Cal State LA campus will vary depending on when the earthquake were to strike. The risk to the campus population will be lessened during periods when classes are not in session or during periods of breaks. Conversely, during the days and hours that classes are in session and staff are at their workplaces, the human vulnerability increases. Generally, people are safer when at home in wood frame structures as earthquakes tend to generate less structural damage to wood construction than in commercial or industrial facilities. The greater number of people on campus at the time of an earthquake will result in more people being exposed to effects from damaged campus facilities or equipment and require greater evacuation assistance. However, in region-wide events this vulnerability may simply shift to the homes and workplaces of members of the campus community and their families.

The aftermath of a major earthquake will likely result in widespread search and rescue operations for trapped and injured individuals. The demand on emergency services will be great, potentially requiring the campus community to be prepared for these scenarios and initiate response actions as needed. There will be needs for emergency medical care, shelter, water, and food for individuals who have been displaced by the earthquake. In earthquakes causing significant damages, there may be a necessity to provide assistance with identification and support to local agencies in mass fatality management.

There may be a need to evacuate members of the campus community from the campus and to other locations that are deemed to be safer locations. The Los Angeles area is densely populated and attracts numerous commuter employees to the urban core. The road and freeway network becomes easily congested in normal situations. As the Cal State LA campus is located at the intersection of Interstate-10 and Interstate-710, access in and out of the campus may be compromised with traffic congestion on these primary thoroughfares.

Certain campus populations will experience greater challenges to a post-earthquake environment. Vulnerable populations including those that rely on specific services, require electrical power, homeless students, experience disabilities, non-English speakers, those whose age make evacuating difficult, and others will be most affected. These individuals will likely need to navigate through earthquake generated debris, extreme stresses of a disaster, an inability to communicate to or gain access to support networks, and find difficulty in accessing equipment or supplies to aid in a specific need.
Estimate of Potential Losses

Estimates of potential losses will be influenced by a variety of factors. The intensity of the earthquake will determine what scale of damages affecting campus infrastructure, equipment, and other impacted features. Losses will be generated by the physical damages, the loss of revenue, loss of academic research, loss of building contents, and community wide economic reductions.

Based on estimate replacement costs of facilities and structures on campus, the maximum total replacement costs due to earthquake are $257,007,988.

Table 13-18: HAZUS Peak Ground Acceleration Zone (PGA) Estimated Losses

<table>
<thead>
<tr>
<th>PGA Zone Designation</th>
<th>Intensity</th>
<th>No of Buildings</th>
<th>Maximum Replacement Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Extreme</td>
<td>X+</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Violent</td>
<td>IX</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Severe</td>
<td>VIII</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Very Strong</td>
<td>VII</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Strong</td>
<td>VI</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Moderate</td>
<td>V</td>
<td>42</td>
<td>$257,007,988</td>
</tr>
<tr>
<td>Light</td>
<td>IV</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Weak</td>
<td>II-III</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Not Felt</td>
<td>I</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>NA</td>
<td>NA</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>No Building Value Data Provided*</td>
<td>NA</td>
<td>13</td>
<td>Unknown</td>
</tr>
</tbody>
</table>

*Buildings with no value defined are also included in the respective Zones they are found in.*
Vulnerability Assessment Conclusions

It is difficult to predict the severity of casualties, property, and cascading impacts generated by future seismic events affecting the greater Los Angeles Basin and the Cal State LA campus. Each of the earthquake generated effects will vary widely based on the intensity of the earthquake, location of the epicenter, proximity to people and development, time of day and year, the soil composition under the impacted structures, building construction, among others. In any case, the potential for a major earthquake exists affecting the campus and causing extensive challenges to the Cal State LA campus and community.

In the event that a major earthquake were to strike along the many fault systems surrounding Los Angeles, the effects could be significant to the campus community and campus operations. The widespread impacts generated by a major earthquake would extend the effects of casualties, damages, and other impacts to the broader Los Angeles County region creating large-scale regionwide needs for critical assistance and a heavy demand on limited emergency resources. The threat and impacts presented to the campus will be shared with the campus community from their homes and places of work. The campus will likely be required to address critical needs independently during early phases of the disaster.

Vulnerabilities will be seen in the physical infrastructure on the campus and the human population of the campus community. Campus infrastructure is vulnerable to severe shaking particularly in areas where the ground is loose or susceptible to liquefaction. Specifically older buildings, masonry constructed buildings, and other structures susceptible to shaking related damage are the most vulnerable. Communication systems, computer networks, and other electronic systems may be vulnerable when overwhelmed by increased demand during emergencies or by shaking related damages. The people of the campus community are vulnerable to effects of intense shaking in the form of injuries from falling debris, exposure to secondary floods or fires, loss of employment, extreme disaster induced stress, and loss of access to critical services or social contacts.

The campus population is additionally vulnerable to the effects of major ground shaking that are far reaching. The psychological and social impacts a major earthquake will give rise to will potentially harm individuals and cause tremendous fear. The willingness to return indoors may be hampered especially as after-shocks continue. These effects are magnified for populations having specific vulnerabilities or access limitations. Populations having various limitations or specific needs may be vulnerable to reduced or eliminated access to essential services that have been rendered incapable to respond.

Identified Data Limitations

Missing campus structural replacement costs and an inventory of building construction types to include status of earthquake retrofitting. HAZUS generated analysis is focused on the broader community level versus finetuning the analysis to the micro-level for facilities such as a university campus.
Erosion

Description of the Hazard

The US Geological Survey (USGS) defines erosion as “the process whereby materials of the earth’s crust are loosened, dissolved, or worn away and simultaneously moved from one place to another”. Erosion may occur in areas of streams and rivers, along bluffs, around immovable objects (such as buildings or bridge abutments), or as a cascading result of other natural hazards, such as earthquakes or wildfires. When erosion occurs along bodies of water, the removal of material causes the shore to move further landward.

Forces such as sea level rise and changes in sediment supply impact erosion gradually and can be difficult to recognize. In contrast, the impacts of short-term events, such as storms and flooding, can be severe and are immediately recognizable. Along the Pacific coast, rain, wind, and waves can induce significant short-term erosion.

Location of the Hazard

Erosion is a severe hazard in coastal communities, where sea level rise and storms contribute to de-sedimentation and the retreat of coastal cliffs, bluffs, and beaches. While coastal erosion can happen in any storm, it is more likely during El Nino events, which occur every 5-7 years. An area’s potential for erosion is determined by several factors, including rainfall, topography, soil characteristics, and vegetative cover. For the purpose of this campus-level analysis, the erosion hazard poses a consistent risk across those areas of the campus with erosion-prone characteristics. In the future, campus leadership may investigate to what extent specific erosion prone locations on the campus are exhibiting erosion in process.

Extent of the Hazard

Erosion is occurring on the Pacific coastline west of Cal State LA. While there is no published scale of severity or extent for this geologic hazard on the Cal State LA campus, erosion is likely to occur if conditions are favorable. Given no historical occurrence of erosion on campus, the planning committee ranks the extent of this hazard as Low.

History of the Hazard

El Nino storms from 2015-16 caused significant coastal erosion in Los Angeles County and mitigation projects are ongoing. However, no incidents of erosion have been recorded on the Cal State LA campus.

Potential Impacts of the Hazard

Coastal erosion can result in severe impacts to local infrastructure, including the undermining of foundations, exposure of underground infrastructure, and breaches of natural or constructed protections. The latter can expose communities to the destructive forces of floodwaters, surge, and debris impacts. On campus, areas of erosion can create pedestrian and transportation hazards, and structures may become unsafe if erosion is not controlled. Public health and safety, structures, and infrastructure can all be negatively impacted, damaged, or destroyed by the erosion hazard.

**Probability of Future Occurrence of the Hazard**

Erosion is an on-going and dynamic process that occurs regularly. As climate change raises sea levels and induces more frequent and intense weather events, coastal and other erosion may generally become more widespread or severe. These events can cause erosion or exacerbate areas already experiencing erosion. That said, with regard to the campus, given the lack of historical events or any known locations with erosion in process, the probability of annual future occurrence on campus is **Low**, though it is likely that at least a limited degree of erosion will occur somewhere on the campus over the long term; conditions could emerge in the future which increase the probability, precipitated by climate change, changes in land-use or other factors.

**Vulnerability to the Hazard**

Topography, soil structure, land use, and precipitation are all factors of erosion. Cal State LA infrastructure and buildings located on steep slopes, in areas with little vegetation, or in areas with conducive soil types are more vulnerable to erosion.

In the wider Los Angeles community, erosion vulnerabilities include agricultural sector job loss, degradation of riverine ecosystems and coastlines, and loss of water quality. CSU leadership may consider performing an analysis on the campus to assess whether any specific at-risk buildings, slopes and soil types in the future.

**Estimate of Potential Losses**

The historic and potential impacts of erosion on property statewide include reduced agricultural productivity, lower surface water quality, and damaged drainage networks.

Current modeling is not precise enough to allow for an assessment of potential losses to buildings and infrastructure on campus.

**Vulnerability Assessment Conclusions**

While the ability to predict future erosion on the Cal State LA campus is limited, the core issues shaping erosion vulnerability on campus are flora and landscaping. If left unchecked, erosion can cause significant damage to campus infrastructure and the surrounding environment.

**Identified Data Limitations**
The complex interactions between soil erosion factors make predictive modeling, determination of hazard areas, and quantification of loss difficult. Localized data on this hazard is also limited, resulting in more generalized findings.

**Extreme Temperatures (Includes Extreme Cold and Extreme Heat)**

**Heat**

**Description of the Hazard**

What is considered an excessively hot temperature varies according to the normal climate for that region. However, when temperatures are extremely high, people are at higher risk for heat-related illnesses, such as dehydration, heat exhaustion, heat stroke, and in severe cases, death.48

Hazards from extreme heat are made worse when high temperatures are accompanied by high levels of humidity, which is defined as the amount of moisture in the air.49 As the temperature climbs, the air is able to hold more moisture. High humidity prevents the human body from cooling down naturally, which leads people to perceive that the temperatures “feels” hotter. The combination of temperature and humidity is known as the heat index.50

Heat stroke, the most serious heat-related illness, occurs when the body is unable to control its temperature. Body temperature rises rapidly, the sweating mechanism fails, and the body cannot cool down.51 In extreme causes, heat stroke can cause confusion and unconsciousness, so the victim is unable to seek treatment without assistance.

There are several groups of people who are uniquely vulnerable to the effects of extreme heat, such as infants and children, older adults aged 65 and up, athletes and outdoor workers, low-income households, and individuals with certain chronic medical conditions.52

**Location of the Hazard**

Extreme heat events are a non-spatial hazard, and may occur throughout the Cal State LA campus.

**Extent of the Hazard**

50 Ibid.
Extreme heat has a wide range of extent and severity markers and characteristics. In the City of Los Angeles, monthly average maximum temperatures in June through October range approximately from the high 70s to the mid-80s. According to data from the National Climatic Data Center (NCDC), the highest daily temperature recorded at in the City of Los Angeles is 113° F on September 27, 2010. The day this record was reached, the National Weather Service’s high-tech thermometer in downtown Los Angeles stopped working.\textsuperscript{53}

The National Weather Service issues a Heat Advisory when the heat index value is expected to reach 100° – 104° F within the next 12 to 24 hours. Excessive Heat Warnings are issued when there is an anticipated heat index of 105° F or greater that will last for two (2) or more hours. Excessive Heat Warnings are issued by the county when any location in the county is expected to reach that criteria.\textsuperscript{54} In anticipation of an Excessive Heat Warning, an Excessive Heat Watch may be issued 1 to 2 days in advance, when the Heat Warning criteria is 50 – 79% likely to occur.

Figure 13-8 (following) depicts the National Weather Service’s methodology for determining the heat index, using the % humidity and the actual temperature.

Figure 13-8: Methodology for Determining Heat Index.

\begin{figure}
\centering
\includegraphics[width=\textwidth]{Figure13-8.png}
\caption{Methodology for Determining Heat Index.}
\end{figure}


As the heat index rises, so does the potential danger to people and animals. Table xx (following) shows the health hazards associated with extreme heat.
### Table 13-19: Health Risks Associated with Heat Index

<table>
<thead>
<tr>
<th>Category</th>
<th>Heat Index</th>
<th>Health Hazards</th>
</tr>
</thead>
<tbody>
<tr>
<td>Extreme Danger</td>
<td>130° F or higher</td>
<td>Heat stroke / sunstroke is likely with continued exposure.</td>
</tr>
<tr>
<td>Danger</td>
<td>105° – 129° F</td>
<td>Sunstroke, heat cramps, and/or heat exhaustion is likely with prolonged exposure and/or physical activity.</td>
</tr>
<tr>
<td>Extreme Caution</td>
<td>90° – 104° F</td>
<td>Sunstroke, heat cramps, and/or heat exhaustion is possible with prolonged exposure and/or physical activity.</td>
</tr>
<tr>
<td>Caution</td>
<td>80° – 89° F</td>
<td>Fatigue is possible with prolonged exposure and/or physical activity.</td>
</tr>
</tbody>
</table>

Based on only five extreme heat events recorded in Los Angeles County since 1950, along with LA County’s established protocols of providing the public with advanced notice of heat events with directives for mitigating impacts, the planning committee ranks the extent of this hazard on campus as **Low**.

### History of the Hazard

Based on data gathered from the National Centers for Environmental Information (NCEI) Storm Events Database, there have been five excessive heat events in Los Angeles County since 1950. These events were consolidated within two periods in 2007 and 2008.

**August 30, 2007; September 1, 2007; September 3, 2007:** A combination of high temperatures and high humidity produced an extreme heat event across Los Angeles County and much of Southern California. Heat index values ranged from 105° to 112° F. There were eight deaths attributable to this excessive heat event.

**June 20, 2008; June 21, 2008:** Afternoon high temperatures during this extreme heat event climbed as high as 114° F. The heat resulted in several power outages due to excessive electrical use.

In addition to these excessive heat events, there have been 100 incidents since 1980 when the temperature in the City of Los Angeles has hit 100° F or greater (as reported by NCDC).

### Potential Impacts of the Hazard

Cal State LA may experience impacts from extreme heat due to cancelled classes or postponed outdoor events in order to protect students, faculty, and staff from the weather.

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In addition to the threat extreme heat poses to humans, high temperatures also pose a threat to utility production, which in turn threaten facilities and operations that rely on utilities. As temperatures rise, more people stay indoors, increasing the demand for air conditioning, fans, and other electronics. This puts a strain on the electrical grid, which can cause temporary outages. These outages can impact operations throughout campus, resulting in interruptions and delays in service. Outages may also negatively impact research efforts on campus, as the inability to maintain a steady, constant temperature may impact research specimens and experimental results.

**Probability of Future Occurrence of the Hazard**

There have been no extreme heat events in Los Angeles County in over a decade, and only five events since 1950 according to NCDC data. Therefore, it is only possible that the hazard will occur annually. It is also important to note that the City of Los Angeles, where the Cal State LA campus is located, does not consider extreme heat to be a primary hazard, and has not included it in its most recent hazard mitigation plan. The rationale for excluding this hazard is that the combination of high temperature and high humidity, which are the requirements for the National Weather Service to declare a heat emergency, are relatively rare in Los Angeles. Los Angeles County, in its hazard mitigation plan, examines extreme heat as a hazard, but only as one small part of a larger discussion regarding the effects of climate change.

**Vulnerability to the Hazard**

When dealing with an extreme heat event, the most common impacts are those generally felt by the people living in the targeted area. For people in particular, heat can kill when the body is pushed beyond its limits. Most heat disorders occur because the victim has been overexposed to heat. As discussed, the major human risks associated with extreme heat include dehydration, sunburn, fatigue, heat exhaustion, heat stroke, and in severe cases, death.

Some portions of the population are more at risk to the effects of extreme heat. The very young, the elderly, and certain groups with chronic medical conditions (such as asthma or other pulmonary illnesses, heart disease, poor blood circulation, neurological illnesses, and obesity) are generally more vulnerable to the effects of extreme heat, and are more likely to suffer illness or death as a result. This is especially true if exposure is extended for a period of time and preventative measures are not taken immediately.

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57 2019 County of Los Angeles All-Hazards Mitigation Plan. 4.1 Climate Change. Print. Retrieved 01.27.21 from: https://lacounty.gov/emergency/county-of-los-angeles-all-hazards-mitigation-plan/
Cal State LA is aware of the potential for heat events and takes precautions to protect staff from the effects of the heat. When it comes to staff safety, supervisors are reminded of Occupational Safety and Health Administration (OSHA) regulations that protect workers from extreme heat.

Therefore, while this is a hazard that the campus may experience with regularity, the campus has ample familiarity with managing the risks and vulnerabilities.

Estimate of Potential Losses

Based on the previous historical occurrences, annualized losses are considered to be negligible. In an extreme heat event, loss of human life or health impacts are a greater concern than is property damage.

Vulnerability Assessment Conclusions

While the ability to predict future heat events at the Cal State LA campus is limited, the effects of climate change may provide some information. According to the Environmental Protection Agency (EPA), Southern California has warmed about three degrees on average over the last century, with less rainfall. This may lead to stronger and more frequent heat events, drought, and an increased risk of wildfires.\(^59\) As such, it may lead to increased levels of those vulnerabilities discussed above.

Identified Data Limitations

Quantitative data on extreme heat impacts, such as public health impacts or impacts to campus power sources or air conditioning equipment is not available at this time.

Description of the Hazard (Extreme Cold)

What is considered an excessively cold temperature varies according to the normal climate for that region. However, when temperatures are far below normal, with higher wind speeds, heat leaves the human body more rapidly, which increases the possibility of negative effects from these extreme temperatures.\(^60\)

The greatest danger from extreme cold is to people, as prolonged exposure can cause frostbite or hypothermia, and can become life threatening. When someone is suffering from hypothermia, body temperatures can become so low that they affect the brain, making it difficult for the victim to think clearly or move well. In the case of frostbite, the frozen tissue becomes numb and the victim may be unaware that anything is wrong until

someone else notices. This makes hazards from extreme cold particularly dangerous, as people may not understand what is happening to them or what to do about it.

The primary hazards from extreme cold are frostbite and hypothermia. Frostbite is caused by freezing of the skin and underly tissue. It causes a loss of feeling and color in the affected areas of the body, and most often affects the nose, chin, fingers, or toes. It can be permanently damaging if not treated promptly and can lead to infection, nerve damage, or amputation in severe cases. The risk of frostbite is increased in people with preexisting conditions, the elderly, people with reduced blood circulation, and people who are not dressed warmly enough for the conditions.

Hypothermia occurs when the body loses heat faster than it can produce heat, causing a dangerously low body temperature. A normal body temperature is around 98.6°F. Hypothermia occurs when your body temperature falls below 95°F. As this happens, the heart and other essential organs cannot work properly. If hypothermia is not treated, it can lead to heart failure, respiratory failure, and eventually to death.

Excessive or extreme cold can accompany severe winter weather, or it can occur without severe weather. For this reason, extreme cold is a separate hazard from severe winter storms.

Location of the Hazard

Extreme cold events are a non-spatial hazard, and may occur throughout the Cal State LA campus.

Extent of the Hazard

Extreme cold has a wide range of extent and severity markers and characteristics. Average nighttime winter temperatures in the City of Los Angeles are typically in the high 40s to low 50s. According to data from the National Climatic Data Center (NCDC), the lowest daily temperature recorded in Los Angeles was 33°F on January 17, 1987. Based on just 2 frost/freeze events in Los Angeles County since 1997, and no extreme cold events, the planning committee ranks the extent of this hazard as Low.

63 Ibid.
The National Weather Service issues Extreme Cold Warnings when the temperature feels like it is -30°F or colder across a wide area for a period of at least several hours. When possible, these advisories are issued a day or two in advance of the conditions.\textsuperscript{65}

The most common extent/severity marker for extreme cold is the Wind Chill scale. Figure 13-9 (following) depicts the National Weather Service’s methodology for determining the wind chill, using wind speed and actual temperature. Although wind chill is not necessarily related to extreme cold as a single cause, the advisory system that the NWS currently uses relies on wind chill to relay warning and advisory information to the public. Extreme cold severity is a function of wind chill and other factors, such as precipitation amount (rain, sleet, ice, and/or snow).

Figure 13-9: Methodology for Determining Wind Chill

\begin{figure}[h]
\centering
\includegraphics[width=\textwidth]{wind_chill_chart.png}
\caption{Methodology for Determining Wind Chill}
\end{figure}

In 2011, the National Weather Service introduced an experimental program that issued warnings for extreme cold events, independent of other severe weather warnings. The test areas included North and South Dakota and Minnesota. However, in 2012, after a

single season of use, the program was abandoned, based on reports of confusion among test audiences.66

History of the Hazard

Based on data gathered from the National Centers for Environmental Information (NCEI) Storm Events Database, Los Angeles County has had two frost/freeze events occurring December 21, 1998 and January 13, 2007, but no extreme cold hazards. [Records for this hazard were first recorded in 1996].

Potential Impacts of the Hazard

Should an extreme cold event occur, Cal State LA might experience impacts due to cancelled classes.

In addition to the threat posed to humans, extreme cold weather poses a significant threat to utility production, which in turn threatens facilities and operations that rely on utilities, specifically climate stabilization. As temperatures drop and stay low, increased demand for heating places a strain on the electrical grid, which can lead to temporary outages. These outages can impact operations throughout the campus, which can result in interruptions and delays in services. These outages may also negatively impact research efforts throughout the campus, as the inability to maintain a steady, constant temperature may result in unintended effects on research specimens.

Probability of Future Occurrence of the Hazard

The City of Los Angeles has only experienced two frost/freeze events within the past two decades, but has never experienced an extreme cold event. Due to the campus’s location in a temperate climate, it is unlikely that this hazard will occur annually. As such, the planning committee ranks the probability of occurrence as Low.

Vulnerability to the Hazard

When dealing with an extreme cold event, the most common impacts are those generally felt by the people living in the targeted area. For people in particular, extreme cold can kill when the body is pushed beyond its limits. Most danger due to the cold is because the victim has been overexposed to low temperatures. As discussed, the major human risks associated with extreme cold include frostbite, hypothermia, and in severe cases, death.

Some portions of the population are more at risk to the effects of extreme cold. The elderly, those with certain preexisting conditions (hypothyroidism, diabetes, and high blood pressure, just to name a few), those with poor blood circulation, and people who are not dressed warmly enough for the cold are generally more vulnerable and are more

likely to suffer illness or death as a result.\(^\text{67}\) This is especially true if exposure is extended for a period of time and preventative measures are not taken immediately.

Cal State LA is not one of the CSU campuses that is at high risk of an extreme cold event.

**Estimate of Potential Losses**

Based on the infrequent historical occurrences of cold/frost events, and no occurrence of extreme cold, annualized losses are considered to be negligible.

**Vulnerability Assessment Conclusions**

While the ability to predict future extreme cold events at the Cal State LA campus is limited, the effects of climate change may provide some information. According to the Environmental Protection Agency (EPA), areas in southern California have warmed approximately three degrees on average over the last century, with less rainfall. This may lead to fewer frost/freeze events in the future.\(^\text{68}\) As such, any existing vulnerabilities to cold will likely be reduced over the long term in Los Angeles.

**Identified Data Limitations**

Numerous public and private actors conduct research, acquire data and disseminate meteorological information and forecasting to the general public, including the CSU university system. Currently, it is assumed that, apart from regular access to climate change models on changes to temperature extremes over time, the CSU community maintains sufficient access to the data needed to plan for, respond to, and mitigate the effects of extreme heat and cold.

**Flood**

**Description of the Hazard**

The incredible geographic diversity in California presents tremendous challenges for flood planning and response. The state is home to extensive mountain ranges such as the Sierra Nevada, Cascades, Klamath, Coastal Ranges, and the Southern California Transverse Range all creating tremendous watersheds. Large river systems drain the mountains traveling through populated communities including the Sacramento and San Joaquin Rivers draining into the California Delta. The state has a complex system of reservoirs, dams, and levees providing water storage and flood protection. Finally, California’s 840-mile coastline exposes the coastal regions to tidal influences.

Floods are characterized by the rising and overflowing of excess water from a water source such as a stream, river, lake, canal, or coastal body onto an area of normally dry


floodplain. A floodplain is a lowland area downstream and adjacent to water bodies that are subject to flood events. Flooding is a naturally occurring event that become hazardous when populations and property are affected.

Flooding can result from excessive precipitation from weather systems generating prolonged rainfall, excessive snowmelt from watersheds upstream from the floodplain, infrastructure failure, exceeding the capacity of dams or levees, tidal influences, or a combination from any of the previous factors.

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Flooding can result from excessive precipitation from weather systems generating prolonged rainfall, excessive snowmelt from watersheds upstream from the floodplane
may result in a catastrophic flood with limited warning time and widespread areas affected.

- **Coastal Flooding** – Coastal flooding can occur in multiple areas along the California coastline. Flooding may result from intense storms coming from the Pacific Ocean that generate elevated water levels or storm surge. The size, duration, winds generated, and intensity of the storm will influence the effect the waves will have on the shoreline. Periods of high tide can aggravate the conditions allowing greater wave impingement into coastal areas.

**Atmospheric River**

California, including the location of this campus, is subject to the effects of a phenomenon referred to as atmospheric rivers. These weather events consist of long, narrow regions in the atmosphere transporting tremendous amounts of water vapor from the tropics. These weather regions behave like rivers in the sky. They can carry heavy volumes of water vapor compared to the amount of water flow at the mouth of the Mississippi River. As these atmospheric rivers arrive into California they tend to generate significant rain and snow.

Atmospheric rivers can arrive in many different shapes and sizes. The larger events are able to generate extreme rainfall amounts resulting in flooding. They can stall over watersheds vulnerable to flooding, often saturated with heavy snow amounts. The atmospheric rivers known as a “Pineapple Express” coming from the tropics and arriving with warmer air may produce heavy rains that will melt ground snow adding to the water volume that will be added in the flood runoff.

These events can produce heavy amounts of precipitation creating extensive damages. However, these events may present as weaker systems that produce precipitation that is enough to be beneficial for the local water supply. At the higher elevations in the California mountains, these events have the potential to generate a tremendous snowpack providing a source of water during the dry summer months.
The science behind atmospheric rivers

An atmospheric river (AR) is a flowing column of condensed water vapor in the atmosphere responsible for producing significant levels of rain and snow, especially in the Western United States. When ARs move inland and sweep over the mountains, the water vapor rises and cools to create heavy precipitation. Though many ARs are weak systems that simply provide beneficial rain or snow, some of the larger, more powerful ARs can create extreme rainfall and floods capable of disrupting travel, inducing mudslides and causing catastrophic damage to life and property. Visit www.research.noaa.gov to learn more.

Location of the Hazard

Cal State LA lies just under 5 miles from downtown Los Angeles. Along the eastern edges of Los Angeles are low rising hills that separate the Los Angeles Basin and the San Gabriel Valley. These include the Ascot Hills which provide a potential for developing water run-off during heavy localized precipitation events. The area surrounding the campus is a developed suburban environment predominately consisting of residential and commercial land uses. The campus is located at the junction of Interstate 10 and Interstate 710 on the northwest corner. A small flood retention basin is found on the opposite side of Interstate 710 from the campus.
The Cal State LA campus is not located in proximity to any significant waterways or flood control systems. The entire Cal State LA campus sits within a Special Flood Hazard Area (SFHA) Zone X: Area of Minimal Flood Risk designation on the Flood Insurance Rate Map. This minimal flood risk rating extends at least 4 miles away from the campus to nearest enhanced area of flood risk. Therefore, transportation routes and critical services in proximity to the campus are found outside of designated flood risks.

**Extent of the Hazard**

The Cal State LA campus is entirely located in a designated Zone X: Area of Minimal Flood Hazard. The access routes into and out of the campus servicing locations in all directions are also found in areas primarily designated as Zone X: Area of Minimal Flood Hazard. In addition, the Cal State LA campus lies outside of a levee flood protected area. Levees protect areas at the base of the foothills and lining flood control channels. This specific hazard does not substantially alter the ability of the campus to maintain operations as the distance to levee protected channels exceeds the protection zones. As such, the planning committee ranks the extent of the hazard on campus as **Low**.
In support of the NFIP, FEMA identifies those areas that are more vulnerable to flooding by producing Flood Hazard Boundary Maps (FHBM), Flood Insurance Rate Maps (FIRM), and Flood Boundary and Floodway Maps (FBFM). Several areas of flood hazards are commonly identified on these maps, including the 1% annual chance flood zone. Flood zones are further delineated by risk and are assigned a letter signifier. The flood zone designations are defined and described in the following table.

Table 13-20: Flood Zone Designations and Descriptions

<table>
<thead>
<tr>
<th>Zone Designation</th>
<th>Percent Annual Chance of Flood</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Zone V</td>
<td>1%</td>
<td>Areas along coasts subject to inundation by the 1% annual chance of flooding with additional hazards associated with storm-induced waves. Because hydraulic analyses have not been performed, no BFEs or flood depths are shown.</td>
</tr>
<tr>
<td>Zones VE and V1-30</td>
<td>1%</td>
<td>Areas along coasts subject to inundation by the 1% annual chance of flooding with additional hazards associated with storm-induced waves. BFEs derived from detailed hydraulic analyses are shown within these zones. (Zone VE is used on new and revised map in place of Zones V1-30.)</td>
</tr>
<tr>
<td>Zone A</td>
<td>1%</td>
<td>Areas with a 1% annual chance of flooding and a 26% chance of flooding over the life of a 30-year mortgage. Because detailed analyses are not performed for such areas, no depths or base flood elevations are shown within these areas.</td>
</tr>
<tr>
<td>Zone AE</td>
<td>1%</td>
<td>Areas with a 1% annual chance of flooding and a 26% chance of flooding over the life of a 30-year mortgage. In most instances, BFEs derived from detailed analyses are shown at selected intervals within these zones.</td>
</tr>
<tr>
<td>Zone AH</td>
<td>1%</td>
<td>Areas with a 1% annual chance of flooding where shallow flooding (usually areas of ponding) can occur with average depths between 1 – 3 feet.</td>
</tr>
<tr>
<td>Zone AO</td>
<td>1%</td>
<td>Areas with a 1% annual chance of flooding, where shallow flooding average depths are between 1 – 3 feet.</td>
</tr>
</tbody>
</table>
Zone X (shaded) | 0.2% | Represents areas between the limits of the 1% annual chance flooding and 0.2% chance flooding.

Zone X (unshaded) | Undetermined | Areas outside of the 1% annual chance floodplain and 0.2% annual chance floodplain, areas of 1% annual chance sheet flow flooding where average depths are less than one (1) foot, areas of 1% annual chance stream flooding where the contributing drainage area is less than one (1) square mile, or areas protected from the 1% annual chance flood by levees. No BFEs or depths are shown within this zone.

History of the Hazard

No record of floods is recorded on campus, however, flooding in Los Angeles and the broader Los Angeles County region have typically occurred during the winter months when Pacific storms are more common. The occurrences of significant flooding typically have been the result of successive intense storms with heavy precipitation. The region has experienced flood events that have caused tens of millions of dollars in damages and casualties. The following provides insight into information of past flooding events that are significant to the Cal State LA campus.

Table 13-21: Historic Flooding Events in Los Angeles County

<table>
<thead>
<tr>
<th>Date</th>
<th>Event</th>
<th>Declaration</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>March 1962</td>
<td>Flood</td>
<td>DR-122-CA</td>
<td>Countywide</td>
</tr>
<tr>
<td>October 1962</td>
<td>Flood</td>
<td>DR-138-CA</td>
<td>Countywide</td>
</tr>
<tr>
<td>February 1963</td>
<td>Flood; Heavy Rains</td>
<td>DR-145-CA</td>
<td>Countywide</td>
</tr>
<tr>
<td>February 1978</td>
<td>Flood; Winter Storms</td>
<td>DR-547-CA</td>
<td>Countywide</td>
</tr>
<tr>
<td>February 1980</td>
<td>Flood; Winter Storms</td>
<td>DR-615-CA</td>
<td>Countywide</td>
</tr>
<tr>
<td>December 1988</td>
<td>Winter Storms</td>
<td>DR-812-CA</td>
<td>Countywide</td>
</tr>
<tr>
<td>February 1992</td>
<td>Winter Storms</td>
<td>DR-935-CA</td>
<td>Countywide</td>
</tr>
<tr>
<td>January 1993</td>
<td>Winter Storms</td>
<td>DR-979-CA</td>
<td>Countywide</td>
</tr>
<tr>
<td>January 1995</td>
<td>Flash Flood; Heavy Rains</td>
<td>DR-1044-CA</td>
<td>Countywide</td>
</tr>
</tbody>
</table>

70 2019 County of Los Angeles All-Hazard Mitigation Plan, 2019
<table>
<thead>
<tr>
<th>Date</th>
<th>Event Description</th>
<th>DR-#</th>
<th>Area</th>
</tr>
</thead>
<tbody>
<tr>
<td>March 1995</td>
<td>Flash Flood; Heavy Rains</td>
<td>1046-CA</td>
<td>Countywide</td>
</tr>
<tr>
<td>December 1996</td>
<td>Flood; Winter Storms</td>
<td>1155-CA</td>
<td>Countywide</td>
</tr>
<tr>
<td>January 1997</td>
<td>Flood</td>
<td>1155-CA</td>
<td>Countywide</td>
</tr>
<tr>
<td>February 1998</td>
<td>Flood; Winter Storms</td>
<td>1203-CA</td>
<td>Countywide</td>
</tr>
<tr>
<td>January 2005</td>
<td>Flood; Winter Storms</td>
<td>1577-CA</td>
<td>Countywide</td>
</tr>
<tr>
<td>February 2005</td>
<td>Flood; Debris Flows</td>
<td>1585-CA</td>
<td>Countywide</td>
</tr>
<tr>
<td>January 2017</td>
<td>Flood; Winter Storms</td>
<td>4305-CA</td>
<td>Countywide</td>
</tr>
</tbody>
</table>

**Potential Impacts of the Hazard**

A flood will potentially result in extensive amounts of water entering onto developed areas. The force and volume of water that is generated by a flood may cause extensive structural damage in areas subject to standing or moving water. The effects of flooding may spread over significant distances covering large areas of land. The extent of the impacts would vary based on a number of factors such as the volume of water flooding, the time of the flood event, the amount of warning provided, the location and extent of the flood boundary, facility elevation, and distance from the flood source. Potential impacts resulting from flooding include:

- Injuries or loss of life
- Property destruction or damage
- Loss of property contents
- Infrastructure damage including roadways, bridges, other transportation means
- Public health hazards resulting from mold, mildew, and disease due to flood water
- Flooded or destroyed lifelines/supply routes
- Damaged or destroyed utilities
- Loss of community economic base
- Employment losses
- Agricultural (crops and livestock) damages or destruction
- Environmental damage
- Prolonged periods of necessary dewatering
- Flooding erosion may alter natural drainage channels
- Societal and community impacts
- Psychological impacts of impacted populations
- Disruptions to education delivery to community
Additionally, individuals who were unable to evacuate in time or refused to leave will likely need assistance or rescue from the flooded area. Remaining in or being trapped by flood waters places individuals in significant risk of injury or death. The impacts extend beyond the danger placed upon the affected individual and places greater resource demands on agencies and organizations making efforts to rescue trapped individuals.

**Probability of Future Occurrence of the Hazard**

Los Angeles County is determined have considerable portions of the county to be at high risk from flooding. The repeated historic occurrences have shown that the region is subject to flooding in any given year. Floods can occur at any time but are most common in the Los Angeles area with winter storms saturated with subtropical moisture. The topography of the area in and around Cal State LA does not generally promote conditions for flood waters to accumulate, although it is thought that specific parts of buildings and areas of the campus have a greater risk for isolated flooding (due to ponding from heavy rainfall). The Cal State LA campus is located within a Zone X Special Flood Hazard Area (Minimal Flood Hazard) and not in close proximity to areas with greater flood risk. However, there is a historic record of isolated urban or street flood events provides a demonstration of potential flood activity.

The probability of future occurrence for flooding is **Unlikely**.

**Vulnerability to the Hazard**

The Cal State LA campus is subject to the effects of limited and isolated flooding and small-scale ponding resulting primarily from excessive precipitation and isolated strong storms. There is a far more remote potential for flooding and damage on campus and surrounding residential and commercial areas of East Los Angeles due to overflow or damage to flood control systems. The flood control channels and drainage systems that surround the campus have limited storage or volume capacities. The campus and the campus community are vulnerable to the effects generated by flooding from these systems.

Vulnerability to flooding on the Cal State LA campus will vary depending on when the flood were to occur and on the location of people and assets located in low lying areas. The risk to the campus population will be lessened during periods when classes are not in session or during periods of breaks. Conversely, during the days and hours that classes are in session and staff are at their workplaces, the human vulnerability increases. Members of the campus community may become trapped on campus depending on the level of flooding occurring on surface streets. However, in rare, region-wide events this vulnerability may be extended to the homes and workplaces of members of the campus community and their families.

Cal State LA is in proximity to a commercial and industrial use facilities. In the unlikely event that these facilities are inundated with flood water, the potential for chemical release exists presenting possible exposures to individuals from the campus community.
These facilities additionally line many of the primary access routes in and out of the campus.

During very low probability, severe flood events, some campus buildings and infrastructure in low lying areas might be vulnerable to localized flooding affecting the university. Campus utilities and communication capabilities could be impacted by flood waters rendering them disabled. An extremely remote chance flood covering a large portion of the city might affect communication capabilities well beyond the boundaries of the campus. Remaining flood waters will leave behind molds and other health concerns in affected campus buildings and facilities likely requiring extensive restoration or demolishing. The residents of the on-campus residence halls, if located in low lying areas, may have transportation limitations requiring evacuation and alternative housing procedures to be implemented if populated. Flood waters may result in damage to campus equipment, communication systems, protected documents, artwork, academic materials, computer systems, research, and other critical activities on lower levels of buildings.

Finally, certain campus populations will experience greater challenges to a post-flood / failure environment. Vulnerable populations will likely need to navigate through flood generated debris, face extreme health safety issues from flood waters, experience extreme stresses of a disaster, an inability to communicate to or gain access to support networks, and find difficulty in accessing equipment or supplies to aid in a specific need. Students remaining on campus such as those residing in the residence halls would be particularly vulnerable especially those without access to adequate transportation.

Estimate of Potential Losses

Estimates of potential losses will be influenced by a variety of factors. The volume and force of the water will determine the scale of damages affecting campus infrastructure, equipment, and other impacted features. The location and elevation above flood waters will affect the level of damage and individuals exposed. The time of the academic year, the day of week, and hour in which the flooding was to occur will influence the number of people on campus and potential casualties. The severity of the storms producing precipitation, the speed of the storms moving across the area, the level of snowpack in the higher elevations, and amount of resulting snowmelt will produce varying effects on damages produced and costs incurred. Losses will be generated by the physical damages, the loss of revenue, loss of academic research, loss of building contents, and community wide economic reductions.

Based on estimate replacement costs of facilities and structures on campus, the maximum total replacement costs due to flood are $257,007,988. However, it is unlikely for flood to cause destructive losses to the entire campus.

Table 13-22: Special Flood Hazard Area (SFHA) Estimated Losses

<table>
<thead>
<tr>
<th>Zone Designation</th>
<th>No of Buildings</th>
<th>Maximum Replacement Cost</th>
</tr>
</thead>
</table>

13-69
<table>
<thead>
<tr>
<th>Zone V</th>
<th>0</th>
<th>0</th>
</tr>
</thead>
<tbody>
<tr>
<td>Zone VE &amp; V 1-30</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Zone A</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Zone AE</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Zone AH</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Zone AO</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Zone X .2%</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Zone X Minimal Risk</td>
<td>42</td>
<td>$257,007,988</td>
</tr>
<tr>
<td>Not in a SFHA</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>No Building Value</td>
<td>13</td>
<td>Unknown</td>
</tr>
<tr>
<td>Data Provided*</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Buildings with no value defined are also included in the respective Zones they are found in.*

Vulnerability Assessment Conclusions

While the campus is located in an area of minimal flood potential (Zone X), the primary vulnerabilities to flood on campus are people and assets in low lying areas exposed to mostly localized flooding and ponding from overflow of campus creeks or low probability, large-scale storms that produce heavy amounts of precipitation directly over the campus and surrounding neighborhoods.

The potential for flooding on the campus and surrounding area, while unlikely, generates the added potential for cascading effects such as disruptions to the local economy, utility failures, disruptions to providing for the needs of the community, and development of public health hazards. These effects would be exacerbated by effects of seasonal flooding, ongoing heavy precipitation, or excessive run-off from the watershed contributing to the river system. The potential for widespread flooding and damage of structures due to the force of water, while unlikely, has exponentially powerful impacts on particular populations among the campus community including those with access or functional needs, international students, the homeless, and students residing in the residence halls.

Identified Data Limitations

Lack of comprehensive historic flooding occurrences, missing campus structural replacement costs, and complete inventory of building construction features or mitigation efforts to lessen the impact due to flood inundation.
Hazardous Materials

Description of the Hazard

A hazardous material is defined in California’s State Hazardous Materials Incident Contingency Plan (1991) as “a substance or combination of substances which, because of quantity, concentration, physical, chemical, or infectious characteristics may: cause, or significantly contribute to an increase in deaths or serious illnesses; and/or pose a substantial present or potential hazard to humans or the environment.” Hazardous materials are one or more of the following: flammable, corrosive or an irritant, oxidizing, explosive, toxic (poisonous or infectious), thermally unstable or reactive, or radioactive. Hazardous materials are ubiquitous in modern society and may be found at all stages of production, consumption, and disposal.

Federal and state laws permit the intentional release of some hazardous materials into the environment such that the risk to human health and the environment is thought to be acceptable. However, sometimes releases are unintentional, resulting from leaks, accidents, or natural hazards. This section focuses on such accidental releases and fall into the following key categories:

Fixed Hazardous Materials Incident: A fixed hazardous materials incident is the accidental release of chemical substances or mixtures during production or handling at a fixed facility.

Transportation Hazardous Materials Incident: A transportation hazardous materials incident is the accidental release of chemical substances or mixtures during highway, waterway or air transport. Populations, built and natural environments are potentially impacted.

Pipeline Incident: A pipeline transportation incident occurs when a break in a pipeline creates the potential for an explosion or leak of a dangerous substance (oil, gas, etc.) possibly requiring evacuation. An underground pipeline incident can be caused by environmental disruption, accidental damage, or sabotage. Incidents can range from a small, slow leak to a large rupture where an explosion is possible. Inspection and maintenance of the pipeline system along with marked gas line locations and an early warning and response procedure can lessen the risk to those near the pipelines.

Hazardous materials can also be classified according to worker safety and health. Information provided by California Division of Safety and Health includes guidelines related to:

- **Safety hazards**: fire and fire byproducts, electricity, flammable gases, unstable structures, demolition, sharp or flying objects, excavations

- **Health hazards**: carbon monoxide ash, soot and dust; asbestos; hazardous liquids; other hazardous substances; heat illness

**Natural-Technological Incidents (Natechs)**: During the past two decades, increasing attention has been given to hazardous materials releases resulting from Natechs or a natural disaster event that triggers a technological hazard event. Natechs are of particular concern for the following reasons:

- They can produce a simultaneous effect on many industrial facilities
- Can overwhelm response capacity
- Containment systems may fail
- May produce cascading disasters
- Response may be hindered by a disaster’s impact on the physical environment

**Location of the Hazard**

Hazardous materials and infrastructure such as fuel tanks, rail lines, chemicals, hazardous waste sites and gas pipelines to varying degrees are located within the CSU system and/or within its surrounding communities. Please refer to Annex ? for the map identifying the types and locations of hazardous materials and infrastructure on or near the CSU – Los Angeles campus. The planning committee indicates that chemicals are located in over 100 science labs across the campus. Also, the campus maintains a “90-day” facility for storing hazardous materials. At larger scales (beyond the campus planning area) hazardous materials and infrastructure are located throughout the city and county of Los Angeles, and reflect different types, configurations and scales dispersed across these geographic areas.

**Extent of the Hazard**

There is no comprehensive statewide vulnerability assessment available at this time. As such, the true extent of the hazardous materials risk in California and its communities is not known, meaning no overarching conclusions have been reached which have been able to integrate all qualitative and quantitative risk factors to produce a comprehensive measure of the extent of the hazard.

However, for the CSU – Los Angeles planning committee, several small-scale chemical spills have taken place on campus. In addition, an extensive and dense array of gas pipelines, rail lines, chemical and hazardous waste sites are located very close to the

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campus. Based on these factors, it is prudent to rank the extent of the hazard for the CSU – Los Angeles campus as Moderate to High, and to consider worst case scenarios as the main driver of policy in order to fully mitigate all possible hazardous materials event outcomes.

For example, according to the 2018 CA State Hazard Mitigation Plan, 400 hazardous materials problems are tied to 32 past earthquakes, including over 150 problems from the Loma Prieta Earthquake alone. That said, the plan indicates that it is likely that many such hazardous materials releases have received little attention in the past because public authorities, the media, and the public have overlooked them in the rush to address and recover from immediate disaster threats, and that responsible parties may have an incentive to understate the extent of releases or not to report them at all.

History of the Hazard

According to the CA Governor’s Office of Emergency Services’ Hazardous Materials Spill Report, the state experiences from 10 to 30 spill events daily. As of April 20th, 2021 already 2096 spill events had occurred. Such events have occurred in all the cities and/or counties where CSU campuses are located.

According to the 2018 CA State Hazard Mitigation Plan, with regard to natural-technological hazard events (Natechs), 400 hazardous materials events are tied to 32 past earthquakes, including over 150 Natech events from the Loma Prieta Earthquake alone. For more details on specific hazmat events, please refer to the local, county and/or multi-jurisdictional hazard mitigation plans where CSU campuses are located at: https://www.caloes.ca.gov/cal-oes-divisions/hazard-mitigation/hazard-mitigation-planning/local-hazard-mitigation-program

According to the campus planning committee, several small-scale chemical spills have taken place on the CSU – Los Angeles campus. Some events required building evacuation due to noxious odors which required fire department response and investigation. Also, one chemical event produced physical damage to the lab itself.

Potential Impact of the Hazard

A large hazardous materials release could affect an entire community or city under certain conditions related to direction of air flow (air-based chemical release) and population density or the contamination of a community’s main water supply. Either type of release could necessitate large scale evacuation. By contrast, in the rural unincorporated areas where population densities are low, even in the event of a large release, the number of homes that may need to be evacuated would be significantly lower than in an urban environment. The occurrence of a hazmat incident can also result


in the shut-down of transportation corridors which can last for hours at a time while the impacted area is stabilized.

The release of some toxic gases may cause immediate death, disablement, or sickness if absorbed through the skin, injected, ingested, or inhaled. Contaminated water resources become unsafe and unusable, depending on the amount of contaminant. Some chemicals cause painful and damaging burns if they come in direct contact with skin. Prolonged and concentrated exposure to such chemicals can produce severe long-term impacts to respiratory, endocrine and nervous systems, heart and brain health.

The potential impacts of chemicals and toxic gases discussed here also apply to the students, staff and environment on the CSU – Los Angeles campus.

With regard to the natural environment overall, contamination of air, ground, or water may result in harm to fish, wildlife, livestock, and crops. The release of hazardous materials into the environment may cause debilitation, disease, or birth defects over a long period of time. Loss of livestock and crops may lead to economic hardships within the community.

Recent California examples include the 2016 Aliso Canyon methane gas leak\(^78\), which caused evacuation of nearby residents, many of whom experienced temporary health problems such as difficulty breathing and eye irritation; and the 2016 Fruitland metal recycle plant fire in Maywood, which released heavy metals such as lead, magnesium, copper, aluminum, antimony, calcium, iron, sulfur, tin, potassium, and zinc which pose severe risks to public health.\(^79\) Health effects from exposure to these metals included short-term symptoms such as irritation to the eyes, nose, throat, and lungs.

**Potential Impact of the Hazard (Natechs)**

Natural disasters, including earthquake, flood, and fire also pose risks to public health and the environment. For example, following the Northridge Earthquake, California State University (CSU) Northridge laboratories and chemical storage rooms experienced multiple chemical spills. Such incidents, triggered by a natural disaster, pose a significant risk to students, faculty, staff, and first responders. At a minimum, all CSU campuses with a science lab (including CSU – Los Angeles) is at risk of potential impact from a natural-technological (combined impact) event.

In a severe flood event, floodwaters are often contaminated with hazardous materials posing a threat to public and animal health, groundwater, and other parts of the environment. These hazardous materials may be released from damaged or flooded underground tank sites (e.g., gas stations or chemical storage facilities), propane tanks,


manure or human waste handling facilities, fertilizer and pesticide storage, agricultural sites, and household hazardous waste.

In a fire event, (such as the October 2017 Northern California firestorms which destroyed approximately 6,000 residences) entire neighborhoods can be burned to the ground. Hazardous material release creates public health concerns which can delay the initial steps of fire recovery, including reopening burned areas to residents and initiating debris removal activities. The post-fire “toxic sweep” poses a risk of coming into contact with toxic substances due to the presence of synthetic and hazardous materials.

Probability of Future Occurrence of the Hazard

The probability of occurrence for a hazmat event on the CSU – Los Angeles campus can be viewed in two different ways: the history of occurrence serves as a sound predictor of future probability assuming current risk and vulnerability factors remain somewhat constant. For the purposes of the current estimate, no current data clearly indicates otherwise. As such, the probability of occurrence is Moderate to High - the campus has experienced several chemical spill events and with 100 or more labs on campus, the risk of occurrence is multiplied. In addition, nearby hazardous materials and infrastructure further increase vulnerability and probability of a campus-related event. Moreover, hazmat occurrences are largely based on human error, and any changes in risk and vulnerability factors such as a decreased vigilance in materials oversight and handling practices or changes in the amount of chemicals or exposure will likely increase the probability on campus.

Vulnerability to the Hazard

Hazardous materials pose a large risk to the CSU – Los Angeles campus. As identified by the campus planning committee and on the hazmat map, the following vulnerabilities are present on campus: chemicals are present in over 100 science and research labs, and the campus 90-day facility contains other hazmat material. In addition, gas pipelines and hazardous waste sites are extremely close to the campus footprint. Gases and chemicals or hazardous waste, if spilled or released, could severely impact human health and campus operations.

Although it is quite difficult to produce a quantitative measure of vulnerability because (unlike natural hazards) the probability of occurrence is dependent on human error, which itself is variable based upon a fluctuating set of interrelated factors, some of which lack prediction or control, given the complexity of how all natural and built environments and hazmat risks factors interrelate at the local or campus level, it is prudent to assume for planning purposes that the campus’ vulnerability is a sub-set of the larger community’s vulnerability. As such, the CSU – Los Angeles leadership maintains vigilance to mitigate the campus’ vulnerabilities identified above at a minimum.

Estimate of Potential Losses

As discussed previously, it is difficult if not impossible to produce an accurate quantitative measure of vulnerability because of the variable nature of a hazardous
materials spill. For example, the release of a toxic airborne chemical in a populated area has severe impact potential, whereas the impact potential of a small chemical spill in a remote or rural area is most likely limited to remediation of soil. And, in both cases, the probability of occurrence is dependent on human error, which itself is variable based upon a fluctuating set of interrelated factors, some of which lack prediction or control. In all cases, different types and amounts of hazardous materials interact with fluctuating combinations of human error to produce different event outcomes with variable impact costs.

Vulnerability Assessment Conclusions

It is well understood that with regards to hazmat vulnerability, each campus and its surrounding community (including CSU – Los Angeles) operates through a complex and dynamic interaction between industrial and commercial inputs and outputs and the natural and built environment. Such activity produces hazardous materials that move through the environment along both convergent and divergent routes and across all levels of land-use from site to campus to city and county and beyond. It is also clear from a review of the Los Angeles County hazard mitigation plan and Cal OES’ records of hazardous material spills, that such events occur with great frequency and varying degrees of severity across jurisdictions statewide. As such, in assessing the vulnerability of the CSU – Los Angeles campus, campus-level risks and vulnerabilities are not discreet or isolated but can become exacerbated or augmented through connections to broader community-level hazmat risks and vulnerabilities.

Finally, in order to draw conclusions on vulnerability, it should be noted that any identified vulnerabilities at the campus level and/or community level are circumscribed and potentially reduced by targeted policy and program interventions. Numerous policies and programs have been established in recent years in response to California’s widespread and complex and integrated hazardous materials risks - California established the Unified Program which consolidates and integrates the administrative requirements, permits, inspections, and enforcement activities of the following environmental and emergency response programs: the Aboveground Petroleum Storage Act (APSA) Program, Area Plans for Hazardous Materials Emergencies, the California Accidental Release Prevention (CalARP) Program, the Hazardous Materials Release Response Plans and Inventories (Business Plans), Hazardous Material Management Plan (HMMP) and Hazardous Material Inventory Statement (HMIS) requirements (California Fire Code), the Hazardous Waste Generator and Onsite Hazardous Waste Treatment (tiered permitting) Programs, and the Underground Storage Tank Program.

Identified Data Limitations

The CSU – Los Angeles planning committee has provided information on campus-level hazmat materials and risks. Data limitations pertain to a comprehensive understanding of human activity and error related to materials control over the long term.
Landslide

Description of the Hazard

A landslide is a down-slope movement of soil, rock, or other debris, and can also be referred to as a mass movement or slope failure. These geological hazards can range in size from a few feet to over a mile in length and width and, when heavy and rapidly moving, can cause serious damage and loss of life.

Landslides are classified based on the type of material and type of movement involved. They can range from slow-moving earth flows to fast-moving debris flows, though many large slope failures involve more than one type of movement. The primary natural triggers of slope failures are water, seismic activity, and volcanic activity. Slope saturation by water can occur from intense rainfall, snowmelt, changes in ground-water levels, and surface-water level changes along coastlines. In winter months, El Nino storms or other high rainfall events may saturate soils and trigger slope failure.

Deep-Seated Landslides

Deep-seated landslides, ranging in depth from ten to several hundred feet, occur as a result of geologic and hydraulic changes, such as earthquakes or increased levels of groundwater. These landslides can move slowly or quickly and can cause extensive property damage, but rarely result in loss of life.

Debris Flows Related to Shallow Landslides

Shallow landslides may mobilize into rapidly moving debris flows and typically occur after sudden saturation of the ground. These types of debris flows are typically more dangerous because they move rapidly, causing both property damage and loss of life.

Debris flows may also occur as a result of post-fire conditions, where wildfires have left barren ground exposed to heavy rainfall. Intense rainfall, generally greater than .5 inch per hour, has the potential to trigger a post-fire debris flow. These landslides may impact lives and properties within its deposition zone, and can result in downstream flooding. These post-fire debris flows often occur during the fall and winter following major summer fires.

Location of the Hazard

The susceptibility of an area to landslides depends on several variables, including magnitude of slope gradients, water content, ground cover, presence of erosion, and slope material and structure. However, landslides are most prevalent in terrain with weak


material and steep slopes, and the highest risk is found in areas with high rainfall or high earthquake potential. Slope failures are also most likely to occur in areas where they have occurred in the past. In California, the most landslide-prone areas are found along the coast and in the northern Franciscan Formation.

General landslide vulnerability can be estimated from the distribution of weak rocks and steep slopes as seen in Figure 13-13. Based on the Figure below, the campus is located directly adjacent to an area of moderate to high landslide susceptibility.

Figure 13-12: Deep-Seated Landslide Susceptibility Surrounding Cal State LA

Extent of the Hazard

In Los Angeles, landslides are more likely to occur in the steep slopes outside of the metropolitan area and along the coastline. The San Gabriel mountains, both steep and erosive, contain steeply walled canyons above areas with high population density. When heavy rain occurs, there is significant potential for floods and landslides throughout the

County, and the indirect impacts of landslides in the region may cover a larger geographical extent. The Cal State LA campus contains and is surrounded by areas of deep-seated landslide susceptibility. Based on the campus’ close proximity to the landslide hazard zone, and the history of significant impacts nearby in the city of Los Angeles, the planning committee ranks the extent of the landslide hazard for the campus as Moderate.

History of the Hazard

FEMA has declared thirteen major disasters involving landslides, mudslides, debris flows, or mud flows in Los Angeles County since 1978. NOAA has recorded five debris flow events in the County since 2004, most of which occurred in the areas directly surrounding metropolitan Los Angeles. The 2018 Southern California Mudflows damaged 40 to 45 homes in Sun Valley and caused a vehicle to strike a natural gas pipeline, which began to leak. Significant landslides have occurred in areas near the campus, though not in locations that would affect the campus directly; there is also no reported history of landslides on campus.

Potential Impacts of the Hazard

Cal State LA may be impacted by the disruption of services as a result of landslides in the region. Students, faculty, and staff who live in nearby communities may also be impacted. Landslides can result in physical damage to buildings and property and have the potential to significantly effect infrastructure. As a landslide moves, it distresses structural foundations by settlement, cracking, and tilting. Fast-moving flows can remove entire structures in one instance, while other types of flows can cause damage gradually.

Transportation and utility infrastructure are particularly vulnerable to landslides, since the failure of any component can disrupt service over a large area. The loss of power and communication and disruption of transportation can have cascading effects throughout an area, including impaired disposal of sewage, contamination of water supplies, and the release of flammable fuels. Transportation routes are also often expensive to clean up, and prolonged obstruction can disrupt the movement of people and goods for long periods of time.

Probability of Future Occurrence of the Hazard

Slope failures are also often triggered by other natural hazards, so landslide frequency is often related to the frequency of these other hazards. As climate change impacts the frequency and intensity of triggers such as rain events, fires, and coastal erosion, landslides may generally occur more often. According to the NCEI Storm Events Database, the City of Los Angeles has been impacted by earthquakes, wildland fires, and severe storms at least every other year since 1960. Given the historic frequency of these contributory sources to landslides and of recorded landslides themselves, the probability of future occurrence in the City of Los Angeles is high. However, while the location of the Cal State LA campus is in proximity to areas of high landslide susceptibility, there is no
reported history of landslides on campus. As such, the planning committee ranks the probability of the landslide hazard on the campus as **Unlikely**.

**Vulnerability to the Hazard**

The vulnerability of the built environment to landslides depends on exposure and is more likely to incur damage as a result of proximity, rather than inferior structural design. The structures most vulnerable to landslides are buildings and utility/transportation lifelines, which can be impacted by either impact or ground deformation. Utilities and transportation infrastructure are particularly vulnerable, due to their geographic extent and susceptibility to physical distress. The Cal State LA campus exhibits building and infrastructure and transportation route vulnerabilities to some degree.

Any population proximal to a landslide when it occurs is vulnerable to its impacts.

**Estimate of Potential Losses**

There are no current models for estimating potential losses from a landslide directly impacting the campus.

Although the economic impact of landslide damage can exceed that of the direct repair costs, there are currently no applicable methods for estimating indirect costs related to Cal State LA.

**Vulnerability Assessment Conclusions**

Community exposure to landslides varies depending on their physical locations – whether in flat plains or on steep hillsides – and on their dependence on critical infrastructure located in landslide hazard zones.

Landslides could impact the campus in a variety of ways, primarily related to indirect impacts to transportation and utilities. Utility outages can impact health, particularly for vulnerable populations, and can cause interruptions in operations. Interruptions may impact student and employee’s ability to travel to campus and the delivery of classes and events.

**Identified Data Limitations**

The ability to predict future landslides at the Cal State LA campus is limited. However, the USGS estimates that climate change-induced shifts in weather will increase the frequency of post-wildfire landslides, which are expected to occur almost every year in California.13

**Power Outage**

**Description of the Hazard**

Los Angeles, California is Los Angeles County’s largest city, and the country’s second largest and most populous city. Los Angeles is in a basin in Southern California and is home to the shores of the Pacific Ocean, large mountain ranges reaching up to 10,000 feet and valleys that experience extreme weather conditions throughout the seasons. Los
Angeles is rich in native plant species partly because of its diversity of habitats, including beaches, wetlands, and mountains. Due to its lush landscapes, hot summers and dry winters can create a significant amount of brush increasing fuel for brushfires within the city limits and within its large suburbs, like the San Fernando Valley, where other Cal State campuses reside, as well.

Most aspects of modern life rely on the near continuous availability of utilities, such as electricity, water, and natural gas. An interruption in the supply or distribution of power can affect the campus in various ways like forcing campus closures to limiting campus operations. These interruptions can produce cascading effects from other hazards, such as major windstorms, winter storms and wildfire, which can prompt an intentional disruption or Public Safety Power Shut Off (PSPS).

A power outage event can interrupt day-to-day operations of the campus, like in-person classes, impede, or limit digital, telephonic or radio communications, create traffic jams around the busy avenues and boulevards surrounding the campus, close the student health center and close restaurants around campus and outside the campus. Additionally, thousands of Cal State LA student residents in on-campus housing would also be affected by a power outage on campus.

Additionally, a severe outage to Los Angeles County or neighboring communities and cities would also directly affect the campus and the community.

An electric power disruptions and outages fall into two categories: intentional and unintentional.

The four types of **intentional** disruptions:

- Planned: Some disruptions are intentional and can be scheduled based maintenance or upgrading needs.
- Unscheduled: Some intentional disruptions must be done "on the spot" in response to an emergency.
- Demand-Side Management: Some customers (i.e., on the demand side) have entered into an agreement with their utility provider to curtail their demand for electricity during periods of peak system loads.
- Load Shedding: When the power system is under extreme stress due to heavy demand and/or failure of critical components, it is sometimes necessary to intentionally interrupt the service to selected customers to prevent the entire system from collapsing. These intentional interruptions result in rolling blackouts.

**Unintentional** or unplanned disruptions are outages that come with essentially no advance notice or warning. This type of disruption is the most problematic. The following are categories of unplanned disruptions:

- Accident by the utility, utility contractor, or others.
Malfunction or equipment failure.
- Equipment overload (utility company or customer).
- Reduced capability (equipment that cannot operate within its design criteria).
- Tree contact other than from storms.
- Vandalism or intentional damage.
- Weather, including lightning, wind, earthquake, flood, and broken tree limbs taking down power lines.
- Wildfire that damages transmission lines.

Location of the Hazard

Although power outages can take place within a certain area, it has the potential to affect the entire planning area equally.

Extent of the Hazard

In order to anticipate outage conditions and reduce impacts, campus facility managers and others keep track of conditions and data provided by the media, municipal utilities and the California Independent System Operator (CAISO). CAISO is tasked with managing the power distribution grid that supplies most of California, except in areas served by municipal utilities, and is thus the entity that coordinates statewide flow of electrical supply. CAISO uses a series of stage alerts to the media based on system conditions. The alerts are:

- Stage 1 - reserve margin falls below 7 percent.
- Stage 2 - reserve margin falls below 5 percent.
- Stage 3 - reserve margin falls below 1.5 percent.

Rotating blackouts become a possibility when Stage 3 is reached. A power outage could affect the entire area of the campus, including the Cal State LA athletic fields, classrooms resident halls, administrative offices, virtual, telephonic and radio communications, leading to loss of lighting in campus parking structures, and creating a cascading hazard for commuters as they depart from or arrive to campus in the evening. Additionally, the university is located within proximity of highly utilized thoroughfares for the transportation of goods to throughout California, within one of the busiest areas of the Southern California.

Given the prevalence of rolling blackouts and other power outages in California, the campus maintains safety precautions, situational awareness, access to emergency power generators and other protocols for managing campus power outages. However, given that recorded outages have taken place on campus, the planning committee ranks the extent of the power outage hazard as Moderate.

History of the Hazard
The City of Los Angeles has experienced power outages over time. Their electric utility provider, the Los Angeles Department of Water and Power (LADWP) has experienced outages, which have affected the residents of Los Angeles over the years. Major power outages impacting the City of Los Angeles in recent years have affected a large number of residents as seen below:

- **1994**: A 6.7-magnitude earthquake rumbled through Los Angeles at 4:30 a.m. causing a power outage citywide.
- **July 8, 2017**: an explosion at a Northridge power plant causes a widespread power outage in the San Fernando Valley, Los Angeles.

The Cal State LA campus has also experienced power outages:

- **March 16, 2005**: the campus experienced a power outage in the morning hours, but the university was able to continue operations despite the minor interruption of power.

Cal State LA did not report any power outages in the recent years, but did advise that the university is expanding their mitigation efforts by replacing sub-stations and upgrading outdated systems that may potentially exacerbate the probability of a power outage.

### Potential Impacts of the Hazard

Instructors, campus residents, staff, and administration rely on electricity for basic operations. During a widespread power failure, it may take anywhere from several hours to days to restore operations if a significant event occurs. Electrical power may be the only cooling source for many individuals around the campus and its community, and long-term outages can potentially put people’s health and life at risk. Disruptions in the supply of heating fuel may put people and property at risk during extremely cold weather if it relies on electric generation or heating mechanisms instead of gas. Additionally, many medical devices, communications devices, and security rely on power to maintain their functions.

### Climate Change and Energy Shortage

Climate change is expected to bring more frequent and intense natural disasters. These changes have created a variability at a rate that makes historical data a poor predictor of future climate. For example, the warmest years on record in California occurred in 2014, 2015, and 2016. The 2016-2017 year broke the record as the wettest ever recorded in the northern Sierra Nevada Mountains.

Changes in temperatures, precipitation patterns, extreme events, and sea-level rise have the potential to decrease the efficiency of thermal power plants and substations, decrease the capacity of transmission lines, render hydropower less reliable, spur an increase in electricity demand, and put energy infrastructure at risk of flooding.

With climate warming, higher costs from increased demand for cooling in the summer are expected to outweigh the decreases in heating costs in the cooler seasons. Hotter temperatures in California will mean more energy (typically measured in “cooling-degree
days”) needed to cool homes and businesses both during heat waves and on a daily basis, during the daytime peak of the diurnal temperature cycle. During future heat waves, historically cooler coastal cities (e.g., San Francisco and Los Angeles) are projected to experience greater relative increases in temperature, such that areas that never before relied on air conditioning will experience new cooling demands.

Secondary impacts of energy shortages are most often felt by vulnerable populations. For example, those who rely on electric power for life-saving medical equipment, such as respirators, are extremely vulnerable to power outages. Also, during periods of extreme heat emergencies, the elderly and the very young are more vulnerable to the loss of cooling systems requiring power sources.

**Probability of Future Occurrence of the Hazard**

The probability of California experiencing a power outage can be difficult to quantify but is a hazard that occurs annually during the same seasonal periods of temperature variance throughout the calendar year. The City of Los Angeles and Los Angeles County experience such outages. As such, the probability ranking for the Los Angeles area is **Likely**. Although the Cal State LA campus has recorded fewer events than the surrounding area, it is prudent to assign this same ranking for the campus.

Climate models suggest summer global temperatures are likely to increase while changes between temperature extremes would be more pronounced. As such, it is expected that power outages will occur more frequently in the future.

**Vulnerability to the Hazard**

Based on the data available, and in consideration of the increasing effects of climate change, the campus remains vulnerable to power outages in terms of impacts to people, power infrastructure and campus operations. Nonetheless, as discussed campus leadership works to reduce vulnerabilities through consistent use of safety and operational protocols and emergency power sources to ensure it is able to mitigate an interruption to electrical power.

**Estimate of Potential Losses**

The data provided by Cal State LA does not report any value for potential losses due to power outage.

**Vulnerability Assessment Conclusions**

Elevators, entry ways, air filtration systems and lighting provide the campus community with the necessary infrastructure and systems to function and navigate through the campus and to maintain a safe campus environment and visibility during nighttime hours. The primary concern for campus leadership is that a loss of power can lead to potential hazards to students, faculty, and staff at Cal State LA. Vulnerable populations (especially students with physical disabilities) may be the most heavily affected by loss of power, as they rely on elevators, entry ways with automatic doors, and locks and lights; a
power outage would impede a disabled student’s ability to travel and utilize the campus and its structures safely.

The use of communication devices, billing, records, and electrical tools may also become unusable due to a loss of electricity. Many records and billing items may have to revert to “by-hand” procedures and paper copies may have to be kept to continue operations. Additionally, classrooms may not be usable if lighting equipment is not functioning impacting a semester or quarter’s progress for the academic year.

Identified Data Limitations

Cal State Los Angeles did not report any monetary or life losses due to a power outage. Also, the campus did not report any incidents involving a power outage directly affecting the campus community and operations.

Volcano (Associated Air Quality)

Description of the Hazard

The US Geological Service defines volcanoes as “openings or vents where lava, tephra (small rocks), and steam erupt on to the Earth’s surface. Through a series of cracks within and beneath the volcano, the vent connects to one or more linked storage areas of molten or partially molten rock (magma). This connection to fresh magma allows the volcano to erupt over and over again in the same location.”

A volcanic eruption occurs when magma, lighter than surrounding rock, is driven upwards by its buoyancy and by pressure from the dissolved gases contained within it. Gases are released from magma as it reaches the surface and pressure decreases. Magma can be erupted in several ways and violent eruptions typically cause tiny pieces of tephra (ash) to be carried away by the wind. This ash is hard, does not dissolve in water, is extremely abrasive and mildly corrosive, and conducts electricity when wet. The gases released in an eruption include carbon dioxide, sulfur dioxide, hydrogen sulfide, and hydrogen halides. Depending on their concentration, these are potentially hazardous to people, animals, agriculture, and property.

Location of the Hazard

There are eight volcanic areas located throughout California. Seven of these - Medicine Lake Volcano, Mount Shasta, Lassen Volcanic Center, Clear Lake Volcanic Field, Long Valley Volcanic Region, Coso Volcanic Field, and Salton Buttes – are considered active volcanoes. No portion of Cal State LA or Los Angeles County is within a volcano hazard zone.

Extent of the Hazard

Volcanic hazards are most severe within a few miles of the volcano vent and the severity generally decreases with distance. Ash impact zones can range from tens to hundreds of miles from the vent source. The US Geological Survey has estimated zones surrounding active volcanoes wherein 2 inches or more of ashfall following an eruption is possible. While Cal State LA does not fall within an estimated ashfall zone, lighter dustings of ash outside of those areas may directly or indirectly impact the campus. As such, the planning committee ranks the extent of the hazard for the campus as Low.

History of the Hazard

No historical eruption events in California have affected the campus. Over the last 1,000 years, there have been at least 12 eruptions in California.11 The most recent volcanic eruption in California occurred at Lassen Peak about 100 years ago, when a major explosion delivered windborne ash over 275 miles away.12

Potential Impacts of the Hazard

The specific impacts vary widely and depend on which type of volcano erupts, the style of explosion, the volume of lava, the eruption duration, and the local water conditions. As Cal State LA is not proximal to an active volcano, only the potential impacts of ashfall and gases have been detailed. While both these hazards can be widespread, their most severe impacts are generally seen closer to the volcanic source.

Although ashfall is typically a nonlethal volcanic hazard, it is the most widespread and disruptive. Falling ash can damage crops, electronics, and machinery. It can also impact human health by irritating the respiratory tract, eyes, and skin. The particles may enter drinking water and structures and may cause structure failure if it is thick and heavy enough. Even a fine layer of ash can disrupt utilities. A portion of California’s major electric transmission lines, aerial telecommunication lifelines, transportation corridors, and water storage and conveyance lie within the state’s volcano hazard zones. Impacts to any of these can impact operations at Cal State LA.

The potential impacts of gases released during volcanic eruptions are as follows:

- Carbon dioxide typically becomes diluted very quickly and is not life threatening. However, it can become trapped in higher concentrations in low-lying areas and has the potential to be fatal.
- Sulfur dioxide can cause acid rain and air pollution downwind of a volcano.
- Hydrogen sulfide can cause irritation of the upper respiratory tract. At high concentrations it can cause unconsciousness and death.
- Hydrogen halides can coat ash particles and, once deposited, poison drinking water, agricultural crops, and grazing land.

Probability of Future Occurrence of the Hazard
The US Geological Survey, based on the record of volcanic activity in California, estimates that the probability of another small- to moderate-sized eruption in the next thirty years is about 16 percent. As such, the annual probability of future occurrence for the campus is ranked by the committee as **Unlikely**.

**Vulnerability to the Hazard**

Populations living near volcanoes are the most vulnerable to eruptions and lava flows. However, volcanic ash can travel and affect populations miles away. The location and thickness of ash in any given area is a function of the severity of the eruption and wind speed and direction. For Cal State LA, there is low vulnerability to the immediate impacts of volcanic eruptions due to the limited area affected and remote potential of an eruption. In the event of a widespread ashfall event, the elderly, infants, and populations with existing respiratory disease will be at higher risk.

**Estimate of Potential Losses**

Impacts to critical infrastructure, agriculture, and property from ashfall have the potential to cause widespread disruption, damage, and economic loss throughout the state. In the event of a widespread ashfall event, impacts will be immediate.

Current modeling is not precise enough to allow for an assessment of potential losses from ashfall to structures or infrastructure on or surrounding the campus.

**Vulnerability Assessment Conclusions**

Cal State LA is unlikely to experience the direct impacts of a volcanic event. While the campus may be indirectly impacted by ashfall elsewhere in the state, direct ashfall impacts are generally unlikely but possible in a widespread event. However, the likelihood of any volcanic eruption in the state impacting the campus is very low.

**Identified Data Limitations**

Not all active volcanoes in California have been zoned for hazards by the US Geological Survey. This, together with the infrequent occurrence of volcanic explosions and number of factors determining type and extent of impacts, make the quantification of potential loss difficult.
Wildfire

Description of the Hazard

While wildfires are a natural part of California’s ecosystem, wildfires in California represent a hazard that presents one of the greatest probabilities of destruction along with a demonstrated history of catastrophic fire events in recent years. The destructive fire seasons of 2017 to 2020 illustrated the destructive forces fire presents to communities across the state. Wildfires may result in the structural loss, infrastructure loss, dangerous air quality, environmental damages, economic impacts, injuries, and loss of life. In many communities throughout California, wildfire presents greatest risk to human life and property.

Wildfires have been defined as any free burning vegetation fire that initiates from an unplanned ignition, whether natural or human caused demanding fire suppression actions to contain. These fires are prone to become uncontrolled, spreading through vegetative fuels rapidly exposing people and structures to harm. Wildfires present a significant risk to communities across the state, as evidenced by increasing trends of structural losses from wildland fires. This risk is elevated in areas where development and community growth has intersected, also known as the wildland-urban interface (WUI). In the interface setting, development itself can provide additional fuel for large fires. Recent fires have also demonstrated the ability of fire to consume populated areas in extreme conditions.

California’s Mediterranean climate in combination with its geography and vast population create a combination of factors that promotes an optimal environment for large fire growth and consequences. As there is great diversity of geographic characteristics across the state, the risks and potential consequences of wildfire must be assessed locally. The physical location, weather patterns, local fuel types and volume, extent of the WUI, topography, and additional factors will factor differently from part of the state to another.

The behavior of wildfires in California is significantly influenced by three distinct geographic factors. These factors will help shape the size, direction of spread, rate of combustion, fire intensity, and ability to pre-heat fuels. The physical factors contributing to wildfire behavior include:

- **Topography** – The rate in which wildfires spread increases with greater slopes in topography. The greater the slope will result in more pre-heating of fuel above the advancing fire. The direction that a slope faces will also influence fire behavior as south facing slopes receive greater solar radiation and thus drier vegetation that is more susceptible to combustion. Ridgetops often denote the end of fire spread as fire has greater difficulty spreading downhill.
- **Weather** – Weather factors substantially in influencing the behavior of wildfires. Wind, temperature, humidity, lightning, and lack of precipitation all contribute to a fire’s ability or inability to spread and intensify. California routinely experiences

85 State of California Hazard Mitigation Plan, September 2018
conditions in which these factors are in alignment to contribute to extreme fire behavior during the summer and fall seasons. High winds, low humidity, and high temperatures provide an environment promoting extreme fire activity.

- **Fuels** – Certain types of vegetation are increasingly prone to igniting and promote more intense burning. Areas with greater “fuel loading” (amount of fuel present in terms of weight of fuel per unit of area) increases the amount of fuel to fuel a fire. Greater volumes of dead or dry vegetation compared to live plants is a critical factor. Vegetation during drought conditions will experience decrease in moisture content increasing the conditions for combustion. Fuels close proximity to one another allows for rapid spread through contact or radiant exposures.

A risk assessment for wildfires should be implemented within a geospatial context focusing on the specific location features and incorporates the three components of the wildfire risk triangle – likelihood, intensity, and susceptibility.

**Location of the Hazard**

Substantial portions of the State of California are exceptionally vulnerable to wildfire activity or reside in a wildland-urban interface (WUI) area due to the vast open spaces, rangelands, forests and other lands with high susceptibility to fire occurring throughout the state. Cal State LA and the City of Los Angeles are located in the heart of the Los Angeles Basin. This area near the university is dominated by urban and suburban communities with limited direct exposures to wildland fire. Cal State LA has extensive residential neighborhoods to the north of campus and opposite from bordering freeways south and east of the campus. Industrial land uses are located to the west of the campus. The multi-lane Interstates 10 and 710 provide the eastern and southern borders of the campus.

The Cal State LA campus is located in the eastern side of Los Angeles bordering the City of Alhambra. The campus 1 mile southeast of the closest area designated as having a high fire hazard at Ascot Hills and Montecito Heights where there is a mix of residential neighborhoods and hillsides with moderate vegetative fuels. The campus is not located next to areas with a fire hazard potential making direct impacts by fire on the campus unlikely.

However, the Cal State LA campus is surrounded by mountains and extensive areas of fire hazards further away. Surrounding the Los Angeles Basin are large mountain ranges including the San Gabriel, San Bernardino, and Santa Ana Mountains. These mountain ranges host three national forests with extensive history of large fire development. The fires that burn in these areas have the potential to develop vast quantities of smoke that can fill the basin in the right wind conditions. The geography of the Los Angeles Basin and San Gabriel, San Fernando, and San Bernardino valleys creates a topography that captures air pollutants including smoke within surrounding mountains and the development of inversion layers. The Cal State LA campus is located in a region in which wildfire smoke can saturate the air around the campus.
Extent of the Hazard

The area immediately surrounding the Cal State LA campus is near but not in immediate proximity to fire hazard zones designated as Very High Fire Hazard Severity Zones (VHFHSZ). The County is surrounded by areas that are considered to be of high fire threat and that would produce (and have produced) vast quantities of smoke and particulates into the air, affecting the air quality on the Cal State LA campus. As a result, the planning committee ranks the extent of the wildfire hazard for the Cal State LA campus as Moderate.

The National Fire Danger Rating System (NFDRS) is the current system in use for rating and classifying the potential danger of fire. The NFDRS tracks the effects of previous weather events on both dead and live fuel loads and adjusts accordingly based on future or predicted weather conditions. These complex relationships and equations are

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computed, and the outputs are expressed in terms that users can quickly and easily understand. The current NFDRS is used by all federal and most state agencies to assess fire danger conditions.

The following table depicts the NFDRS, from the US Forest Service’s Wildland Fire Assessment System.

Table 13-23: National Fire Fire Danger Rating System87

<table>
<thead>
<tr>
<th>Rating</th>
<th>Basic Description</th>
<th>Detailed Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>CLASS 1: Low Danger (L)</td>
<td>Fires not easily started</td>
<td>Fuels do not ignite readily from small firebrands. Fires in open or cured grassland may burn freely a few hours after rain, but wood fires spread slowly by creeping or smoldering and burn in irregular fingers. There is little danger of spotting.</td>
</tr>
<tr>
<td>COLOR CODE: Green</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CLASS 2: Moderate Danger (M)</td>
<td>Fires start easily and spread at a moderate rate</td>
<td>Fires can start from most accidental causes. Fires in open cured grassland will burn briskly and spread rapidly on windy days. Woods fires spread slowly to moderately fast. The average fire is of moderate intensity, although heavy concentrations of fuel – especially draped fuel -- may burn hot. Short-distance spotting may occur but is not persistent. Fires are not likely to become serious and control is relatively easy.</td>
</tr>
<tr>
<td>COLOR CODE: Blue</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CLASS 3: High Danger (H)</td>
<td>Fires start easily and spread at a rapid rate</td>
<td>All fine dead fuels ignite readily, and fires start easily from most causes. Unattended brush and campfires are likely to escape. Fires spread rapidly and short-distance spotting is common. High intensity burning may develop on slopes or in concentrations of fine fuel. Fires may become serious and their control difficult, unless they are hit hard and fast while small.</td>
</tr>
<tr>
<td>COLOR CODE: Yellow</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CLASS 4: Very High Danger (VH)</td>
<td>Fires start very easily and spread at a very fast rate</td>
<td>Fires start easily from all causes and immediately after ignition, spread rapidly and increase quickly in intensity. Spot fires are a constant danger. Fires burning in light fuels may quickly develop high-intensity characteristics - such as long-distance spotting - and fire whirlwinds when they burn into heavier fuels. Direct attack at the head of such fires is</td>
</tr>
<tr>
<td>COLOR CODE: Orange</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Fires under extreme conditions start quickly, spread furiously, and burn intensely. All fires are potentially serious. Development into high intensity burning will usually be faster and occur from smaller fires than in the Very High Danger class (4). Direct attack is rarely possible and may be dangerous, except immediately after ignition. Fires that develop headway in heavy slash or in conifer stands may be unmanageable while the extreme burning condition lasts. Under these conditions, the only effective and safe control action is on the flanks, until the weather changes or the fuel supply lessens.

Due to the impacts of wildfires on public health, agencies across the nation have adopted the use of the Air Quality Index (AQI) to communicate and provide a consistent approach to air quality measurements and categorization. The AQI primarily focuses on the health effects caused by pollutants in the air such as smoke. The goal of the AQI is to provide advisories to assist the public in determining when to reduce exposures to inhalation of air pollution as pollution levels rise.
History of the Hazard

The State of California has a long history of chronic and destructive wildfires throughout the state. On average, 8,300 wildfires have caused burnt 928,245 acres across the state over the 20-year period between 2000 and 2020. Los Angeles County also has a long history of wildfire activity primarily in the foothills and mountains of the San Gabriel and Santa Monica Mountains. Wildfires occurring in Los Angeles County have resulted in hundreds of thousands of acres burned and hundreds of millions of dollars in damages.

The area immediately surrounding the Cal State LA campus is near but not in immediate proximity to fire hazard zones designated as High Fire Hazard Severity Zones. The campus does not have a history of wildfire activity occurring within proximity to the campus. However, the County is surrounded by areas that are considered to be of high fire threat that would produce vast quantities of smoke and particulates into the air. The Los Angeles campus has experienced multiple days of poor air quality due to fires burning in Los Angeles, Orange, Riverside, and San Bernardino Counties. The 2017, 2018, and 2020 fire seasons in particular illustrated the increase in wildfire generated smoke saturating the air of communities throughout the state including Los Angeles County. Cal State LA personnel reported the ongoing development of policies and procedures to address the response to poor air quality days.

89 California Department of Forestry and Fire Protection, Stats and Events, https://www.fire.ca.gov/stats-events/
Table 13-24: Historic Large-Scale Fires Near Cal State LA\textsuperscript{90}

<table>
<thead>
<tr>
<th>Date</th>
<th>Fire</th>
<th>Location</th>
<th>Declaration</th>
<th>Damages</th>
</tr>
</thead>
<tbody>
<tr>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
</tr>
</tbody>
</table>

Potential Impacts of the Hazard

The location of the Cal State LA campus surrounded by areas of urban development removed from areas with a fire hazard places a minimal direct threat from wildfire to the campus. The potential impacts to wildfire exist with members of the campus community who reside or work in these fire hazard zones.

Potential impacts to the campus community resulting from wildfires include:

- Injuries or loss of life
- Campus property destruction or damage
- Residential property destruction or damage
- Commercial property destruction or damage
- Loss of property contents
- Infrastructure damage
- Damaged or destroyed lifelines/supply routes
- Damaged or destroyed utilities
- Damaged or destroyed critical facilities supporting campus emergency support needs
- Loss of community economic base
- Employment losses
- Loss to ground supporting vegetation on hillsides resulting in erosion or landslides in future precipitation events
- Agricultural (crops and livestock) damages or destruction
- Environmental damage
- Societal and community impacts
- Damage to organizations and facilities providing support services to vulnerable populations
- Greater evacuation challenges for those most vulnerable
- Psychological impacts of impacted populations
- Disruptions to education delivery to community

Potential impacts to the campus resulting from wildfire generated smoke include:

- Dangerous levels of air pollution
- Human Health Effects
  - Similar health impacts to pets

\textsuperscript{90} 2019 Los Angeles County All-Hazards Mitigation Plan, 2019
Air conditioning systems overwhelmed
Greater demands on air filtration systems
Greater demands on healthcare systems
Reduced outdoor work productivity
Closures of academic sessions

Additionally, there remains a number of secondary impacts from wildfires that could affect the campus community. Utilities feeding areas of Los Angeles including the campus may be damaged resulting in power outages. Fire-related damage in the watersheds will likely cause future landslides, degradation to plants supporting hillsides, and impact the hydroelectric power capabilities. Fires may present threats to areas of recreation, scenic value, and wildlife that are a part of the culture of the campus community. Finally, the campus may experience effects of evacuated individuals arriving on campus from other areas as a location of refuge.

Probability of Future Occurrence of the Hazard

Based on the minimal wildfire threat potential in the area surrounding the Cal State LA campus, including the distance to Fire Hazard Severity Zones and density of residential and commercial development, the probability of wildfire related damage is considered **Unlikely**.

Based on the wildfire threat potential in the area surrounding Southern California including the hills and mountains throughout the region, the volume of areas in elevated Fire Hazard Severity Zones throughout the southern portions of the state, and the historic occurrences of smoke, the probability of wildfire generated smoke impacts to air quality is considered **Possible**.

Vulnerability to the Hazard

The Cal State LA campus is not likely to be subject to direct impact from wildfire due to the campus location in an urban/suburban area of East Los Angeles. The vulnerabilities to the effects of wildfire would largely lie within the campus community who may reside or work in locations that are exposed to the Fire Hazard Severity Zones outside of the urban areas of Los Angeles. Wildfires occurring in other areas of the region may result in the displacement of large numbers of people. These effects may spill onto the campus in the form of evacuees or facility support to emergency resources.

Fire directly threatening the campus would likely take the form of localized fires involving single structures or small areas. Smaller vegetation fires are possible surrounding the campus in the urban forest or fields surrounding the city. These incidents would likely have little impact to the campus.

The primary basis of vulnerability is based on the population affected and the built environment exposed. In general, newer construction will be more fire resistant than older buildings as building and fire codes and construction technology have improved.
Density of buildings and proximity of fuels to buildings or equipment at risk of combustion would additionally influence the fire’s ability to spread to structures.

Some areas of particular vulnerability on the campus includes:

- Students and staff engaging in outdoor activities when the air is determined to be unhealthy are vulnerable to adverse health effects.
- Buildings with ineffective HVAC or do not have HVAC will cause limitations in filtering of air during smoke filled days.
- Power outages or brownouts during days with high levels of smoke will limit shelter in place options during heat events in summer.
- Santa Ana wind events may push large volumes of smoke into Los Angeles.

The greater concerns regarding vulnerabilities to wildfire on Cal State LA are related to the smoke that fires in the area would produce. The recent summer seasons have clearly demonstrated the reality of large wildfires producing enough smoke to fill the Los Angeles Basin even from substantial distances away. These recent fires have displayed how the effects of this smoke impact the general population and especially vulnerable populations. Cal State LA students, faculty, and staff both on campus and off campus face these same vulnerabilities related to smoke filled air.

Smoke generated from large wildfires pose a threat in terms of diminished air quality that would be exposed to the population within the area of smoke distribution. Individuals with existing health problems such as respiratory or cardiac illnesses are increasingly vulnerable to wildfire generated smoke. Staff who work in roles requiring outdoor activity will be increasingly exposed during days where the air quality index is considered unhealthy or worse. Student athletes participating in outdoor sports and engaging in aerobic activities are increasingly vulnerable to the effects of wildfire.

The vulnerability to members of the campus community in which wildfire generated smoke on the Cal State LA campus will vary depending on when the air quality was to reach unhealthy levels. The risk to the campus population will be lessened during periods when classes are not in session or during periods of breaks. Conversely, during the days and hours that classes are in session and staff are at their workplaces, human vulnerability increases. However, in region-wide events this vulnerability may be shared with the homes and workplaces of members of the campus community and their families.

Certain campus populations will experience greater challenges to a post-flood / failure environment. Vulnerable populations will likely face disproportionate health safety issues from smoke filled air, experience increased stresses, may require the need to remain away from the campus enclosed at home, and may find difficulty in accessing equipment or supplies to aid in a specific need.

Estimate of Potential Losses

Estimates of potential losses will be influenced by a variety of factors. Costs would also be likely to include mitigation or repairs of HVAC systems, sealing of doors and windows, and other methods of keeping smoke from entering buildings. Secondary costs would
include lost academic days during campus closures, lost staff on campus productivity, and health and medical interventions for affected members of the campus community.

Based on estimate replacement costs of facilities and structures on campus, the maximum total replacement costs due to wildfire are $257,007,988. Due to the lack of a complete inventory of building and facility costs, the total replacement estimate is likely much higher. However, the location of the campus in an urban/suburban setting removed from hazard prone areas makes wildfire related damages unlikely.

Table 13-25: Wildfire Hazard Potential (WHP) Zone Estimated Losses

<table>
<thead>
<tr>
<th>WHP Zone</th>
<th>No of Buildings</th>
<th>Maximum Replacement Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Extreme</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Very High</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>High</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Moderate</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Low</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Very Low</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Non-Burnable</td>
<td>87</td>
<td>$257,007,988</td>
</tr>
<tr>
<td>No Building Value Data Provided*</td>
<td>28</td>
<td>Unknown</td>
</tr>
</tbody>
</table>

*Buildings with no value defined are also included in the respective Zones they are found in.

Vulnerability Assessment Conclusions

The occurrence of wildfires has been a frequent event in Los Angeles County. However, wildfire incidents do not pose a direct risk to the Cal State LA campus. The location of the Cal State LA campus surrounded by densely developed residential, commercial, and industrial land uses mitigates any vulnerabilities of wildfire hazards to the campus community or facilities.

Communities located within or near the Wildland Urban Interface may be subject to damaging fires. These same communities may be home to members of the campus community. The students, faculty, and staff of Cal State LA who live or work in these hazard areas may experience vulnerabilities to the direct exposure to wildfire not likely at the campus. These effects may create tremendous challenges that could impact their ability to maintain engagement with university academic or professional activities. The potential for large-scale wildfires in the region further generates the added potential for a number of cascading effects such as disruptions to the local economy, utility failures, disruptions to providing for the needs of the community, and development of public health hazards.
Additionally, the topography of Southern California surrounded by mountains allows for smoke filled air to linger in the valleys of the Los Angeles Basin with the potential for unhealthy air quality depending on wind conditions. Fires in surrounding mountains generating tremendous quantities of smoke present tremendous health related vulnerabilities to members of the campus community. The campus community exposed to these unhealthy air conditions are vulnerable to a variety of potential health related effects.

**Identified Data Limitations**

Data limitations include missing campus structural replacement costs, and lack of both a complete inventory of building construction types and mitigation efforts to lessen the impact due to fire activity. HAZUS generated analysis is focused on the broader community level versus fine-tuning the analysis to the micro-level for facilities such as a university campus.

**Severe Weather (Wind, Tornado, Hail, and Lightning)**

**Description of the Hazard**

Severe weather can be described as a variety of weather or climate events that are beyond or near the ends of the range of observed weather patterns and behavior. These events can include high or extreme winds, storms, lightning, hail, tornadoes, heat waves, unusually cold temperatures, extreme rainfall, and flooding. \(^91\) According to the Intergovernmental Panel on Climate Change (IPCC), to be classified as severe (or extreme), the occurrence of each value of a climate or weather variable (e.g., wind, hail, lightning, tornado, etc.) must be “above (or below) a threshold value near the upper (or lower) ends of the range of observed values of the variable.” \(^92\)

Severe weather in California can be generated by local, regional, and/or global weather and climate influences. From the individual thunderstorm to the Santa Ana wind event to the strong El Niño, damaging weather elements that are produced by and accompany severe weather and climate phenomena (e.g., damaging winds, hail, lightning, and tornadoes) occur throughout California and the California State University (CSU) system.

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Global Scale Influences on Severe Weather in California: El Niño, La Niña, and ENSO

The El Niño-Southern Oscillation (ENSO) is a recurring climate pattern involving changes in the temperature of waters in the central and eastern tropical Pacific Ocean. On periods ranging from about three (3) to seven (7) years, the surface waters across a large swath of the tropical Pacific Ocean warm or cool by anywhere from 1°C to 3°C, compared to normal. This oscillating warming and cooling pattern, referred to as the ENSO cycle, directly affects rainfall distribution in the tropics and can have a strong influence on weather across the United States and other parts of the world.

El Niño and La Niña are extreme phases of the ENSO cycle, with a third phase occurring between them called the Neutral phase. The El Niño phase is characterized by unusually warm ocean temperatures and weaker-than-normal east winds in the Equatorial Pacific, while the La Niña phase is characterized by unusually cold ocean temperatures and stronger-than-normal east winds in the Equatorial Pacific. Both extreme ENSO phases lead to significant differences from the average ocean temperatures, winds, surface pressure, and rainfall across parts of the tropical Pacific. The Neutral phase indicates that conditions are near their long-term average.

The extreme ENSO phases affect the frequency and intensity of weather events across the world, including in California. On average, areas across California experience exceptionally stormy winters with increased precipitation under El Niño conditions, but experience less stormy and drier winters under La Niña conditions. This variability in storminess and precipitation brought on by El Niño and La Niña events affects the both the frequency and intensity of severe weather conditions experienced by all CSU campuses, including Cal State LA.

Regional Climate Influences on Severe Weather across California

Most of the weather in California is influenced by the wet-winter/ dry-summer Mediterranean climate pattern. In the summer months, Pacific storm tracks are deflected north due to the position of the Pacific High (i.e., a large-scale atmospheric circulation over the Northeast Pacific Ocean), preventing Pacific storms from reaching California. As a result, most summer storms are generated due to the incursion of moist air from the Gulf of Mexico or the Gulf of California, and occur as scattered, locally heavy showers in the desert and mountain regions of the state. In the winter months, the Pacific High decreases in intensity and moves south, permitting powerful Pacific storms to move into and across the state; these storms can produce extreme winds, heavy rains (including

93 Retrieved on 07.18.2021 from https://www.weather.gov/mhx/ensowhat
95 Retrieved on 07.17.2021 from https://www.climate.gov/news-features/understanding-climate/el-ni%C3%B1o-and-la-ni%C3%B1a-frequently-asked-questions
96 Retrieved on 07.16.2021 from https://www.pmel.noaa.gov/elnino/what-is-el-nino
“atmospheric river” events), and widespread coastal and inland flooding. (Please see the Flood Hazard profile in this document for information on Floods.) As a result, storm events accompanied by precipitation in California are far more frequent in the winter months than they are in the summer months.98

While the Mediterranean climate pattern influences the seasonal frequency, intensity, geographic spread, and type of some severe weather events CSU campuses experience (including Cal State LA), other severe weather phenomena may occur in California at any time of the year. For example, near the coast and over the Central Valley, there appears to be no defined seasonality to thunderstorms, and these storms are usually light and infrequent. Thunderstorms are more intense and more frequent in the intermediate and higher elevations of the Sierra Nevada, and occur with greater frequency during the summer months.99

Types of Storms in California

The 2018 California State Hazard Mitigation Plan (SHMP) defines a storm as a violent atmospheric disturbance occurring over land and/or water that is distinguished by its strength, characteristics, and the scale of the resulting damage.100 The SHMP also lists the following types of storms that produce hazardous conditions and potential damage throughout the state of California.101 These storms affect (in varying degrees) all CSU campuses, including Cal State LA.

- **Thunderstorm**: A rain-bearing cloud that also produces lightning. Thunderstorms can produce some of nature’s most destructive and deadly weather including tornadoes, hail, strong winds, lightning and flooding.102 Thunderstorms are caused by an atmospheric imbalance from warm unstable air rising rapidly into the atmosphere. Lightning, which occurs during all thunderstorms, can strike anywhere.103 Thunderstorms can produce some of nature’s most destructive and deadly weather including tornadoes, hail, strong winds, lightning and flooding.104 Severe thunderstorms are more intense, violent, and dangerous thunderstorms. The National Oceanic and Atmospheric Administration (NOAA) defines a severe thunderstorm as any storm that produces one or more of the following elements:

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98 Retrieved on 07.17.2021 from https://wrcc.dri.edu/Climate/narrative_ca.php
Damaging winds or speeds of 58 mph (50 knots) or greater, hail 1 inch in diameter or larger, and/or a tornado.\textsuperscript{105} \textsuperscript{106}

- **Hailstorm**: a type of storm that precipitates round chunks of ice. Hailstorms usually occur during regular thunderstorms.\textsuperscript{107}

- **Wind storm**: marked by high wind with little or no precipitation.\textsuperscript{108}

- **Winter storm**: A storm that can produce a combination of freezing rain, sleet, heavy snow, and/or strong winds.\textsuperscript{109}

- **Coastal storm**: large wind-driven waves and/or storm surge that strike the coastal zone.\textsuperscript{110}

- **Ice storm**: Ice storms are one of the most dangerous forms of winter storms. When surface temperatures are below freezing, but a thick layer of above-freezing air remains aloft, rain can fall into the freezing layer and freeze upon impact into a glaze of ice. In general, 8 millimeters (0.31 inch) of accumulation is all that is required, especially in combination with breezy conditions, to start downing power lines as well as tree limbs. Ice storms also make unheated road surfaces too slick to drive on. Ice storms can vary in time range from hours to days and can cripple small towns and large urban centers alike.\textsuperscript{111}

- **Snowstorm**: A heavy fall of snow accumulating at a rate of more than 5 centimeters (2 inches) per hour that lasts several hours. Snowstorms, especially ones with a high liquid equivalent and breezy conditions, can down tree limbs, cut off power, and paralyze travel over a large region.\textsuperscript{112}
Severe Weather Hazard Elements: Wind Hazards, Hail, and Lightning

This hazard profile concentrates on the following types of severe weather hazards: wind hazards (including tornadoes), hail, and lightning. These hazards are produced by a variety of weather phenomena, including thunderstorms, coastal storms, winter storms, and topographically-enhanced downslope winds. While storm and downslope wind hazards are responsible for severe weather events across the CSU system, only the wind, tornado, hail, and lightning elements generated by these hazards are covered in this profile. (Storm-related hazards such as flooding and extreme temperatures are covered in other sections of this document.)

Wind Hazards

Wind is the horizontal movement of air past any given point. Wind begins with differences in air pressures; pressure that is higher at one point than another sets up a force, pushing the high towards the low pressure. Wind gusts are defined as “rapid fluctuations in the wind speed with a variation of 10 knots or more between peaks and lulls.”

Wind hazards in California take several forms: High Wind, Strong Winds, Thunderstorm Winds, Mountain-Valley (Downslope) Winds, and Tornadoes. These hazards are encountered across California, and have the potential to cause harm to or loss of life and/or property throughout California and the CSU system (including Cal State LA).

High Winds, Strong Winds, and Thunderstorm Winds

The National Weather Service reports three (3) types of wind events that occur areas over land: High Winds, Strong Winds, and Thunderstorm Winds. Collectively, these reports are used to determine the frequency with which wind hazard events have affected areas across the U.S., including California.

High Winds

High winds are defined as sustained non-convective winds of 35 knots (40 mph) or greater lasting for 1 hour or longer, or gusts of 50 knots (58 mph) or greater for any duration (or otherwise locally/regionally defined). In some mountainous areas, the above numerical values are 43 knots (50 mph) and 65 knots (75 mph), respectively.

Strong Winds

Strong winds are defined as non-convective winds gusting less than 50 knots (58 mph), or sustained winds less than 35 knots (40 mph), resulting in a fatality, injury, or damage.

Thunderstorm Winds

Thunderstorm winds are winds that arise from thunderstorm convection (occurring within 30 minutes of lightning being observed or detected), with speeds of at least 50 knots (58 mph). They can also be winds of any speed (non-severe thunderstorm winds below 50 knots (58 mph)) producing a fatality, injury, or damage.\textsuperscript{117}

Please note: \textit{Straight-line wind} is a term used to define any thunderstorm wind that is not associated with rotation. It is used mainly to differentiate from the rotational winds found in tornado-producing storms.\textsuperscript{118} However, it is not a term used in the NCEI Storm Events Database, and therefore cannot be used to determine severe weather history of or potential impacts to CSU campuses.

Tornadoes

A tornado is an extreme severe weather wind hazard. A tornado is a rapidly rotating column of air extending from a thunderstorm to the surface of the Earth.\textsuperscript{119} This column extends between cloud and the Earth’s surface. The damage from tornadoes comes from the strong winds they contain and the flying debris they create. It is generally believed that rotational wind speeds can be as high as 300 mph in the most violent tornadoes.\textsuperscript{120} On a local scale, tornadoes are the most violent and most destructive of all atmospheric phenomena.\textsuperscript{121}


\textbf{Santa Ana Winds.} A type of wind hazard that is peculiar to Southern California is called a \textit{Santa Ana Wind}. Santa Ana winds are strong, topographically-enhanced, extremely dry downslope winds that originate inland and affect coastal southern California and northern Baja California (Mexico).\textsuperscript{122} They occur when air from a region of high pressure over the dry, desert region of the southwestern U.S. flows westward towards low pressure located off the California coast. This creates dry winds that flow east to west through the mountain passages in Southern California. These winds have a strong seasonal component; they are most common during the cooler months of the year, occurring from September through May. Santa Ana winds typically feel warm (or even hot) because as the cool desert air moves down the side of the mountain, it is compressed, which causes the temperature of the air to rise. If strong enough, Santa Ana winds can cause major property damage, and may present difficulties for airborne and seagoing transportation.

\textsuperscript{118} Retrieved on 07.15.2021 from https://www.nssl.noaa.gov/education/svrwx101/wind/types/
\textsuperscript{119} Retrieved on 07.15.2021 from https://www.earthnetworks.com/tornado/
\textsuperscript{120} Retrieved on 07.15.2021 from https://www.nssl.noaa.gov/education/svrwx101/tornadoes/faq/
\textsuperscript{121} Retrieved on 07.15.2021 from https://www.weather.gov/bgm/severedefinitions
They also may increase wildfire risk because of the dryness of the winds and the speed at which they can spread a flame across the landscape.\textsuperscript{123} (Note: The Wildfire hazard is profiled elsewhere in this document.)

Figure below illustrates the mechanisms involved in the generation of Santa Ana winds across Southern California.

Figure 13-15: What Drives a Santa Ana Wind?\textsuperscript{124}

\textbf{Diablo Winds}. The Diablo wind is another type of topographically-enhanced downslope wind phenomenon that occurs in the North-Central areas of California. Diablo winds are offshore wind events that flow northeasterly over Northern California’s Coast Ranges, often creating high wind speeds downwind of major canyons and over ridges, and extreme fire danger for the San Francisco Bay Area. Diablo winds are driven by a surface...
pressure gradient that forms in response to an inverted pressure trough that develops over California.125

**Sundowner Winds.** Sundowner winds are significant and potentially damaging downslope wind and warming events that periodically occur along a short segment of the southern California coast in the vicinity of Santa Barbara, CA. The unique topography of this coastal region promotes the development of Sundowner wind events: over a length of about 100 km, the coastline is oriented approximately west–east, with the adjoining narrow coastal plain bounded by a steeply rising (to elevations greater than 1200 m) and coast-parallel mountain range. Called Sundowner winds because they often begin in the late afternoon or early evening, their onset is typically associated with a rapid rise in temperature and decrease in relative humidity, and the winds tend to blow from the north from the Santa Ynez Mountains to the coast of Santa Barbara County, California. During the more intense Sundowner wind events, wind speeds can be of gale force 39-54 miles per hour or higher, and can even reach hurricane force (≥ 74 miles per hour) in the most extreme cases. Temperatures over the coastal plain, and even at the coast itself, can rise significantly above 37.8°C (100°F). Seasonally, Sundowner winds peak in March, April, and May, with a minimum during summer and a secondary peak in winter that often corresponds with Santa Ana winds. In addition to causing a dramatic change from the more typical marine-influenced local weather conditions, Sundowner wind episodes have produced significant wind-related property and agricultural damage, as well as conditions of extreme fire danger.126 127 128

**Hail**

Hail is a form of precipitation consisting of solid ice that forms inside thunderstorm updrafts.129 It is roughly round in shape and at least 0.2’ in diameter. Hail develops in the upper atmosphere as ice crystals that are bounced about by high velocity updraft winds; the ice crystals accumulate frozen droplets and fall after developing enough weight. The size of hailstones varies and is a direct consequence of the severity and size of the storm that produces them – the higher the temperatures at the Earth’s surface, the greater the strength of the updrafts and the amount of time hailstones are suspended, and therefore the greater the size of the hailstone.130

**Lightning**

Lightning is an electrical discharge produced by a thunderstorm. Lightning rapidly heats the air in its immediate vicinity to about 50,000°F - about five times the temperature of the surface of the sun. This compresses the surrounding air and creates a supersonic shock wave, which decays to an acoustic wave that is heard as thunder.\(^{131}\)

The discharge may occur within or between clouds, between the cloud and air, between a cloud and the ground, or between the ground and a cloud.\(^{132}\) Lightning that is produced from thunderstorms in which precipitation evaporates before reaching the ground is called “dry lightning.”

**Location of the Hazard**

Severe weather is a non-spatial hazard, and can occur anywhere in the CSU system, including on the Cal State LA campus. No one area of the campus – or of the surrounding community – is subject to experiencing severe weather more than any other area.

There is geographic variability among the different types of mountain and valley wind events (as a sub-category of the severe weather hazard). Santa Ana winds occur in Southern California, Diablo winds occur in North-Central California, and Sundowner winds occur almost exclusively in Santa Barbara County, California.

**Extent of the Hazard**

Severe weather hazards are non-spatial hazards that potentially affect all Cal State LA campus areas equally. However, the smallest geographic unit of measurement for almost all official severe weather event data is at the county level. Because the severe weather data used do not exist at the campus level, it is assumed that the same (or similar) severe weather risks to Cal State LA reflect those of the surrounding community and County. As a result, all assets and people at Cal State LA are at risk from the effects of severe weather and can expect to experience at least some (or the complete range of) endemic severe weather hazards. In consideration of the campus’ design, layout, and operations, the severe weather history and degree of severity in the Los Angeles area, and the history and degree of severity of each severe weather sub-type identified by the extent scales (below), the campus planning committee ranks the overall extent of the Severe Weather hazard as **MODERATE**. See each sub-hazard below for the planning committee’s sub-type extent ranking.

**Wind Hazard: Non-Rotational**

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The Beaufort Scale is an empirical measure that relates wind speed to observed conditions at sea or on land. Its full name is the Beaufort wind force scale.\textsuperscript{133} First developed in 1805, it is still used today to estimate wind strengths.\textsuperscript{134}

Table 13-26: Beaufort Wind Force Scale\textsuperscript{135}

<table>
<thead>
<tr>
<th>Force</th>
<th>Speed (mph)</th>
<th>Speed (knots)</th>
<th>Description</th>
<th>Specifications for use at sea</th>
<th>Specifications for use on land</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0-1</td>
<td>0-1</td>
<td>Calm</td>
<td>Sea like a mirror.</td>
<td>Calm; smoke rises vertically.</td>
</tr>
<tr>
<td>1</td>
<td>1-3</td>
<td>1-3</td>
<td>Light Air</td>
<td>Ripples with the appearance of scales are formed, but without foam crests.</td>
<td>Direction of wind shown by smoke drift, but not by wind vanes.</td>
</tr>
<tr>
<td>2</td>
<td>4-7</td>
<td>4-6</td>
<td>Light Breeze</td>
<td>Small wavelets, still short, but more pronounced. Crests have a glassy appearance and do not break.</td>
<td>Wind felt on face; leaves rustle; ordinary vanes moved by wind.</td>
</tr>
<tr>
<td>3</td>
<td>8-12</td>
<td>7-10</td>
<td>Gentle Breeze</td>
<td>Large wavelets. Crests begin to break. Foam of glassy appearance. Perhaps scattered white horses.</td>
<td>Leaves and small twigs in constant motion; wind extends light flag.</td>
</tr>
<tr>
<td>4</td>
<td>13-18</td>
<td>11-16</td>
<td>Moderate Breeze</td>
<td>Small waves, becoming larger; fairly frequent white horses.</td>
<td>Raises dust and loose paper; small branches are moved.</td>
</tr>
<tr>
<td>5</td>
<td>19-24</td>
<td>17-21</td>
<td>Fresh Breeze</td>
<td>Moderate waves, taking a more pronounced long form; many white horses are formed.</td>
<td>Small trees in leaf begin to sway; crested wavelets form on inland waters.</td>
</tr>
<tr>
<td>6</td>
<td>25-31</td>
<td>22-27</td>
<td>Strong Breeze</td>
<td>Large waves begin to form; the white foam crests are more extensive everywhere.</td>
<td></td>
</tr>
</tbody>
</table>

\textsuperscript{133} Retrieved on 07.15.2021 from \url{https://www.rmets.org/resource/beaufort-scale}
\textsuperscript{134} Retrieved on 07.15.2021 from \url{https://www.weather.gov/mfl/beaufort}
\textsuperscript{135} Retrieved on 07.15.2021 from \url{https://www.weather.gov/mfl/beaufort}
<table>
<thead>
<tr>
<th></th>
<th>32-38</th>
<th>28-33</th>
<th>Near Gale</th>
</tr>
</thead>
<tbody>
<tr>
<td>7</td>
<td></td>
<td></td>
<td>Large branches in motion; whistling heard in telegraph wires; umbrellas used with difficulty.</td>
</tr>
<tr>
<td></td>
<td>Sea heaps up and white foam from breaking waves begins to be blown in streaks along the direction of the wind.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Whole trees in motion; inconvenience felt when walking against the wind.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>39-46</th>
<th>34-40</th>
<th>Gale</th>
</tr>
</thead>
<tbody>
<tr>
<td>8</td>
<td></td>
<td></td>
<td>Moderately high waves of greater length; edges of crests begin to break into spindrift. The foam is blown in well-marked streaks along the direction of the wind.</td>
</tr>
<tr>
<td></td>
<td>Breaks twigs off trees; generally impedes progress.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>47-54</th>
<th>41-47</th>
<th>Severe Gale</th>
</tr>
</thead>
<tbody>
<tr>
<td>9</td>
<td></td>
<td></td>
<td>High waves. Dense streaks of foam along the direction of the wind. Crests of waves begin to topple, tumble and roll over. Spray may affect visibility</td>
</tr>
<tr>
<td></td>
<td>Slight structural damage occurs (chimney-pots and slates removed)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>55-63</th>
<th>48-55</th>
<th>Storm</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td></td>
<td></td>
<td>Very high waves with long overhanging crests. The resulting foam, in great patches, is blown in dense white streaks along the direction of the wind. On the whole the surface of the sea takes on a white appearance. The tumbling of the sea becomes heavy and shock-like. Visibility affected.</td>
</tr>
<tr>
<td></td>
<td>Seldom experienced inland; trees uprooted; considerable structural damage occurs.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>64-72</th>
<th>56-63</th>
<th>Violent Storm</th>
</tr>
</thead>
<tbody>
<tr>
<td>11</td>
<td></td>
<td></td>
<td>Exceptionally high waves (small and medium-size ships might be for a time lost to view behind the waves). The sea is completely covered with long white patches of foam lying along the direction of the wind. Everywhere the edges of the wave crests are blown into froth. Visibility affected.</td>
</tr>
<tr>
<td></td>
<td>Very rarely experienced; accompanied by widespread damage.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>73+</th>
<th>64+</th>
<th>Hurricane</th>
</tr>
</thead>
<tbody>
<tr>
<td>12</td>
<td></td>
<td></td>
<td>The air is filled with foam and spray. Sea completely white with driving spray; visibility very seriously affected.</td>
</tr>
</tbody>
</table>
Based on those extent ranking factors identified (above), the planning committee ranks the extent of non-rotational wind hazards as **MODERATE**.

**Extent: Tornado**

Tornadoes have their own severity/extent scale. Until 2007, tornadoes were measured and described according to the Fujita Scale.\(^{136}\)

In February 2007, use of the Fujita Scale was discontinued. In its place, the Enhanced Fujita (EF) Scale is used. The Enhanced Fujita scale considers how most structures are designed and is thought to be a much more accurate representation of the surface wind speeds in the most violent tornadoes. Like the original Fujita scale, the Enhanced Fujita scale is a set of wind estimates (not measurements) based on damage.

It is important to note the **date** that a tornado occurred. Tornadoes that occurred prior to February, 2007 are classified using the original Fujita scale and will not be converted to the Enhanced Fujita Scale.

Table below illustrates the Fujita Scale in use prior to February 2007.

**Table 13-27: Fujita Tornado Scale (Pre-February 2007)\(^{137}\)**

<table>
<thead>
<tr>
<th>F-Scale Number</th>
<th>Intensity Phrase</th>
<th>Wind Speed</th>
<th>Type of Damage</th>
</tr>
</thead>
<tbody>
<tr>
<td>F0</td>
<td>Gale tornado</td>
<td>40-72 mph</td>
<td>Some damage to chimneys; breaks branches off trees; pushes over shallow-rooted trees; damages sign boards.</td>
</tr>
<tr>
<td>F1</td>
<td>Moderate tornado</td>
<td>73-112 mph</td>
<td>The lower limit is the beginning of hurricane wind speed; peels surface off roofs; mobile homes pushed off foundations or overturned; moving autos pushed off the roads; attached garages may be destroyed.</td>
</tr>
<tr>
<td>F2</td>
<td>Significant tornado</td>
<td>113-157 mph</td>
<td>Considerable damage. Roofs torn off frame houses; mobile homes demolished; boxcars pushed over; large trees snapped or uprooted; light object missiles generated.</td>
</tr>
</tbody>
</table>

---

<table>
<thead>
<tr>
<th>F3</th>
<th>Severe tornado</th>
<th>158-206 mph</th>
<th>Roof and some walls torn off well-constructed houses; trains overturned; most trees in forest uprooted.</th>
</tr>
</thead>
<tbody>
<tr>
<td>F4</td>
<td>Devastating tornado</td>
<td>207-260 mph</td>
<td>Well-constructed houses leveled; structures with weak foundations blown off some distance; cars thrown and large missiles generated.</td>
</tr>
<tr>
<td>F5</td>
<td>Incredible tornado</td>
<td>261-318 mph</td>
<td>Strong frame houses lifted off foundations and carried considerable distances to disintegrate; automobile sized missiles fly through the air in excess of 100 meters; trees debarked; steel reinforced concrete structures badly damaged.</td>
</tr>
<tr>
<td>F6</td>
<td>Inconceivable tornado</td>
<td>319-379 mph</td>
<td>These winds are very unlikely. The small area of damage they might produce would probably not be recognizable along with the mess produced by F4 and F5 wind that would surround the F6 winds. Missiles, such as cars and refrigerators would do serious secondary damage that could not be directly identified as F6 damage. If this level is ever achieved, evidence for it might only be found in some manner of ground swirl pattern, for it may never be identifiable through engineering studies.</td>
</tr>
</tbody>
</table>

Table below illustrates the Enhanced Fujita (EF) Scale, currently in use. Tornadoes that have occurred since February, 2007 are classified using the Enhanced Fujita Scale.
Table 13-28: Enhanced Fujita Scale (February 2007 and Later)  

<table>
<thead>
<tr>
<th>Enhanced Fujita Category</th>
<th>Wind Speed</th>
<th>Potential Damage</th>
</tr>
</thead>
<tbody>
<tr>
<td>EF0</td>
<td>65-85 mph</td>
<td>Light damage. Peels surface off some roofs; some damage to gutters or siding; branches broken off trees; shallow-rooted trees pushed over.</td>
</tr>
<tr>
<td>EF1</td>
<td>86-110 mph</td>
<td>Moderate damage. Roofs severely stripped; mobile homes overturned or badly damaged; loss of exterior doors; windows and other glass broken.</td>
</tr>
<tr>
<td>EF2</td>
<td>111-135 mph</td>
<td>Considerable damage. Roofs torn off well-constructed houses; foundations of frame homes shifted; mobile homes completely destroyed; large trees snapped or uprooted; light-object missiles generated; cars lifted off ground.</td>
</tr>
<tr>
<td>EF3</td>
<td>136-165 mph</td>
<td>Severe damage. Entire stories of well-constructed houses destroyed; severe damage to large buildings such as shopping malls; trains overturned; trees debarked; heavy cars lifted off the ground and thrown; structures with weak foundations blown away some distance.</td>
</tr>
<tr>
<td>EF4</td>
<td>166-200 mph</td>
<td>Devastating damage. Well-constructed houses and whole frame houses completely leveled; cars thrown and small missiles generated.</td>
</tr>
<tr>
<td>EF5</td>
<td>&gt;200 mph</td>
<td>Incredible damage. Strong frame houses leveled off foundations and swept away; automobile-sized missiles fly through the air in excess of 100 m (107 yd); high-rise buildings have significant structural deformation; incredible phenomena will occur.</td>
</tr>
</tbody>
</table>

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Based on the extent ranking factors identified (above), the planning committee ranks the extent of tornados as **LOW**.

**Extent: Hail**

The National Oceanic and Atmospheric Administration and the Tornado and Storm Research Organization (TORRO) have combined efforts to create the Hailstorm Intensity Scale. Table below provides details of this scale.

Table 13-29: Combined NOAA/TORRO Hailstorm Intensity Scale\(^\text{139}\)

<table>
<thead>
<tr>
<th>Size Code</th>
<th>Intensity Category</th>
<th>Typical Hail Diameter</th>
<th>Approximate Size</th>
<th>Typical Damage Impacts</th>
</tr>
</thead>
<tbody>
<tr>
<td>H0</td>
<td>Hard Hail</td>
<td>Up to 0.33”</td>
<td>Pea</td>
<td>No damage</td>
</tr>
<tr>
<td>H1</td>
<td>Potentially Damaging</td>
<td>0.33” – 0.60”</td>
<td>Marble or Mothball</td>
<td>Slight damage to plants and crops</td>
</tr>
<tr>
<td>H2</td>
<td>Potentially Damaging</td>
<td>0.60” – 0.80”</td>
<td>Dime or grape</td>
<td>Significant damage to fruit, crops, and vegetation</td>
</tr>
<tr>
<td>H3</td>
<td>Severe</td>
<td>0.80” – 1.20”</td>
<td>Nickel to Quarter</td>
<td>Severe damage to fruit and crops, damage to glass and plastic structures, paint and wood scored</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Code</th>
<th>Extent</th>
<th>Diameter (&quot;&quot;&quot;)</th>
<th>Size Comparison</th>
<th>Damage/Impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>H4</td>
<td>Severe</td>
<td>1.20” – 1.60”</td>
<td>Half Dollar to Ping Pong Ball</td>
<td>Widespread glass damage, vehicle body damage</td>
</tr>
<tr>
<td>H5</td>
<td>Destructive</td>
<td>1.60” – 2.0”</td>
<td>Silver Dollar to Golf Ball</td>
<td>Wholesale destruction of glass, damage to tiled roofs, significant risk of injuries</td>
</tr>
<tr>
<td>H6</td>
<td>Destructive</td>
<td>2.0” – 2.4”</td>
<td>Lime or Egg</td>
<td>Aircraft body dented; brick walls pitted</td>
</tr>
<tr>
<td>H7</td>
<td>Very Destructive</td>
<td>2.4” – 3.0”</td>
<td>Tennis Ball</td>
<td>Severe roof damage, risk of serious injuries</td>
</tr>
<tr>
<td>H8</td>
<td>Very Destructive</td>
<td>3.0” – 3.5”</td>
<td>Baseball to Orange</td>
<td>Severe damage to aircraft body</td>
</tr>
<tr>
<td>H9</td>
<td>Super Hailstorms</td>
<td>3.5” – 4.0”</td>
<td>Grapefruit</td>
<td>Extensive structural damage, risk of severe or fatal injuries to persons caught in the open</td>
</tr>
</tbody>
</table>

Based on those extent ranking factors identified (above), the planning committee ranks the extent of the hail hazard as **LOW**.
**Extent: Lightning**

The National Weather Service (NWS) uses a Lightning Activity Level (LAL) scale to indicate the frequency and character of cloud-to-ground (C/G) lightning. The scale uses a range of 1 – 6, with 6 being the high end of the scale. Table 13-XX provides details of the LAL scale.

Table 13-30: Lightning Activity Level (LAL) Scale

<table>
<thead>
<tr>
<th>Rank</th>
<th>Cloud and Storm Development</th>
<th>Areal Coverage</th>
<th>Counts C/G per 5 Minutes</th>
<th>Counts C/G per 15 Minutes</th>
<th>Average C/G per Minute</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>No Thunderstorms</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>2</td>
<td>Cumulus clouds are common but only a few reaches the towering stage. A single thunderstorm must be confirmed in the rating area. The clouds mostly produce virga, but light rain will occasionally reach ground. Lightning is very infrequent.</td>
<td>&lt;15%</td>
<td>1-5</td>
<td>1-8</td>
<td>&lt;1</td>
</tr>
<tr>
<td>3</td>
<td>Cumulus clouds are common. Swelling and towering cumulus cover less than 2/10 of the sky. Thunderstorms are few, but 2 to 3 occur within the observation area. Light to moderate rain will reach the ground, and lightning is infrequent.</td>
<td>15% to 24%</td>
<td>6-10</td>
<td>9-15</td>
<td>1-2</td>
</tr>
</tbody>
</table>

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140 Retrieved on 07.19.2021 from [https://graphical.weather.gov/definitions/defineLAL.html](https://graphical.weather.gov/definitions/defineLAL.html)
Lightning Activity Level Scale

<table>
<thead>
<tr>
<th>Rank</th>
<th>Cloud and Storm Development</th>
<th>Areal Coverage</th>
<th>Counts C/G per 5 Minutes</th>
<th>Counts C/G per 15 Minutes</th>
<th>Average C/G per Minute</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>Swelling cumulus and towering cumulus cover 2-3/10 of the sky. Thunderstorms are scattered but more than three must occur within the observation area. Moderate rain is commonly produced, and lightning is frequent.</td>
<td>25% to 50%</td>
<td>11-15</td>
<td>16-25</td>
<td>2-3</td>
</tr>
<tr>
<td>5</td>
<td>Towering cumulus and thunderstorms are numerous. They cover more than 3/10 and occasionally obscure the sky. Rain is moderate to heavy, and lightning is frequent and intense.</td>
<td>&gt;50%</td>
<td>&gt;15</td>
<td>&gt;25</td>
<td>&gt;3</td>
</tr>
<tr>
<td>6</td>
<td>Dry lightning outbreak. (LAL of 3 or greater with majority of storms producing little or no rainfall.)</td>
<td>&gt;15%</td>
<td>None</td>
<td>None</td>
<td>None</td>
</tr>
</tbody>
</table>

Based on those extent ranking factors identified (above), the planning committee ranks the extent of the lightning hazard as **LOW**.

**Extent: Thunderstorms that Generate Wind, Tornado, Hail, and Lightning Hazard Events**

Thunderstorms are not explicitly identified as a severe weather category for this hazard profile. However, they are responsible for most tornado, lightning, and hail hazard events – as well as a significant number of wind hazard events – across California and the CSU system. While individual thunderstorms affect relatively small areas, there are many instances in which thunderstorms can cluster together and/or travel in a line over long distances, producing significant damage over large geographic areas.

A thunderstorm is classified as “severe” when certain meteorological parameters within the thunderstorm are reached (i.e., damaging winds or speeds of 58 mph (50 knots) or greater, hail 1 inch in diameter or larger, and/or a tornado). However, there is currently no
established, objective severity scale for thunderstorms.\textsuperscript{141, 142} That said, according to the \textit{Glossary of Meteorology} published by the American Meteorological Society (AMS), a thunderstorm is reported as \textit{light, medium, or heavy} according to following five (5) characteristics:

- the nature of the lightning and thunder;
- the type and intensity of the precipitation, if any;
- the speed and gustiness of the wind;
- the appearance of the clouds; and
- the effect upon surface temperature.\textsuperscript{143}

A thunderstorm may also be classified by the nature of the overall weather situation in which the thunderstorm is produced, including:

- \textbf{Airmass Thunderstorm}: A thunderstorm produced by local convection within an unstable air mass;\textsuperscript{144}
- \textbf{Frontal Thunderstorm}: An individual thunderstorm the initiation of which results from rising motion associated with a front, \textit{or} a thunderstorm within a convective system generated and organized by frontal rising motion;\textsuperscript{145} or
- \textbf{Squall-line Thunderstorm}: An individual thunderstorm included within a squall line (i.e., a continuous or broken line of active deep moist convection frequently associated with thunder).\textsuperscript{146, 147}

Based on the extent ranking factors identified (above) in relation to campus layout and operations, and past event low degree of severity, the planning committee ranks the extent of the thunderstorm hazard as \textbf{LOW}.

\textsuperscript{141} Retrieved on 07.15.2021 from https://www.noaa.gov/explainers/severe-storms
\textsuperscript{142} Retrieved on 07.15.2021 from https://www.weather.gov/safety/thunderstorm
History of the Hazard

Severe weather hazards have been an annual occurrence in Los Angeles County and on the Cal State LA campus. Historical data for these hazards are presented below.

Historical Storm Data Collection: NCEI Storm Events Database

Historical information regarding severe weather hazards can be found using The National Centers for Environmental Information (NCEI) Storm Events Database. The Storm Events Database contains searchable, archived National Weather Service (NWS) storm data from January 1950 to April 2021, as entered by NOAA’s National Weather Service (NWS). Due to changes in the data collection and processing procedures over time, there are unique periods of record available depending on the event type.\(^{148}\) For example, from 1950 through 1954, only tornado events were recorded; from 1955 through 1995, only tornado, thunderstorm wind, and hail events were introduced into the database; from 1996 to present, 45 additional event types are recorded, including high wind, strong wind, and lightning events.\(^{149}\) To obtain the most accurate portrayal of severe weather event frequency, searches of the Storm Events Database are conducted using data collected since 01/01/1996. As a reminder, all official severe weather event data is at the county level. Severe weather data do not exist at the campus level. That said, it may be the case that the campus to some degree experiences the severe weather events reported for the surrounding community and County.

Wind Hazards (excluding Tornadoes)

Information obtained from the NCEI Storm Event Database website shows the number of events (or occurrences) of wind hazard events in Los Angeles County since 1996.\(^{150}\) Here, wind hazard events include all “High Wind,” “Strong Wind,” and “Thunderstorm Wind” storm reports.\(^{151}\)

- **High Wind**: at least 387 events, or approximately 15.28 events per year\(^ {152}\)
- **Strong Wind**: at least 3 events, or 0.12 events per year\(^ {153}\)

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\(^{151}\) National Climatic Data Center. Storm Events Database. Retrieved 07.29.2021 from [https://www.ncdc.noaa.gov/stormevents/](https://www.ncdc.noaa.gov/stormevents/)

\(^{152}\) National Climatic Data Center. Storm Events Database. Retrieved 07.29.2021 from [https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType%28Z%29=High+Wind&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=LOS%2BANGELES%3A3A7&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitButton=Search&state#ips=6%2CCALIFORNIA](https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType%28Z%29=High+Wind&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=LOS%2BANGELES%3A3A7&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitButton=Search&state#ips=6%2CCALIFORNIA)

\(^{153}\) National Climatic Data Center. Storm Events Database. Retrieved 07.29.2021 from [https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType%28Z%29=Strong+Wind&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&count](https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType%28Z%29=Strong+Wind&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&count)
Thunderstorm Wind: at least 43 events, or approximately 1.70 events per year.\textsuperscript{154}

All Wind Hazard events (excluding Tornadoes): at least 427 events, or approximately 16.86 events per year.\textsuperscript{155} (Note: This was determined by conducting a simultaneous search of the component wind hazards of high wind, strong wind and thunderstorm wind.)

Overall, in Los Angeles County, there have been at least 427 wind hazard events since 1996, excluding tornadoes.\textsuperscript{156} That translates to an approximate average historical frequency of occurrence of 16.86 wind hazard events per year.

Please note: Differences between the sums of individual component severe weather hazard event Database searches (i.e., 433 events) and simultaneous Database searches of all severe weather hazard events (i.e., 427 events) may be due to the following factors: (1) multiple event types are in the same record (e.g., "Thunderstorm Wind/Hail" or "Hail/Tornado;" and/or (2) severe weather hazard events such as “Thunderstorm Wind” or “Hail” that are reported for Los Angeles County have actually taken place hundreds of miles away, but are erroneously recorded as events that have occurred in the County.\textsuperscript{157} When such a discrepancy arises, the more conservative aggregate hazard wind event value (i.e., 427 events) is used to determine the historical frequency of occurrence for the severe weather hazard. The origin of this discrepancy is unknown at this time.

Historical Wind Hazard Losses for Los Angeles County since 1996

According to the NCEI Storm Events Database, the wind hazard events that Los Angeles County has experienced since 1996 have been costly. There have been 2 deaths and 4

\textsuperscript{154} National Climatic Data Center. Storm Events Database. Retrieved 07.29.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Thunderstorm+Wind&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=LOS%2BANGELES%3A37&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA

\textsuperscript{155} National Climatic Data Center. Storm Events Database. Retrieved 07.29.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28Z%29+High+Wind&eventType=%28Z%29+Strong+Wind&eventType=%28C%29+Thunderstorm+Wind&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=LOS%2BANGELES%3A37&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA

\textsuperscript{156} National Climatic Data Center. Storm Events Database. Retrieved 07.29.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28Z%29+High+Wind&eventType=%28Z%29+Strong+Wind&eventType=%28C%29+Thunderstorm+Wind&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=LOS%2BANGELES%3A37&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA

injuries reported from wind hazard events (excluding tornadoes) in Los Angeles County; no property or crop damage has been reported.158

**Tornado Wind Hazards**

Information from the NCEI Storm Events Database indicates that since 1996, there have been 12 reported events of tornadoes in Los Angeles County, which translates to approximately **0.47** tornado events per year.159

The vast majority of tornado reports in Los Angeles County since 1996 have been of tornadoes with a severity rating of F0/EF0. Only one (1) or 12 of the tornadoes reported in has been rated F1/EF1 or higher (it was an F1 tornado that occurred in 1998); that translates to approximately **0.04** events of F1/EF1 tornadoes have occurred per year in Los Angeles County.160

**Historical Tornado Hazard Losses for Los Angeles County since 1996**

According to the NCEI Storm Events Database, the tornado hazard events that Los Angeles County has experienced since 1996 have been minimal. There have been no deaths, or property or crop damage reported; however, 1 injury has been reported.161 (Note: An F1/EF1 tornado that occurred in Los Angeles County in 1998 was responsible for the one (1) reported injury.)

**Hail**

Information from the NCEI Storm Events Database indicates that since 1996, there have been 18 reported events of hail in Los Angeles County, which translates to approximately **0.71** hail events per year.162 (Note: The NCEI Storm Event Database search results for hail indicate that there has been a total of 19 reports of hail since 1996. However, one (1) entry

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158 National Climatic Data Center. Storm Events Database. Retrieved 07.29.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28Z%29+High+Wind&eventType=%28Z%29+Strong+Wind&eventType=%28C%29+Thunderstorm+Wind&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=LOS%2BANGELES%3A37&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitButton=Search&statefips=6%2CCALIFORNIA

159 National Climatic Data Center. Storm Events Database. Retrieved 07.29.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Tornado&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=LOS%2BANGELES%3A37&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitButton=Search&statefips=6%2CCALIFORNIA

160 National Climatic Data Center. Storm Events Database. Retrieved 07.29.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Hail&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=LOS%2BANGELES%3A37&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitButton=Search&statefips=6%2CCALIFORNIA

161 National Climatic Data Center. Storm Events Database. Retrieved 07.29.2021 from

162 National Climatic Data Center. Storm Events Database. Retrieved 07.29.2021 from

13-119
is for a hail event in San Diego County, over 100 miles away from Los Angeles County. The origin of this error is unknown at this time.)

**Historical Hail Hazard Losses for Los Angeles County since 1996**

According to the NCEI Storm Events Database, the hail hazard events that Los Angeles County has experienced since 1996 have been costly. While there have been no deaths, injuries, or crop damages reported, there have been property damage estimates that have totaled approximately $3,500,000; the property damage estimate reflects one (1) hail hazard event that occurred in 2003.\(^{163}\) (Note: The San Diego County hail event that was included erroneously in the search results for hail hazard events in Los Angeles County accounted for all injuries (i.e., 5) and crop damage estimates (i.e., $300,000) presented in the search results.)

**Lightning**

Information from the NCEI Storm Events Database indicates that since 1996, there have been 9 reported events of lightning in Los Angeles County, which translates to approximately 0.36 lightning events per year.\(^{164}\)

**Historical Lightning Hazard Losses for Los Angeles County since 1996**

According to the NCEI Storm Events Database, the lightning hazard events that Los Angeles County has experienced since 1996 have been costly. While no property or crop damages have been reported, there have been 2 deaths and 13 injuries attributed to lightning hazard events.\(^{165}\)

**All Severe Weather Hazard Events Recorded by the NCEI Storm Events Database**

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\(^{163}\) National Climatic Data Center. Storm Events Database. Retrieved 07.29.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Hail&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=LOS%2BANGELES%3A37&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA

\(^{164}\) National Climatic Data Center. Storm Events Database. Retrieved 07.29.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Lightning&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=LOS%2BANGELES%3A37&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA

\(^{165}\) National Climatic Data Center. Storm Events Database. Retrieved 07.29.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Lightning&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=LOS%2BANGELES%3A37&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA
Information obtained from the NCEI Storm Events Database indicates that there have been 466 occurrences of the severe weather hazard in Los Angeles County. This translates to **18.39 severe weather hazard occurrences per year**.\(^{166}\)

Please note: Differences between the sums of individual component severe weather hazard event Database searches (i.e., 472 events) and simultaneous Database searches of all severe weather hazard events (i.e., 466 events) may be due to the following factors: (1) multiple event types are in the same record (e.g., “Thunderstorm Wind/Hail” or “Hail/Tornado;” and/or (2) severe weather hazard events such as “Thunderstorm Wind” or “Hail” that are reported for Los Angeles County have actually taken place hundreds of miles away, but are erroneously recorded as events that have occurred in the County.\(^{167}\)

When such a discrepancy arises, the more conservative aggregate hazard wind event value (i.e., 466 events) is used to determine the historical frequency of occurrence for the severe weather hazard. The origin of this discrepancy is unknown at this time.

### Historical, Aggregated Severe Hazard Losses for Los Angeles County since 1996

According to the NCEI Storm Events Database, the severe weather events that Los Angeles County has experienced since 1996 have been costly. There have been 4 deaths and 18 injuries, and property damage estimates have totaled approximately $3,500,000; no crop damage has been reported. *It is important to note that for all Los Angeles County severe weather hazard events recorded on the Storm Events Database, lightning has accounted for half of the deaths, and for 13 out of 14 (92.9%) injuries reported. However, hail has accounted for all estimated property damages.*

### Wind Hazards Not Included in the NCEI Storm Events Database

#### Santa Ana Winds

Santa Ana wind events occur at least twice per month from October through April.\(^{168}\)

From 1948 to 2012, total of 2056 events on the 65-year record were recorded in the Southern California region, yielding an average of **32 occurrences per year**. Typical Santa Ana wind events last 1–2 days and represent 27% of the occurrences, with events lasting

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\(^{166}\) National Climatic Data Center. Storm Events Database. Retrieved 07.29.2021 from [https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Hail&eventType=%28Z%29+HighWind&eventType=%28C%29+Lightning&eventType=%28Z%29+StrongWind&eventType=%28C%29+ThunderstormWind&eventType=%28C%29+Tornado&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=LOS%2BANGELES%3A37&hailfilter=0.0&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2,CCALIFORNIA


up to 6 days accounting for 90% of all occurrences. The remaining 10% are made up almost entirely of events lasting between 7 and 12 days.\textsuperscript{169, 170}

Figure below shows the mean monthly frequency per season of Santa Ana Wind events detected from 1948 to 2012. Extreme Santa Ana wind events are shown in dark red, and are defined as those events that are above the 90th percentile of all events on record.

Figure 13-16: Mean Annual Frequency of Santa Ana Wind events (1948-2012)\textsuperscript{171, 172}


**Diablo Winds**

Diablo wind events occur approximately **2.5 events per year**. These events are most frequent during the fall and early winter seasons, with the highest frequency of events occurring in October. As a result, the highest risk of Diablo-wind-related damage is in the fall and early winter.\(^\text{173}\)

Figure below shows the monthly frequency of Diablo winds (along with average live fuel moisture content). The Diablo Wind data are derived from a 17-year climatology of San Francisco Bay Area regional surface weather stations.\(^\text{174}\)

Figure 13-17: Monthly Frequency of Diablo Winds and Average Live Fuel Moisture Content (Dashed Line)\(^\text{175}\)

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**Sundowner Winds**

Strong sundowner wind events occur approximately **2-3 times per year**. These events can create sharp temperature rises, local gale force winds, and significant weather-related problems. Rare, “explosive” types of sundowner wind events occur about 6 times per century that present dangerous weather situations, generating extremely strong and hot winds that can reach gale force or higher speeds.\(^\text{176}\)

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\(^\text{174}\) Retrieved on 07.15.2021 from [https://www.fireweather.org/diablo-winds](https://www.fireweather.org/diablo-winds)

\(^\text{175}\) Retrieved on 07.13.2021 from [https://www.fireweather.org/diablo-winds](https://www.fireweather.org/diablo-winds)

Historical Frequency of All Severe Weather Hazards

Table below shows the average historical frequency of severe weather hazard events for Los Angeles County since 1996.)

Table 13-31: Severe Weather Hazard Event

Frequencies for Los Angeles County since 1996.

<table>
<thead>
<tr>
<th>Severe Weather Hazard Category</th>
<th>Average Number of Hazard Events Per Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wind (Includes High, Strong and Thunderstorm Winds ONLY)</td>
<td>16.86</td>
</tr>
<tr>
<td>Tornado</td>
<td>0.47</td>
</tr>
<tr>
<td>Hail</td>
<td>0.71</td>
</tr>
<tr>
<td>Lightning</td>
<td>0.36</td>
</tr>
<tr>
<td>Diablo Wind*</td>
<td>2.5</td>
</tr>
<tr>
<td>Santa Ana Wind</td>
<td>32</td>
</tr>
<tr>
<td>Sundowner Wind*</td>
<td>2 to 3</td>
</tr>
</tbody>
</table>

* Note: The Diablo and Sundowner wind hazards are not present in Los Angeles County. They are included here for information purposes only.

Potential Impacts of the Hazard

The significance (or priority) of a hazard’s potential impacts is based primarily on the frequency and resulting damage caused by the hazard, including deaths/injuries and property, crop, and economic damage. All assets and people within Cal State LA campus areas are at risk from the effects of severe weather.

Wind Hazards (Including Tornadoes)

Wind hazard events have the potential to impact people, property, and operations on campuses across the CSU system. People caught in the open during an extreme wind event are exposed to high winds and debris, and could be injured or killed.

The habitability of buildings can be compromised (by damaging roofs, windows, or other weak points in the building envelope), leading to long-term operational issues for the
campus. As with most university campuses, space is always at a premium at the Cal State LA campus, and the loss of any currently utilized space due to building or structural damage would likely disrupt operations and the University’s mission.

Extreme wind events can result in power failure, which would impact the operation of the campus. Fallen tree limbs and other potential transportation hazards may also cause disruption to the surrounding community and limit ingress/egress to the campus.

According to the City of Los Angeles 2018 Local Hazard Mitigation Plan, “Adverse Weather,” which includes hazards such as high winds and tornadoes, is considered to have high impact on people, and medium impact on property. As a result, wind hazards have a moderate to high potential impact on the city and (by extension) on the Cal State LA campus.177

**Hail**

Hail typically impacts property by damaging structures, cars, and utilities as it falls. Dents in cars, broken glass, and holes in roofs are common impacts of hail. Injuries to people from hail are less common, though they can happen, as hail is a hard object falling in an unpredictable manner at a fairly high rate of speed.

The City of Los Angeles 2018 Local Hazard Mitigation Plan does not explicitly profile hail, as it is not considered to be a common adverse weather event in Los Angeles. As a result, hail hazards are considered to have a minimal potential impact on the city and (by extension) on the Cal State LA campus.178

**Lightning**

Lightning strikes the United States about 20-25 million times a year.179 Although most lightning occurs in the summer months, people can be struck at any time of year. Since 1990, lightning has killed an average of 39 people each year in the United States, and hundreds more have been injured.180 Property losses due to lightning have been very costly across the U.S. For example, from 2005 through 2020, U.S. homeowner’s insurance claim payouts for lightning losses totaled approximately $15,334,600,000, or $958,412,500 worth of payouts per year.181 (Commercial claim payouts for lightning losses for the U.S. were not available.)

The City of Los Angeles 2018 Local Hazard Mitigation Plan does not explicitly profile lightning, as it is not considered to be a common adverse weather event in Los Angeles. As a result, lightning hazards are considered to have a minimal potential impact on the city and (by extension) on the Cal State LA campus.\(^\text{182}\)

### Probability of Future Occurrence of the Hazard

Areas throughout California, including all California State University (CSU) campuses, experience severe weather events every year, and future occurrences of such events are projected to increase in both their frequency and intensity. The City of Los Angeles 2018 Local Hazard Mitigation Plan states that “adverse weather” hazards (i.e., wind and tornado) have a **high** probability of occurrence in Los Angeles.\(^\text{183}\) Also, according to the NCEI Storm Events Database, some of these same severe weather hazards (e.g., wind hazards) have occurred in surrounding County far more than once a year. Furthermore, while the severe weather hazard is a non-spatial hazard that affects all areas of the Cal State LA campus equally, the smallest geographic unit of measurement for almost all official severe weather event data is at the county level. Because the severe weather data used in this assessment do not exist at the campus level, it is assumed that the severe weather probabilities for the Cal State LA campus reflect those of the surrounding community and County identified in the Table below.

Based on the data available from both The City of Los Angeles 2018 Local Hazard Mitigation Plan and the NCEI Storm Events Database, the severe weather hazard is expected to occur on (or otherwise impact) the Cal State LA campus **at least once on an annual basis**. Therefore, the probability of future occurrence of the severe weather hazard for Cal State LA is **HIGHLY LIKELY**. See Table below for probabilities of future occurrence for component severe weather hazards for the county (including all city areas) and the campus.

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Table 13-32: Severe Weather Hazard Probabilities of Future Occurrence for Los Angeles County and Cal State LA

<table>
<thead>
<tr>
<th>Severe Weather Hazard Category</th>
<th>Average Number of Hazard Events Per Year</th>
<th>Probability of Future Occurrence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wind (Includes High, Strong and Thunderstorm Winds ONLY)</td>
<td>16.86</td>
<td>Highly Likely</td>
</tr>
<tr>
<td>Tornado</td>
<td>0.47</td>
<td>Possible</td>
</tr>
<tr>
<td>Hail</td>
<td>0.71</td>
<td>Likely</td>
</tr>
<tr>
<td>Lightning</td>
<td>0.36</td>
<td>Possible</td>
</tr>
<tr>
<td>Diablo Wind**</td>
<td>2.5</td>
<td>Not Rated</td>
</tr>
<tr>
<td>Santa Ana Wind</td>
<td>32</td>
<td>Highly Likely</td>
</tr>
<tr>
<td>Sundowner Wind**</td>
<td>2 to 3</td>
<td>Not Rated</td>
</tr>
</tbody>
</table>

Severe Weather Hazard Highly Likely

** Note: The Diablo and Sundowner wind hazards are not present in Los Angeles County, and therefore are not rated for probability of future occurrence. They are included here for information purposes only.

Vulnerability to the Hazard

People, structures, and assets on the Cal State LA campus are all vulnerable to the impacts associated with severe weather. Infrastructure can be damaged or destroyed by hail, wind, tornadoes, thunderstorms, and lightning, which can result in service interruptions and outages. Structures can be damaged or destroyed by hail, wind, tornadoes, thunderstorms, and lightning. People can be injured or killed by lightning, flying debris, hail, or extreme wind events. The Cal State LA campus also has vehicles, as well as off-campus conference and recreational facilities, that are all vulnerable to a severe weather event.

Estimate of Potential Losses

Severe weather is a non-spatial hazard that affects the entire Cal State LA campus. Each of the hazards associated with severe weather can result in losses throughout the planning area.
All structures within the Cal State LA campus are at risk from severe weather. There are approximately 115 buildings on the main campus that could be damaged by wind, hail, and/or lightning. If even a fraction of these assets were to be damaged, the resulting estimated losses would still be in the millions of dollars. The total replacement costs due to severe weather hazard are $257,007,988 for 87 of the buildings, and are unknown for the remaining 28 buildings. An analysis of projected dollar losses to campus buildings from severe weather as a percentage of building replacement costs is also not currently available, though CSU leadership may pursue such data in the future.

The population at the Cal State LA campus varies throughout the day. As of Fall, 2019, Cal State LA had 26,361 students and 2,821 faculty and staff. All are at risk from severe weather events, with 29,182 being directly vulnerable in this scenario.

Vulnerability Assessment Conclusions

Severe weather presents a variety of hazards to the Cal State LA campus. People, assets, infrastructure, and vehicles can all be damaged by this hazard, and losses can quickly begin to rise. In the aggregate, severe weather is a frequently occurring hazard (mostly in the form of wind hazard events) that presents a variety of risks to Cal State LA.

It is evident that the Cal State LA campus has vulnerabilities to and risks from severe weather hazard incidents, and that pre-event planning, communication, and mitigation efforts should be implemented. Public education and outreach regarding areas of shelter that could be used by campus populations during severe weather events is considered by campus leadership to be one viable mitigation option. The campus planning committee will continue to look for feasible and cost-effective options for the mitigation of severe weather risks going forward.

Identified Data Limitations

Numerous federal agencies maintain a variety of records regarding losses associated with hazards. Unfortunately, no single source is considered to offer a definitive accounting of all losses. The Federal Emergency Management Agency (FEMA) maintains records on federal expenditures associated with declared major disasters. The US Army Corps of Engineers (USACE) and the Natural Resources Conservation Service (NRCS) collect data on losses during the course of some of their ongoing projects and studies. Additionally, the National Oceanic and Atmospheric Administration’s (NOAA) National Centers for Environmental Information (NCEI) collects and maintains data about natural hazards in summary format, as well as occurrences, dates, injuries, deaths, and estimated costs for individual storm events. Many of these databases and other data collection

services, including the NCEI, have inherent data limitations when searching for information at a scale as small as a single campus.

The best available data and records have been used throughout this section. Where no data or records exist or could be located, that deficiency is noted.
13.4 Social Resilience Assessment

Overview

While every person is vulnerable to risk, individuals from diverse populations such as those with access and functional needs are disproportionately more vulnerable and may be at a higher risk to harm in a disaster event. In addition to physical vulnerabilities, the intersectionality between physical hazard risks and population social vulnerabilities must be considered to holistically address overall campus risk.

As inclusivity is a high priority for CSU, addressing campus risk and resilience must be done through the lens of inclusion and equity. Addressing social vulnerability is an increasingly critical requirement of state and national doctrines and described in Section 4.4 of the HVRA Base Plan. Every individual of the campus’s richly diverse population group needs to have the capacity, skills, and knowledge in order to understand, access, and participate in risk reduction and disaster response in ways that are meaningful to their own unique situation. In a campus community, having strong social support networks and active involvement in community disaster responses may negatively or positively impact these opportunities and reduce the resilience-building process. This section offers a glimpse into the Cal State LA campus’s unique social construct, population demographics, strengths and concerns and presents a high-level assessment of the resilience, coping capacities and potential social vulnerabilities of students, staff and faculty. The research variables that were asked are often considered sensitive subjects, and few are traditionally included in emergency management/hazard mitigation planning.

This social resilience assessment of college campuses is the first of its kind in the nation. The research methodology unfolded as the interviews with campuses progressed. The assessment data presented are not definitive or authoritative. The answers, analysis, and suggested trends are strictly indicators for potential social risk. They do not represent an accurate data capture as limitations on the data gathering process influenced an ability to provide accuracy. This assessment provides indications of increased risk, not accuracy of response or a true reflection of the situation of the campus. The information presented is to be considered in the context of the more detailed system-wide CSU social vulnerability assessment that is included in the baseline HVRA.

Campus-Identified Populations of Concern

During the campus interview, the following responses were provided when asked, “In considering the diverse population group(s) amongst student body, faculty and staff, which are of the most concern in your emergency management planning?”
Table 13-33: High level summary of campus populations of concern

<table>
<thead>
<tr>
<th>Question</th>
<th>Campus Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>Which population groups amongst the student body, faculty, and staff, are of the most concern for physical and social vulnerabilities in emergency management planning?</td>
<td>Students with disabilities</td>
</tr>
<tr>
<td></td>
<td>Students and employees who speak English as a second language</td>
</tr>
<tr>
<td>Which population groups are most difficult to reach in an event?</td>
<td>Students without computers and/or internet access</td>
</tr>
<tr>
<td>Which population groups have little/limited support networks if impacted by an event?</td>
<td>International students</td>
</tr>
<tr>
<td></td>
<td>Students in university housing</td>
</tr>
<tr>
<td></td>
<td>First generation students</td>
</tr>
<tr>
<td></td>
<td>Commuter students</td>
</tr>
</tbody>
</table>
Resilience Variables Related to Campus Emergency Management

The interviewees were asked to reflect on a set of 12 variables for the campus populations of student, faculty and staff: homelessness (*housing insecurity*), food security, health and wellness, disability/access and functional needs (AFN), racial equity, digital equity, communications, international students, immigrants/immigration status issues (*undocumented, DACA, etc.*), LGBTQI (Lesbian Gay Bisexual Transgender Questioning (or queer) Intersex), and transportation dependency. They were also offered an opportunity to add any other factor they wanted to include. The following two questions were asked:

- Is this factor a particular issue of concern for emergency management on your campus? Responses were summarized as **Very High, High, Medium, Low**
- Is this factor reflected in the emergency plans and processes for your campus? Responses were summarized as **Yes, No, In Progress, NA**

In order to provide a high-level qualitative response for the answers, the approach of averaging response was taken. If conflicting answers were expressed by the interviewees, the answer (code) was averaged out. A detailed explanation of the response averaging approach is included in the base HVRA.
Table 13-34: Campus-specific emergency management issues of concern and inclusion in emergency management plans and processes.

<table>
<thead>
<tr>
<th>Issue of Concern</th>
<th>Plans &amp; Processes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Homelessness (Housing Insecurity)</td>
<td>Low</td>
</tr>
<tr>
<td>Food Security</td>
<td>Low</td>
</tr>
<tr>
<td>Health &amp; Wellness</td>
<td>Low</td>
</tr>
<tr>
<td>AFN</td>
<td>Very High</td>
</tr>
<tr>
<td>Racial Equity</td>
<td>Low</td>
</tr>
<tr>
<td>Digital Equity</td>
<td>Very High</td>
</tr>
<tr>
<td>Comms.</td>
<td>Low</td>
</tr>
<tr>
<td>International Students</td>
<td>Low</td>
</tr>
<tr>
<td>Immigrants / Immigration Status</td>
<td>Low</td>
</tr>
<tr>
<td>LGBTQI</td>
<td>Low</td>
</tr>
<tr>
<td>Transportation Dependency</td>
<td>High</td>
</tr>
</tbody>
</table>

Qualitative Narrative: Campus Overview of Potential Resilience Vulnerabilities

The following are interview notes of interest:

- In some important areas there were disagreement in answers. Table X answers are response averaged on these questions.
- Interviewee expressed robust interest in whether these issues need to be included in the emergency management planning processes and plans.
- DAFN is an issue of concern: Reflected in plans and they meet monthly on the press advisory committee, 14 on all different dept./ send out to all the building administrators so when emergency the floor monitors will look for the one person and the stairwell evac point
- The only issue for racial equity is campus protests and demonstrations of what is going one. It is an issue because of the large Latino population. Any inference of inequity and students engaged on social media will videotape and post. It is not reflected in plans but if needs to more robust they will incorporate it.
- Focused on corrective measures for Immigrants/immigration status issues (undocumented, DACA, etc.) Taking care of people when they don’t understand because of language barriers, it is an education piece, and recognized that students from other country sometimes “don’t react well.”
- Transportation dependency is an issue of concern because it is a heavily commuter campus with Metro Link adjacent to the campus. All rely on public transportation and are given incentives. It is a problem when public transport is down or when risk is involved, such as in COVID.

Campus High Hazards and Potentially Vulnerable Populations

This section provides a brief introduction to the link between socially vulnerable populations and a particular hazard type. While extensive research has been conducted on the impacts of hazards, not all linkages have been documented or published, and detail for finding them are beyond the scope of this assessment. It’s important to note, the intersectional nature of what makes an individual’s personal experience and resilience to an event is played out by unique factors for that individual or population. The nuanced social vulnerabilities often come from the social and physical environment in which a person is embedded.

In order to aid in further assessing campus resilience, below is a general description of the known impacts. From some hazards, the descriptions are robust, while others are only brief introductions.

Table 13-35: Cal State LA *Highly Likely, Likely and Possible* Hazards

<table>
<thead>
<tr>
<th>Hazard</th>
<th>Future Occurrence Probability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Communicable Disease</td>
<td>Highly Likely</td>
</tr>
<tr>
<td>Drought</td>
<td>Highly Likely</td>
</tr>
<tr>
<td>Earthquake</td>
<td>Possible</td>
</tr>
<tr>
<td>Erosion</td>
<td>Likely</td>
</tr>
<tr>
<td>Extreme Temperature</td>
<td>Possible (Heat Only)</td>
</tr>
<tr>
<td>Flood</td>
<td>Possible</td>
</tr>
<tr>
<td>Hazardous Materials</td>
<td>Possible</td>
</tr>
<tr>
<td>Power Outage</td>
<td>Likely</td>
</tr>
<tr>
<td>Sea Level Rise</td>
<td>Highly Likely</td>
</tr>
<tr>
<td>Tsunami</td>
<td>Likely</td>
</tr>
<tr>
<td>Wildfire</td>
<td>Unlikely (Fire); Possible (Smoke)</td>
</tr>
</tbody>
</table>
**Drought**

The 2012-2016 drought had severe effects on two vulnerable sectors of our population: those in low-income brackets, and those, especially Native Americans, who rely on subsistence fishing for their livelihoods. Water bills increased throughout the state. Due to rising water prices, for the working poor, many have paid four to five percent of their income for water. Since many CSU students are commuters, and many living with families, future drought impacts may potentially affect a percentage of non-resident students. NASA’s modeling shows that future droughts are likely to last longer and be more intense, even leading to “megadroughts” in the western states. Fresh water supplies are predicted to be full of extremes, with both droughts and extreme precipitation events being more severe. The interrelationship between drought and other hazard conditions may lead to a set of secondary impacts. Drought conditions lead to water quality issues due to loss of drinking water, increased fire danger that leads to drought-induced fires and elevated AQI levels, as well as extreme heat or prolonged heat events.

**Earthquake**

Impacts on populations from earthquakes are complex, with long-term implications on social stability for all populations. In addition to the physical impact exposure during a no-notice earthquake event and the social and logistical challenges of a recovering community, an earthquake can have lasting impacts long afterwards due to post traumatic stress disorder (PTSD).

Socioeconomic vulnerabilities of populations at risk were analyzed in the hypothetical yet scientifically realistic earthquake sequence that is being used to better understand hazards for the San Francisco Bay region during and after a magnitude-7 earthquake (mainshock) on the Hayward Fault and its aftershocks. In this study, the at-risk populations located in areas of concentrated damage are anticipated to experience longer recovery trajectories, increased long term housing displacement, and transportation impacts due to dependencies on transit dependencies. When neighborhood schools close, families with school age children may move to other areas to keep their children in schools. Persons with access and functions needs are likely to be more dependent on access to functioning medical, social and personal health care services that would be overwhelmed by the event and therefore increasing their vulnerabilities. For the homeless populations, the loss of social community services and damages to shelters could add to protracted relocations. For the young and mobile populations who rent, the major disruption to housing, jobs and transit will also drive relocation. Widespread housing damage and preexisting housing market constraints will make it “extremely

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challenging” for the socially and economically vulnerable populations to find alternative housing near their home communities. Those who utilize interim and irregular housing for months and years after a disaster are more vulnerable to physical, social, and mental disorders, including suicide, substance abuse, and physical and verbal abuse. Aftershocks and post disaster conditions delay population return and increase outmigration.  

**Erosion**

Risk from erosion relates to earthen and infrastructural losses. The degree of vulnerability to these events and their impacts depends on human behavior and the traditional social factors such as situational awareness, prior knowledge of hazards, social capital and decision-making capabilities, as well as increased vulnerability due to social factors, such as racial and economic disparities.

**Extreme Temps**

People susceptible to respiratory ailments (asthma, lower and upper respiratory disease) disproportionately suffer from the effects of fire, smoke, air pollutions, allergens, heat and PSPS. Those with limited income or without resources are affected disproportionately due to the inability to provide safe shelter, air conditioning, cooling, air purification, medical care, and quality foods, and are also least able to obtain information related to climate risks and adaptation strategies.

**Heat**

Heatstroke, cardiovascular disease, respiratory disease and cerebrovascular disease are related to extreme heat events. Increased number of heat waves creates heat-related physical stress on populations and is exacerbated in the metropolitan areas where greater amounts of heat-absorbing surfaces (e.g., asphalt and concrete) trap heat and emit higher temperatures throughout the night.

The heat also extends the geographic range and the distribution of disease-carrying insects and pests. Health professionals are concerned that California’s warming climate will allow species to acclimate. Such vectors include such pests as ticks that carry Lyme disease, and mosquitos that transmit Zika, dengue fever, West Nile, plague and tularemia. Some others, such as chikungunya, Chagas disease, and Rift Valley fever virus, are threats as well.

Some communities of color and some low-income, homeless, and immigrant populations are more exposed to heat waves, as these groups often reside in urban areas affected by heat island effects. In addition, these populations are likely to have limited adaptive capacity due to a lack of adequately insulated housing, inability to afford or to use air conditioning, inadequate access to public shelters such as cooling centers, and

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inadequate access to both routine and emergency health care. These social, economic, and health risk factors give rise to the observed increase in deaths and disease from extreme heat in some immigrant and impoverished communities.

Heat stroke, the most serious heat-related illness, occurs when the body is unable to control its temperature. Body temperature rises rapidly, the sweating mechanism fails, and the body cannot cool down. In extreme causes, heat stroke can cause confusion and unconsciousness, so the victim is unable to seek treatment without assistance.

There are several groups of people who are uniquely vulnerable to the effects of extreme heat, such as infants and children, older adults aged 65 and up, athletes and outdoor workers, low-income households, and individuals with certain chronic medical conditions.

When dealing with an extreme heat event, the most common impacts are those generally felt by the people living in the targeted area. For people in particular, heat can kill when the body is pushed beyond its limits. Most heat disorders occur because the victim has been overexposed to heat. As discussed, the major human risks associated with extreme heat include dehydration, sunburn, fatigue, heat exhaustion, heat stroke, and in severe cases, death.

Some portions of the population are more at risk to the effects of extreme heat. The very young, the elderly, and certain groups with chronic medical conditions (such as asthma or other pulmonary illnesses, heart disease, poor blood circulation, neurological illnesses, and obesity) are generally more vulnerable to the effects of extreme heat, and are more likely to suffer illness or death as a result.

This is especially true if exposure is extended for a period of time and preventative measures are not taken immediately. Distributional implications of impacts, and even less on distributional implications of adaptation actions.”

Flood

Risk from floods relates to community risk, exposure and infrastructural losses. The degree of vulnerability to these events and their impacts depends on human behavior and the traditional social factors such as situational awareness, prior knowledge of hazards, social capital and decision-making capabilities. The exposure of humans to floods continues to increase, driven by changes in hydrology and land use. The adverse impacts on socially vulnerable populations are amplified because a disproportionately high number live in flood-prone areas. Research has shown that places of social vulnerabilities are places characterized by housing and racial disparities, such as mobile home parks, structural fragility and poverty, and higher percentages of populations such

as Black and Native Americans, and others with shared histories of discrimination, marginalization and exclusion. ¹⁹⁰

Health impacts from flooding are well recognized due to the extensive history of flooding in California and around the nation. The impacts range from waterborne illnesses from contaminated waters, respiratory illnesses that impact the lungs, throat, and airways from airborne particles, mold on flooded buildings that can trigger asthma, allergies and other illnesses—all which are particularly impactful to older, younger and individuals with pre-existing health condition. Foodborne illnesses can increase if there are issues with power outages or sewer overflows. Individuals with increased mental health concerns can be impacted by the stress or anxiety from the impacts of the flood. Poor quality housing can increase vulnerability to many flood risks, including flood inundation, power outages, mold growth, rodent vectors, and serious health impacts. For those with limited finances, flood inundation and impacts to infrastructure or farmlands may lead to extensive income losses.

The poorest residents suffer disproportionately to flood situations, especially those who have been less able to fund homeowner’s insurance to protect against flood losses. Loss of life is not unusual in flooding situations, as is loss of property, livestock, pets, workplaces, and tourist industries. There is a strong interrelationship between water events and other hazards. Flooding, storms and water quality are related to each other. Drought conditions can exacerbate floods as the surface soils are hardened and not as ready to allow surface water absorption. Extreme heat events can cause snowmelt, inundating waterways and causing flood and water quality issues. Flooding and storm events can have impacts on public health, environmental health, agricultural heath and economic system health. Mental health issues are reported for all people who have experience flood losses, including anxiety, fear, anger, sadness and grief. ¹⁹¹ Additionally, waterborne disease outbreaks are reported weeks after the flood events. Mold contamination leads to indoor air issues. Damp indoor environments lead to increased prevalence of asthma, and also upper and lower respiratory symptoms. These issues may influence the diverse CSU populations, both on and off campus, in a number of ways long after a flood event, or the related hazards impacts, has concluded.

Hazardous Materials

The severity of a hazardous materials release depends upon the type of material released, the amount of the release, and the proximity to populations or environmentally sensitive areas such as wetlands or waterways. The release of materials can lead to injuries or


evacuation of nearby residents. Wind direction at the time of the release can also have a bearing on the severity (as well as the location and extent) of a hazardous materials release.

The primary threat from the hazardous materials incident hazard is to the structures located along transmission lines and transportation routes or near facilities that use or store hazardous materials. Minor incidents would likely cause no damage and little disruption, assuming they could be contained quickly. Major incidents could have fatal and disastrous consequences. The severity of a hazardous material release relates primarily to its impact on human safety and welfare and on the threat to the environment. Threats to human safety and welfare include:

- Poisoning of water or food sources and/or supply
- Presence of toxic fumes or explosive conditions
- Damage to personal property
- Need for the evacuation of people
- Interference with public or commercial transportation

Environmental risks are not uniformly distributed across groups of people. Age, poverty, and minority status place some groups at a disproportionately high risk for environmental disease. Poor access to health information and health care means less health promotion, less risk avoidance, a less healthy diet, and more adverse conditions that increase susceptibility to exposure. Delayed recognition of exposure, diagnosis, and treatment allows effects to accumulate.

**Power Outage/Public Safety Power Shutdowns (PSPS)**

Loss of power creates economic hardship to a region experiencing regular PSPS events, such as those experienced throughout the state over the recent years. Many businesses close, including gas stations, grocery stores, and local retail establishments. These impacts may deeply impact students dependent on support jobs, as well impacting family members of campus staff and faculty. PSPS increases risks to the public due to inability to use medical devices, spoilage of food and medicines, and disruption to infrastructure, such as supply of clean water and electricity used to run home medical equipment, such as lift chairs and ventilators.

**Wildfire**

Increased wildfire threat occurs especially in the end of fall, when conditions are driest, but before the winter rains have come; an east-to-west wind gusts exacerbate fire risk. Wildfire threats have the concomitant threat of Public Safety Power Shutoffs (PSPS). And,

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192 [https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3222496/](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3222496/)

in the case of an actual wildfire, danger exists both from fire and from the smoke. Recent wildfires have demonstrated that some demographics are disproportionately affected. Native Americans are six times more likely to be affected than white people. Blacks and Hispanic people are 50 percent more vulnerable. These values take into account the likelihood of a community being affected and the greater difficulty of that community to recover. These statistics reflect the lack of access to resources to pay for insurance, to rebuild and recover, to implement fire safety measures, and to access other resources. Price gouging after a fire (such as documented in Sonoma County after the 2017 Tubbs Fire) further exacerbates the disparity. Furthermore, the disabled and the elderly are at particular risk from extreme wildfire conditions, as they are often not as able to effectively evacuate. Of the 85 people who died in the Camp Fire in Butte in 2018, 62 of them were at least 65 years old.

Smoke from wildfires creates a significant public health threat. Especially vulnerable are individuals who have heart or lung issues, such heart disease, lung disease or asthma. Those most vulnerable include the medically fragile, elderly and children. Air Quality Indexes track the level of the following: particulate matter, surface levels of ozone, carbon monoxide, sulfur dioxide, and nitrogen dioxide. All of these can cause respiratory distress and harm lungs.

The California Department of Public Health reports the increased public health risks, and risk indicators that include: heat-related ED visits, populations living in wildfire areas, adults with multiple chronic conditions, populations living in poverty, race/ethnicity, outdoor workers, public transit access, air conditioner ownership and tree canopy.

Hazard Mitigation and Emergency Management Planning

The goal of this high-level assessment is to provide a starting point to encourage further exploring campus social risks and vulnerabilities, as well as to inform and to enhance holistic emergency management and hazard mitigation decision making, planning

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processes and future adaptive risk management strategies. By including the social resilience factors, mitigation investments may move beyond standardized planning and regulations, structure and infrastructure projects, and natural systems protections to embrace a more expanded, customized emergency operations plan and an education and outreach program unique to the campus.

A more robust social resilience inquiry is strongly encouraged to develop an accurate picture, based on methodical and scientific research-based data. Such an effort would be envisioned through both nuanced discussions with a variety of campus stakeholders and the invitation of nontraditional stakeholders to join in a collaborative resilience partnership. Such a forward-leaning effort would be directly in keeping with CSU’s commitment to inclusion and equity in risk reduction.
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14.1 University Profile

University History

Cal Maritime was established as the California Nautical School in 1929 when the California State Assembly Bill no. 253 was signed into law by Governor C. C. Young. The bill authorized the creation of the school, appointment of a Board of Governors to manage the school and the acquisition of a training vessel. The school’s mission was "to give practical and theoretical instruction in navigation, seamanship, steam engines, gas engines, and electricity in order to prepare young men to serve as officers in the American Merchant Marine." By 1930, a training vessel and a school site in the San Francisco Bay Area city of California City (now Tiburon) had been acquired.

Due to the Great Depression, the early days of the Academy were full of financial uncertainty. As early as 1933, some state legislators were calling for the school's abolition. In order to save money, the cadets and instructors alike lived and held classes aboard the training vessel, the "T.S. California State". Only after the passage of the Merchant Marine Act of 1936 did the funding for the Academy become stabilized.

In 1939 the California Nautical School adopted its present name, the California Maritime Academy. By 1940 the Academy was granting Bachelor of Science degrees and Naval Reserve commissions to its graduates; this step marked the beginning of the transition from the status of trade school to college. During World War II, the Academy was evicted from its site in California City (Tiburon) and moved to its present location in Vallejo, California in 1943.

In the 1970s, after surviving another round of budget cuts and calls for the Academy's abolition, Cal Maritime became a four-year institution. The 1970s also marked the time when the first minority and female cadets graduated from Cal Maritime.

In 1996, Cal Maritime became the twenty-second campus of the California State University system. The new affiliation improved the academy's funding prospects considerably. As of Fall 2019, Cal Maritime was serving 911 students.

Today, Cal Maritime continues its mission of providing rigorous nautical training to cadets. The current training vessel for cadets is the "T.S. Golden Bear", and is the third training ship to carry that name.

Cal Maritime is the only degree-granting maritime academy on the West Coast of the U.S., and one of only seven in the nation. The school is designated as a Native American Pacific Islander-Serving Institution (AANAPISI).

University Governance

The campus president is the chief executive officer who oversees the administration of the entire university. The president manages campus operations and fundraising, sets campus priorities, and oversees the hiring and support of staff and faculty. The president also maintains a close working relationship with the CSU’s systemwide
office, reporting to the chancellor and participating in the system-wide Executive Council.

The provost is the chief academic officer of the university, overseeing all academic affairs and programs of the university. The provost is responsible for the academic integrity of the campus, the academic departments, faculty development, academic policy development and implementation, the assessment and accreditation of academic programs, the library, and student support programs, including admissions, continuing education, enrollment management, and financial aid. The Provost’s Council, with representation from these various areas, serves as the advisory body to the provost.

Additionally, all shipboard and waterfront training, and professional development of Academy cadets is managed by the Office of Marine Programs. This Office is headed by the Director of Marine Programs & Commanding Officer of Training Ship *Golden Bear*.

**University Mission**

The California State University Maritime Academy's mission is to:

 Provide each student with a college education combining intellectual learning, applied technology, leadership development, and global awareness.

 Provide the highest quality licensed officers and other personnel for the merchant marine and national maritime industries.

 Provide continuing education opportunities for those in the transportation and related industries.

 Be an information and technology resource center for the transportation and related industries.

 Cal Maritime’s uses the four (4) points of the compass to meet the university’s mission statement. The four elements are intellectual learning, applied technology, leadership development and global awareness; the latter requires all Cal Maritime students to spend time abroad as part of their education.

**University Location**

Cal Maritime is located in Vallejo, CA (population 121,722). The 92-acre waterfront campus is situated on the edge of San Francisco Bay, approximately 30 miles from San Francisco. Cal Maritime is one of only seven campuses granting maritime degrees in the U.S., and is the only maritime academy located on the West Coast.

**University Population**

In the Fall of 2019, Cal Maritime enrolled 911 students. Approximately 45.4% of the student population was White, followed by 22.4% Latinx students, 12.7% Asian American, Native American, and Pacific Islander students (combined), and 3.0% Black students. Additionally, 329 faculty and staff were employed by Cal Maritime.
14.2 Interim Final Rule for Hazard Vulnerability and Risk Assessment

Requirement §201.6(c)(2): The plan shall include a risk assessment that provides the factual basis for activities proposed in the strategy to reduce losses from identified hazards. Local risk assessments must provide sufficient information to enable the jurisdiction to identify and prioritize appropriate mitigation actions to reduce losses from identified hazards.

Requirement §201.6(c)(2)(i): [The risk assessment shall include a] description of the type...location and extent of all natural hazards that can affect the jurisdiction. The plan shall include information on previous occurrences of hazard events and on the probability of future hazard events.

Requirement §201.6(c)(2)(ii): [The risk assessment shall include a] description of the jurisdiction’s vulnerability to the hazards described in paragraph (c)(2)(i) of this section. This description shall include an overall summary of each hazard and its impact on the community.

Requirement §201.6(c)(2)(ii): [The risk assessment] must also address National Flood Insurance Program (NFIP) insured structures that have been repetitively damaged floods.

Requirement §201.6(c)(2)(ii)(A): The plan should describe vulnerability in terms of the types and numbers of existing and future buildings, infrastructure, and critical facilities located in the identified hazard area.

Requirement §201.6(c)(2)(ii)(B): [The plan should describe vulnerability in terms of an] estimate of the potential dollar losses to vulnerable structures identified in paragraph (c)(2)(ii)(A) of this section and a description of the methodology used to prepare the estimate..

Requirement §201.6(c)(2)(ii)(C): [The plan should describe vulnerability in terms of] providing a general description of land uses and development trends within the community so that mitigation options can be considered in future land use decisions.

Requirement §201.6(c)(2)(iii): For multi-jurisdictional plans, the risk assessment must assess each jurisdiction’s risks where they vary from the risks facing the entire planning area.

14.3 Hazard Identification and Risk Assessment

Overview of Cal Maritime Academy History of Hazards

Numerous federal agencies maintain a variety of records regarding losses associated with hazards. Unfortunately, no single source is considered to offer a definitive accounting of all losses. The Federal Emergency Management Agency (FEMA)
maintains records on federal expenditures associated with declared major disasters. The US Army Corps of Engineers (USACE) and the Natural Resources Conservation Service (NRCS) collect data on losses during the course of some of their ongoing projects and studies. Additionally, the National Oceanic and Atmospheric Administration’s (NOAA) National Centers for Environmental Information (NCEI) database collects and maintains data about natural hazards in summary format. The data includes occurrences, dates, injuries, deaths, and estimated costs. Many of these databases and other data collection services, including the NCEI, have inherent data limitations when searching for information at a university scale.

The best available data and records were used throughout this assessment.

**Hazard Identification**

As part of the initial hazard identification process, the Campus Assessment Team considered potential hazards with the most chance to significantly affect the planning area. The hazards include those that have occurred in the past and may occur in the future. A variety of sources were used to develop the list of hazards considered including national, regional, and local sources such as emergency operations plans, FEMA’s *How-To Series*, websites, published documents, databases, and maps, as well as discussion among the Campus Assessment Team members.

In the initial phase of the planning process, the Campus Assessment Team considered 14 hazards and the risks they create for the University and its material assets, population, and operations. The hazards initially considered, and the determinations as to the treatment of those hazards, are shown in Table 14-1 (following).

Table 14-1: Hazard Identification Determinations

<table>
<thead>
<tr>
<th>Hazard</th>
<th>Determination (Yes/No)</th>
<th>Reason for Determination</th>
<th>Future Occurrence Probability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Communicable Disease</td>
<td>Yes</td>
<td>Hazard of concern for campus</td>
<td>Highly Likely</td>
</tr>
<tr>
<td>Dam and Levee Failure</td>
<td>Yes</td>
<td>Hazard of concern for campus</td>
<td>Unlikely</td>
</tr>
<tr>
<td>Drought</td>
<td>Yes</td>
<td>Hazard of concern for campus</td>
<td>Highly Likely</td>
</tr>
<tr>
<td>Earthquake</td>
<td>Yes</td>
<td>Hazard of concern for campus</td>
<td>Possible</td>
</tr>
<tr>
<td>Erosion</td>
<td>Yes</td>
<td>Hazard of concern for campus</td>
<td>Likely</td>
</tr>
<tr>
<td>Extreme Temperature</td>
<td>No</td>
<td>Not a hazard of concern for campus</td>
<td>N/A</td>
</tr>
<tr>
<td>Flood</td>
<td>Yes</td>
<td>Hazard of concern for campus</td>
<td>Unlikely</td>
</tr>
<tr>
<td>Hazardous Materials</td>
<td>Yes</td>
<td>Hazard of concern for campus</td>
<td>Unlikely</td>
</tr>
<tr>
<td>---------------------</td>
<td>-----</td>
<td>------------------------------</td>
<td>---------</td>
</tr>
<tr>
<td>Landslide</td>
<td>Yes</td>
<td>Hazard of concern for campus</td>
<td>Possible</td>
</tr>
<tr>
<td>Power Outage</td>
<td>Yes</td>
<td>Hazard of concern for campus</td>
<td>Likely</td>
</tr>
<tr>
<td>Sea Level Rise</td>
<td>No</td>
<td>Not a hazard of concern for campus</td>
<td>N/A</td>
</tr>
<tr>
<td>Tsunami</td>
<td>Yes</td>
<td>Hazard of concern for campus</td>
<td>Likely</td>
</tr>
<tr>
<td>Volcano</td>
<td>Yes</td>
<td>Hazard of concern for campus</td>
<td>Unlikely</td>
</tr>
<tr>
<td>Wildfire</td>
<td>Yes</td>
<td>Hazard of concern for campus</td>
<td>Possible (Fire); Possible (Smoke)</td>
</tr>
</tbody>
</table>

**Future Occurrence Probability**

In order to determine the probability of future occurrences of each hazard profiled, the following scale was developed:

- **Highly Likely**- 76%-100% that the hazard would occur annually.
- **Likely**- 50%-75% that the hazard would occur annually.
- **Possible**- 11%-49% that the hazard would occur each annually.
- **Unlikely**- 0%-10% that the hazard would occur each annually.
Communicable Disease

Description of the Hazard

Communicable diseases are illnesses that occur due to infectious agents or their toxic products and are infectious due to their potential of transmission from one person or species to another by a replicating agent. They may be transmitted from a reservoir to a susceptible host either directly as from an infected person or animal or indirectly through the agency of an intermediate plant or animal host, vector, or the inanimate environment. Communicable diseases are clinically evident illness resulting from the presence of pathogenic microbial agents, including pathogenic viruses, pathogenic bacteria, fungi, protozoa, multi-cellular parasites, and aberrant proteins known as prions. The degree of spread of a communicable disease depends on both the ability of an organism to enter, survive and multiply in the host and the comparative ease with which the disease is transmitted to other hosts.

Some ways in which communicable diseases spread are by:

- Travel through the air, such as tuberculosis, measles, or COVID-19;
- Physical contact with an infected person, such as through touch (staphylococcus), sexual intercourse (gonorrhea, HIV), fecal/oral transmission (hepatitis A), or droplets (influenza, TB, COVID-19);
- Contact with a contaminated surface or object (Norwalk virus), food (salmonella, E. coli), blood (HIV, hepatitis B), or water (cholera); and
- Bites from insects or animals capable of transmitting the disease (mosquito: malaria and yellow fever; flea: plague)

Collectively, the twenty-three (23) campuses and Chancellor’s Office of the California State University (CSU) system have identified nine (9) communicable disease hazards that that have had significant impacts on their respective student, faculty, and staff populations. Of these communicable diseases, COVID-19 is considered to be the most prominent and widespread agent across all CSU campuses. (See Table 14-2 below.)

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Table 14-2: Communicable Diseases at Identified CSU Campuses

<table>
<thead>
<tr>
<th>Collective List of Communicable Diseases Identified by All CSU Campuses</th>
<th>Number of CSU Campuses (Including Chancellor’s Office) Identifying Communicable Disease Having Significant Impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>COVID-19 (SARS-CoV-2)</td>
<td>24</td>
</tr>
<tr>
<td>Meningitis</td>
<td>7</td>
</tr>
<tr>
<td>Measles</td>
<td>6</td>
</tr>
<tr>
<td>Influenza (Including H1N1/ Swine Flu)</td>
<td>6</td>
</tr>
<tr>
<td>Tuberculosis</td>
<td>5</td>
</tr>
<tr>
<td>Norovirus</td>
<td>4</td>
</tr>
<tr>
<td>Mumps</td>
<td>2</td>
</tr>
<tr>
<td>E. Coli</td>
<td>2</td>
</tr>
<tr>
<td>Sexually Transmitted Diseases (STDs)</td>
<td>2</td>
</tr>
</tbody>
</table>

(Source: Interviews with CSU campus staff at CSU campuses and at CSU Chancellor’s Office.)

With the exception of COVID-19, there is variability among CSU campuses regarding which communicable diseases have had the greatest impact on individual campus communities. Table 14-3 shows the communicable disease hazards that have had the greatest impact on each CSU campus.

Table 14-3: Communicable Disease Hazards at CSU Campuses with Greatest Impact.

<table>
<thead>
<tr>
<th>CSU Campus</th>
<th>Identified Communicable Disease Hazards with the Greatest Impact on CSU Campus</th>
</tr>
</thead>
<tbody>
<tr>
<td>CSU Bakersfield</td>
<td>COVID-19, Meningitis</td>
</tr>
<tr>
<td>CSU Channel Islands</td>
<td>COVID-19, Measles</td>
</tr>
<tr>
<td>Chico State</td>
<td>COVID-19, Tuberculosis</td>
</tr>
<tr>
<td>CSU Dominguez Hills</td>
<td>COVID-19</td>
</tr>
<tr>
<td>Cal State East Bay</td>
<td>COVID-19, Meningitis</td>
</tr>
<tr>
<td>Fresno State</td>
<td>COVID-19, Meningitis, Tuberculosis</td>
</tr>
<tr>
<td>Cal State Fullerton</td>
<td>COVID-19, Influenza</td>
</tr>
<tr>
<td>Humboldt State</td>
<td>COVID-19, Measles, Norovirus, Influenza, STDs</td>
</tr>
<tr>
<td>Cal State Long Beach</td>
<td>COVID-19</td>
</tr>
<tr>
<td>Institution</td>
<td>Disease(s)</td>
</tr>
<tr>
<td>--------------------------------------</td>
<td>------------------------------------------------</td>
</tr>
<tr>
<td>Cal State LA</td>
<td>COVID-19, E. coli, Measles</td>
</tr>
<tr>
<td>Cal Maritime</td>
<td>COVID-19</td>
</tr>
<tr>
<td>CSU Monterey Bay</td>
<td>COVID-19</td>
</tr>
<tr>
<td>CSUN (Northridge)</td>
<td>COVID-19, Measles</td>
</tr>
<tr>
<td>Cal Poly Pomona</td>
<td>COVID-19, Influenza (Swine Flu - H1N1)</td>
</tr>
<tr>
<td>Sacramento State</td>
<td>COVID-19</td>
</tr>
<tr>
<td>Cal State San Bernardino</td>
<td>COVID-19, Tuberculosis</td>
</tr>
<tr>
<td>San Diego State</td>
<td>COVID-19, Meningitis, Mumps</td>
</tr>
<tr>
<td>San Francisco State</td>
<td>COVID-19</td>
</tr>
<tr>
<td>San José State</td>
<td>COVID-19, H1N1</td>
</tr>
<tr>
<td>Cal Poly San Luis Obispo</td>
<td>COVID-19, Meningitis, Norovirus</td>
</tr>
<tr>
<td>CSU San Marcos</td>
<td>COVID-19</td>
</tr>
<tr>
<td>Sonoma State</td>
<td>COVID-19, H1N1, Norovirus</td>
</tr>
<tr>
<td>Stanislaus State</td>
<td>COVID-19, Tuberculosis</td>
</tr>
<tr>
<td>Office of the Chancellor</td>
<td>COVID-19</td>
</tr>
<tr>
<td>CSU System-Wide</td>
<td>COVID-19, Meningitis, Measles, Tuberculosis, Influenza-Swine Flu-H1N1, Mumps, Norovirus, E. coli, STDs</td>
</tr>
</tbody>
</table>

(Source: Interviews with CSU campus staff at CSU campuses and at CSU Chancellor’s Office.)

**Descriptions of Identified Communicable Disease Hazards at Cal Maritime**

Cal Maritime has not provided information on communicable disease hazards that have had the greatest impact on its campus. However, it has provided COVID-19-oriented resources, guidance, and health and safety training to its cadets and employees, and has instituted protocols to protect those on campus from contracting COVID-19. Because of this robust response, it is assumed that Cal Maritime considers COVID-19 to be a communicable disease hazard.

The following is a brief description of the assumed communicable disease hazard (i.e., COVID-19) for Cal Maritime.

**COVID-19 (SARS-CoV-2)**

Coronaviruses are a family of viruses that can cause illnesses such as the common cold, severe acute respiratory syndrome (SARS) and Middle East respiratory syndrome (MERS). In 2019, a new coronavirus was identified as the cause of a disease outbreak that originated in China. This virus is now known as the **severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2)**. The disease it causes is called
Coronavirus Disease 2019 (COVID-19). In March 2020, the World Health Organization (WHO) declared the COVID-19 outbreak a pandemic.

Signs and symptoms of coronavirus disease 2019 (i.e., COVID-19) may appear two to 14 days after exposure. Common signs and symptoms can include fever, cough, and tiredness. Early symptoms of COVID-19 may also include a loss of taste or smell.

The virus that causes COVID-19 spreads easily among people, and more continues to be discovered over time about how it spreads. Data has shown that the COVID-19 virus spreads mainly from person to person among those in close contact (within about 6 feet, or 2 meters). The virus is transmitted by respiratory droplets being released when someone with the virus coughs, sneezes, breathes, sings or talks. These droplets can be inhaled or land in the mouth, nose or eyes of a person nearby. In some situations, the COVID-19 virus can spread by a person being exposed to small droplets or aerosols that stay in the air for several minutes or hours (i.e., airborne transmission). It's not yet known how common it is for the virus to spread this way.

The COVID-19 virus can also spread if a person touches a surface or object with the virus on it and then touches his or her mouth, nose or eyes; however, this is not considered to be a main way it spreads.

The severity of COVID-19 symptoms can range from very mild to severe. Some people may have only a few symptoms, and some people may have no symptoms at all. However, some people may experience worsened symptoms, such as worsened shortness of breath and pneumonia. People who are older have a higher risk of serious illness from COVID-19, and the risk increases with age. People who have existing medical conditions also may have a higher risk of serious illness from COVID-19. In some cases, the disease can cause severe medical complications and may even lead to death.\(^5\)

Location of the Hazard

Communicable diseases have the potential to affect the entire Cal Maritime planning area equally. As a result, the communicable disease hazard can be found at the Cal Maritime Academy campus located in Vallejo, CA (Solano County). Because of the ubiquitous nature of many communicable diseases, students, faculty, staff at (and visitors to) the Cal Maritime land-based campus are at risk of exposure to the communicable disease hazard.\(^6\)

The communicable disease hazard can also be found on the T.S. Golden Bear, a training ship that serves as the primary training platform for Cal Maritime Cadets. Each summer, cadets in their first and third years depart with licensed faculty officers for the two-month Training Cruise.\(^7\) If there is any breach in communicable disease

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\(^6\) California State University. *About CSU.* Retrieved 4.29.2021 from: https://www2.calstate.edu/csuintempl/about-the-csu

prevention protocols, the close quarters training ship environment could initiate, accelerate, and/or exacerbate any communicable disease hazard events.

CSU Student Housing Locations and Populations

Although CSU-campus-owned student housing opportunities have been severely limited due to the COVID-19 pandemic, this situation is temporary. Eventually, students will be allowed back on campus at full capacity, and many of these students will be living in campus-owned housing. When this occurs, over 53,000 students (i.e., just over 11% of the CSU total enrollment) will be at increased risk of exposure to communicable disease hazards, owing to the “close-quarters” living arrangements in student housing. For Cal Maritime, approximately 85% of its 911 enrolled students (or 744 students) reside in student housing. 8,9

Extent of the Hazard

Various communicable diseases are categorized by the Center for Disease Control and Prevention (CDC) by levels of containment called Biosafety Levels (or BSLs). The higher the BSL, the greater the level of containment and level of effort necessary to prevent transmission of the disease, and therefore the greater the hazard. Biosafety Levels prescribe procedures and levels of containment for a particular microorganism or material (including research involving recombinant or synthetic nucleic acid molecules) and procedures associated with that containment. BSLs also consider primary barriers (e.g., biosafety cabinets), secondary barriers, facility design, air handling, laboratory security, etc. BSLs are graded from 1 to 4; as the BSL increases so does the relative risk of the agent/procedures as well the stringency of procedures and facility design.

Figure 14-1 describes the different BSLs, and provides examples of communicable diseases that would typically fall in to these classifications, as well as the typical protections that would be necessary to prevent transmission of each of the diseases.

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The Extent of Cal Maritime Communicable Disease Hazards Except COVID-19:

There was no information provided on communicable disease hazards on campus.

The Extent of Cal Maritime COVID-19 Communicable Disease Hazard:

As a microorganism, the SARS-CoV-2 (COVID-19) virus requires a high level of containment. It is therefore classified at BSL-3.  

History of the Hazard

Over an approximately one-year period, from mid-March, 2020 to March 23, 2021, there were a reported 10 cases of COVID-19 at Cal Maritime. Each CSU campus is an integral part of the surrounding community. Any event that occurs on a CSU campus has an effect on both the adjacent areas of campus and on the community-at-large – and vice-versa. Communicable disease hazard events are no exception. Most communicable disease data are maintained by at the state and at the county levels, and are not generally available at the municipal or campus levels, unless (a) the CSU campus falls under the jurisdiction of a city-level health department, or (b) a geographically specific outbreak occurs on campus or in the local community. The exception to this is the current COVID-19 pandemic, where both campus and County-level case data have been collected. As a result, it is important to provide COVID-19 case statistics for both CSU campuses and the counties where CSU campus assets are located.

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Tables 14-5 and 14-6 show campus- and County-level COVID-19 Case data for Cal Maritime. These case data are updated on at least a weekly basis. (Please note that the COVID-19 case numbers here may not reflect the most recent updates.)

Table 14-4: Confirmed COVID-19 Case data for Cal Maritime (as of 03/18/2021)\textsuperscript{12}

<table>
<thead>
<tr>
<th>Statistic</th>
<th>Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cases</td>
<td>10</td>
</tr>
</tbody>
</table>

(Note: Case count includes external results submitted to Cal Maritime.)

Table 14-5: Confirmed COVID-19 Statistics for Solano County, CA (as of 03/22/2021)\textsuperscript{13}

<table>
<thead>
<tr>
<th>Classification</th>
<th>Statistic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cases</td>
<td>30,745</td>
</tr>
<tr>
<td>Deaths</td>
<td>181</td>
</tr>
</tbody>
</table>

Potential Impacts of the Hazard

Communicable disease outbreaks and pandemics have (and will continue to have) direct impact on life, health, and safety across the CSU system (including the Cal Maritime campus). The extent of this impact is contingent on the type of infection or contagion, the severity of the outbreak, and the speed at which it is transmitted. Property and infrastructure integrity may be affected if large portions of the campus population contract communicable diseases at the same time and are therefore unable to perform maintenance, operations, and educational tasks. This would be particularly disruptive if those impacted are first responders or other essential personnel. Long-term outbreaks affecting large numbers of Cal Maritime students could result in cancelled classes, delayed matriculation, or other disruptions to the CSU System’s mission. This has already occurred with the current COVID-19 pandemic, and could occur again with more virulent strains of communicable diseases, including COVID-19.

Communicable disease hazards found across the CSU system (including Cal Maritime) vary both by level of containment (BSL) (described previously) and by level of individual/public health risk, or Risk Group (RG) level. While BSLs describe the procedures and required levels of containment in a laboratory setting, Risk Groups (RGs) reflect the potential effects of disease exposure on humans or animals. Like BSLs, RGs range from Level 1 (RG1) to Level 4 (RG4), with Level 1 (RG1) posing minimal risk to healthy individuals and public health and Level 4 (RG4) posing a very serious or extreme risks to individuals and public. BSLs generally correlate with Risk


Group (RG) Levels (e.g., a RG2 agent is worked with at BSL-2), but there are exceptions (e.g., production volumes, high-risk procedures, etc.). ¹⁴

The World Health Organization’s (WHO) Laboratory Biosafety Manual, 3rd ed., NIH Guidelines, categorizes Risk Groups (RGs) in the following way:

Table 14-6: WHO Risk Group Categorization¹⁵

<table>
<thead>
<tr>
<th>Risk Group (RG)</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>RG1</td>
<td>Rarely associated with disease in healthy adult humans or animals and pose no-to-little public health risk (e.g., Saccharomyces cerevisiae, E. coli K-12 strain derivatives often used for recombinant/molecular biology, many environmental organisms)</td>
</tr>
<tr>
<td>RG2</td>
<td>Associated with mild to moderate disease for which preventative measures or post exposure treatments are often available; public health impact is limited (e.g., Streptococcus pyogenes, Salmonella, hepatitis B virus)</td>
</tr>
<tr>
<td>RG3</td>
<td>Associated with serious to lethal human disease for which preventative vaccines or post-exposure therapies may be scarce. Public health impact is limited-to-moderate (e.g., Mycobacterium tuberculosis, hantaviruses, West Nile virus, SARS)</td>
</tr>
<tr>
<td>RG4</td>
<td>Associated with serious to lethal human disease for which preventative vaccines or post exposure therapies are not usually available. Public health impact is high (e.g., Ebola virus, Marburg virus, smallpox virus, etc.)</td>
</tr>
</tbody>
</table>

Table 14-8 describes the four (4) Risk Group Levels (RGs), and provides examples of communicable diseases that would typically fall into these classifications, and the typical protections that would be necessary to prevent transmission of the disease. It is important to note that all but two (2) communicable disease hazards identified by CSU campuses fall under either the lower-risk RG1 or RG2 categories. COVID-19 and tuberculosis are the two (2) communicable diseases fall under the higher-risk RG3 category. However, with the advent of the recently-developed COVID-19 vaccine, and with the expectation of an increasingly robust vaccine supply, it is possible that the RG level for COVID-19 could be lowered in the future, thereby reducing both the extent and the potential impact of COVID-19.


Table 14-7: Risk Group Levels (RGs) with Example Diseases and Recommended Precautions

<table>
<thead>
<tr>
<th>Level</th>
<th>Examples</th>
<th>Typical Protection to Prevent Transmission</th>
</tr>
</thead>
<tbody>
<tr>
<td>RG I</td>
<td>E. Coli</td>
<td>Precautions are minimal, most likely involving gloves and some sort of facial protection. Usually, contaminated materials are left in open (but separately indicated) waste receptacles. Decontamination procedures for this level are similar in most respects to modern precautions against everyday viruses (i.e.: washing one's hands with anti-bacterial soap, washing all exposed surfaces of the lab with disinfectants, etc.).</td>
</tr>
</tbody>
</table>
| RG 2  | Chicken Pox
Hepatitis A, B, C
Lyme disease
Salmonella
Mumps
Measles
Malaria
Scrapie
Dengue Fever
HIV | These bacteria and viruses cause mild disease in humans or are difficult to contract via aerosol. Routine diagnostic work with clinical specimens can be done safely at BSL-2, using BSL-2 practices and procedures. |
### RG 3

<table>
<thead>
<tr>
<th>Anthrax</th>
<th>West Nile Virus</th>
<th>SARS Virus (Including COVID-19)</th>
<th>Tuberculosis</th>
<th>Typhus</th>
<th>Yellow Fever</th>
<th>Hantaviruses</th>
<th>Avian Flu</th>
</tr>
</thead>
</table>

These bacteria and viruses cause severe to fatal disease in human, but vaccines or other treatments do exist to combat them. Laboratory personnel have specific training in handling pathogenic and potentially lethal agents and are supervised by competent scientists who are experienced in working with these agents. This is considered a neutral or warm zone.

### RG 4

<table>
<thead>
<tr>
<th>H5N1 (Bird Flu)</th>
<th>Dengue Hemorrhagic Fever</th>
<th>Marburg Virus</th>
<th>Ebola Virus</th>
<th>Smallpox</th>
<th>Lassa Fever</th>
<th>Crimean-Congo Hemorrhagic Fever</th>
<th>Other Hemorrhagic Diseases</th>
</tr>
</thead>
</table>

These viruses and bacteria cause severe to fatal disease in humans, for which vaccines or other treatments are *not* available. When dealing with biological hazards at this level the use of a Hazmat suit and a self-contained oxygen supply is mandatory. The entrance and exit of a BSL-4 lab will contain multiple showers, a vacuum room, an ultraviolet light room, autonomous detection system, and other safety precautions designed to destroy all traces of the biohazard. Multiple airlocks are employed and are electronically secured to prevent both doors opening at the same time. All air and water service going to and coming from a BSL-4 lab will undergo similar decontamination procedures to eliminate the possibility of an accidental release.

### Probability of Future Occurrence of the Hazard

There have been cases of a variety of communicable disease throughout the CSU system, including COVID-19 (SARS-CoV-2), Meningitis, Measles, Influenza (Including H1N1/Swine Flu), Tuberculosis, Norovirus, Mumps, E. Coli, and Sexually Transmitted Diseases (STDs). However, there are significant data limitations regarding non-COVID-19 communicable disease cases, as the information thereof is outdated, anecdotal, and/or inadequate. As a result, it is not feasible to provide quantitative probabilities of future occurrence for non-COVID-19 communicable disease hazards. However, based on the limited data, it is feasible to present qualitative probabilities of future occurrence based on ranges of communicable disease frequency.
Table 14-9: shows a probability scale of future occurrence for the nine (9) communicable disease hazards profiled in this assessment. This scale is divided into four (4) levels of probability:

Table 14-8: Likelihood of Future Hazard Occurrence

<table>
<thead>
<tr>
<th>Likelihood</th>
<th>Parameters for Determining Likelihood</th>
</tr>
</thead>
<tbody>
<tr>
<td>Highly Likely</td>
<td>76 – 100% probability that hazard will occur annually (high to very high frequency)</td>
</tr>
<tr>
<td>Likely</td>
<td>50 – 75% probability that hazard will occur annually (moderate to high frequency)</td>
</tr>
<tr>
<td>Possible</td>
<td>11 – 49% probability that hazard will occur annually (low to moderate frequency)</td>
</tr>
<tr>
<td>Unlikely</td>
<td>0 – 10% probability that hazard will occur annually (very low to low frequency)</td>
</tr>
</tbody>
</table>

Due to significant data limitations surrounding non-COVID communicable diseases, the probability of future occurrence of CSU-system-wide communicable disease is measured by the proportion of campuses that have identified a particular communicable disease as having an impact on the campus community. In this measure, the more frequent a communicable disease is seen as impactful CSU-wide, the greater the probability of future occurrence. Note: Each communicable disease’s system-wide probability ranking reflects the ranking at the individual CSU campus level unless noted otherwise.

Table 14-9: Probability of Future Occurrence of Communicable Disease Hazard for CSU System
<table>
<thead>
<tr>
<th>Disease</th>
<th>Cases</th>
<th>Probability</th>
<th>Vulnerability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tuberculosis</td>
<td>5</td>
<td>0.21</td>
<td>Possible</td>
</tr>
<tr>
<td>Norovirus</td>
<td>4</td>
<td>0.17</td>
<td>Possible</td>
</tr>
<tr>
<td>Mumps</td>
<td>2</td>
<td>0.08</td>
<td>Unlikely</td>
</tr>
<tr>
<td>E. Coli</td>
<td>2</td>
<td>0.08</td>
<td>Unlikely</td>
</tr>
<tr>
<td>Sexually Transmitted Diseases (STDs)</td>
<td>2</td>
<td>0.08</td>
<td>Unlikely</td>
</tr>
</tbody>
</table>

(Source: Interviews with staff at CSU campuses and at the CSU Chancellor’s Office.)

Vulnerability to the Hazard

Vulnerability to a communicable disease hazard resides in the population of a given area – both human and animal – not in the infrastructure or physical assets. While CSU assets and infrastructure could be impacted indirectly by the communicable disease hazard, these impacts would be secondary to the impact that the communicable disease hazard would have on students, faculty, staff, and visitors at CSU campuses.

CSU campus settings are geographically diverse, with locations ranging from small towns to medium-sized cities to densely populated urban areas. Hundreds of thousands of people work, study, and/or pass through CSU campuses on any given day. (As of Fall 2019, the CSU System had 480,541 students and 53,763 faculty and staff.) Each of these persons is vulnerable to communicable disease, particularly if it is a pathogen that individual has not been immunized against, or for which no immunization exists. Prolonged outbreaks could result in a loss of services, failure of infrastructure (from lack of operators or maintenance), and closure of facilities. This exact scenario has played out in the current COVID-19 pandemic at Cal Maritime. 17,18

Estimate of Potential Losses

COVID-19 Pandemic Health Impact on CSU Campuses and Surrounding Communities

The most prescient metric for estimating losses from COVID-19 is loss of life. The nationwide campus-related COVID-19 death rate of 0.02% remains well below the average COVID-19 death rate in the U.S. However, due to data limitations, there is no information on CSU-campus-specific deaths by COVID-19 or by any other communicable diseases. In fact, COVID-19 is the only communicable disease for which case reports have been readily available for CSU campuses.

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17 The California State University. Enrollment. Retrieved 05.03.2021 from: https://www2.calstate.edu/csusystem/about-the-csu/facts-about-the-csu/enrollment/Pages/default.aspx  
18 The California State University. Employee Head Count by Campus. Retrieved 05.03.2021 from: https://www2.calstate.edu/csusystem/faculty-staff/employee-profile/csu-workforce/Pages/employee-headcount-by-campus.aspx
At some point in the future, CSU campuses will return to full capacity. Without adequate surveillance regarding campus access and student and employee interaction, CSU campuses (including Cal Maritime) are at risk of developing an extreme incidence of COVID-19, and may become “super-spreaders” for adjacent communities. The emergence of more virulent COVID-19 variants would only add to the potential for high negative impacts on life safety, operations, and service delivery across the CSU system. (Other communicable diseases would also re-emerge, but with low to moderate negative impacts on life safety, operations, and service delivery.)

Economic Impact of COVID-19 Pandemic on CSU Financial Health

During the first few months of the COVID-19 pandemic in 2020, the CSU system suffered tremendous negative fiscal impacts. From March through July of 2020 alone, over $146 million worth of revenue losses were sustained across the CSU system due to refunds to students for parking, housing and dining service fees during Spring Semester, 2020. Figure 14-2 below for the economic impact to the SJSU campus. Several CSU campuses saw refund losses surpass $10 million. (See 14-2.)

Figure 14-2: CSU COVID-19 Cost Tracking Showing Revenue Refund Losses and Increased Costs

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Mitigative Relief from Federal Assistance

The $1.5 billion in total federal assistance sent to the CSU system will help relieve the losses of revenues from services like dorms, parking and dining services during a year of mainly empty campuses. (See Table 14-11) However, because of staggering COVID-related revenue losses, the CSU system is planning for three (3) years of fiscal duress.

Table 14-10: Total Federal Assistance to CSU for COVID-19 Related Losses, 2020 – 2021\textsuperscript{21,22,23}

<table>
<thead>
<tr>
<th>Institution</th>
<th>December 2020 Stimulus</th>
<th>CARES Act</th>
<th>ARP Act Total Funding Allocation</th>
<th>Total Estimated Federal COVID Relief Funding</th>
</tr>
</thead>
<tbody>
<tr>
<td>California Polytechnic State University</td>
<td>$20,752,799</td>
<td>$14,725,000</td>
<td>$37,000,928</td>
<td>$72,478,727</td>
</tr>
<tr>
<td>California State Polytechnic University, Pomona</td>
<td>$48,614,353</td>
<td>$31,102,000</td>
<td>$86,044,649</td>
<td>$165,761,002</td>
</tr>
<tr>
<td>California State University Channel Islands</td>
<td>$14,288,099</td>
<td>$8,512,000</td>
<td>$24,915,170</td>
<td>$47,715,269</td>
</tr>
<tr>
<td>California State University Maritime Academy</td>
<td>$1,381,700</td>
<td>$1,204,000</td>
<td>$2,472,622</td>
<td>$5,058,322</td>
</tr>
<tr>
<td>California State University - Sacramento</td>
<td>$59,891,260</td>
<td>$35,643,000</td>
<td>$104,900,133</td>
<td>$200,434,393</td>
</tr>
<tr>
<td>California State University, Bakersfield</td>
<td>$22,855,632</td>
<td>$12,483,000</td>
<td>$40,285,565</td>
<td>$75,624,197</td>
</tr>
<tr>
<td>California State University, Chico</td>
<td>$31,603,856</td>
<td>$20,019,000</td>
<td>$55,754,538</td>
<td>$107,377,394</td>
</tr>
</tbody>
</table>


<table>
<thead>
<tr>
<th>Institution</th>
<th>Tuition</th>
<th>Grant Aid</th>
<th>Research</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>California State University, Dominguez Hills</td>
<td>$31,843,563</td>
<td>$18,312,000</td>
<td>$55,915,410</td>
<td>$106,070,973</td>
</tr>
<tr>
<td>California State University, East Bay</td>
<td>$24,243,652</td>
<td>$14,394,000</td>
<td>$42,929,208</td>
<td>$81,566,860</td>
</tr>
<tr>
<td>California State University, Fresno</td>
<td>$52,725,317</td>
<td>$32,557,000</td>
<td>$92,926,594</td>
<td>$178,208,911</td>
</tr>
<tr>
<td>California State University, Fullerton</td>
<td>$67,736,949</td>
<td>$41,088,000</td>
<td>$120,859,884</td>
<td>$229,684,833</td>
</tr>
<tr>
<td>California State University, Long Beach</td>
<td>$67,421,424</td>
<td>$41,202,000</td>
<td>$119,508,329</td>
<td>$228,131,753</td>
</tr>
<tr>
<td>California State University, Los Angeles</td>
<td>$61,905,561</td>
<td>$40,067,000</td>
<td>$108,543,672</td>
<td>$210,516,233</td>
</tr>
<tr>
<td>California State University, Monterey Bay</td>
<td>$13,455,716</td>
<td>$8,705,000</td>
<td>$23,922,768</td>
<td>$46,083,484</td>
</tr>
<tr>
<td>California State University, Northridge</td>
<td>$74,004,088</td>
<td>$47,458,000</td>
<td>$131,021,450</td>
<td>$252,483,538</td>
</tr>
<tr>
<td>California State University, San Bernardino</td>
<td>$42,438,131</td>
<td>$27,924,000</td>
<td>$74,982,459</td>
<td>$145,344,590</td>
</tr>
<tr>
<td>California State University, San Marcos</td>
<td>$26,602,684</td>
<td>$15,542,000</td>
<td>$46,496,808</td>
<td>$88,641,492</td>
</tr>
<tr>
<td>California State University, Stanislaus</td>
<td>$22,007,207</td>
<td>$12,928,000</td>
<td>$38,636,391</td>
<td>$73,571,598</td>
</tr>
<tr>
<td>Humboldt State University</td>
<td>$16,130,016</td>
<td>$11,146,000</td>
<td>$28,831,619</td>
<td>$56,107,635</td>
</tr>
<tr>
<td>San Diego State University</td>
<td>$45,914,127</td>
<td>$30,394,000</td>
<td>$80,592,385</td>
<td>$156,900,512</td>
</tr>
<tr>
<td>San Francisco State University</td>
<td>$47,404,409</td>
<td>$30,000,000</td>
<td>$83,075,470</td>
<td>$160,479,879</td>
</tr>
<tr>
<td>San Jose State University</td>
<td>$46,631,939</td>
<td>$30,977,000</td>
<td>$82,976,130</td>
<td>$160,585,069</td>
</tr>
</tbody>
</table>
Vulnerability Assessment Conclusions

Before the COVID-19 pandemic, populations at all CSU campuses and CSU-affiliated facilities were substantial. Collectively, as of Fall 2019, CSU campuses had 480,541 students and 53,763 faculty and staff. All were at risk from the communicable disease events, with 534,304 people being directly vulnerable. The COVID-19 pandemic has caused campus population numbers to plummet to a small fraction of full capacity.

At some point in the future, campus population numbers will return to their pre-pandemic levels, and students, faculty, and staff will again be vulnerable to the communicable disease hazard. If just 10% of the total CSU population were to become ill with a highly infective communicable disease like influenza or another strain of SARS, this would mean that approximately 53,430 people would be sick at the same time. This scenario would likely overwhelm available on-campus medical services could even overwhelm portions of the larger community’s medical resources – especially if there were large numbers of infected people with immune system compromises or other underlying health problems. Table 14-12 shows the “10% outbreak scenario” projections both for each CSU campus and for the entire CSU system.

Table 13-11: Scenario of Communicable Disease Hazard Affecting 10% of the CSU Population

<table>
<thead>
<tr>
<th>CSU Campus</th>
<th>Approximate Enrollment Population (Fall 2019)</th>
<th>Approximate Total FT/PT Faculty/Staff Population (Fall 2019)</th>
<th>Total Combined Approximate Student and Faculty/Staff Population</th>
<th>10% Outbreak Scenario (Students and Faculty/Staff Combined)</th>
</tr>
</thead>
<tbody>
<tr>
<td>CSU Bakersfield</td>
<td>11,199</td>
<td>1,277</td>
<td>12,476</td>
<td>1,248</td>
</tr>
<tr>
<td>CSU Channel Islands</td>
<td>7,093</td>
<td>994</td>
<td>8,087</td>
<td>809</td>
</tr>
<tr>
<td>Chico State</td>
<td>17,019</td>
<td>1,969</td>
<td>18,988</td>
<td>1,899</td>
</tr>
<tr>
<td>CSU Dominguez Hills</td>
<td>17,027</td>
<td>1,761</td>
<td>18,788</td>
<td>1,879</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Institution</th>
<th>Total Enrollment</th>
<th>International</th>
<th>Total Undergraduate</th>
<th>Total Graduate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cal State East Bay</td>
<td>14,705</td>
<td>1,764</td>
<td>16,469</td>
<td>1,647</td>
</tr>
<tr>
<td>Fresno State</td>
<td>24,139</td>
<td>2,534</td>
<td>26,673</td>
<td>2,667</td>
</tr>
<tr>
<td>Cal State Fullerton</td>
<td>39,868</td>
<td>3,736</td>
<td>43,604</td>
<td>4,360</td>
</tr>
<tr>
<td>Humboldt State</td>
<td>6,983</td>
<td>1,171</td>
<td>8,154</td>
<td>815</td>
</tr>
<tr>
<td>Cal State Long Beach</td>
<td>38,074</td>
<td>4,004</td>
<td>42,078</td>
<td>4,208</td>
</tr>
<tr>
<td>Cal State LA</td>
<td>26,361</td>
<td>2,821</td>
<td>29,182</td>
<td>2,918</td>
</tr>
<tr>
<td>Cal Maritime</td>
<td>911</td>
<td>329</td>
<td>1,240</td>
<td>124</td>
</tr>
<tr>
<td>CSU Monterey Bay</td>
<td>7,123</td>
<td>1,059</td>
<td>8,182</td>
<td>818</td>
</tr>
<tr>
<td>CSUN (Northridge)</td>
<td>38,391</td>
<td>3,832</td>
<td>42,223</td>
<td>4,222</td>
</tr>
<tr>
<td>Cal Poly Pomona</td>
<td>27,914</td>
<td>2,650</td>
<td>30,564</td>
<td>3,056</td>
</tr>
<tr>
<td>Sacramento State</td>
<td>31,156</td>
<td>3,228</td>
<td>34,384</td>
<td>3,438</td>
</tr>
<tr>
<td>Cal State San Bernardino</td>
<td>20,311</td>
<td>2,118</td>
<td>22,429</td>
<td>2,243</td>
</tr>
<tr>
<td>San Diego State</td>
<td>35,081</td>
<td>3,702</td>
<td>38,783</td>
<td>3,878</td>
</tr>
<tr>
<td>San Francisco State</td>
<td>28,880</td>
<td>3,401</td>
<td>32,281</td>
<td>3,228</td>
</tr>
<tr>
<td>San José State</td>
<td>33,282</td>
<td>3,568</td>
<td>36,850</td>
<td>3,685</td>
</tr>
<tr>
<td>Cal Poly San Luis Obispo</td>
<td>21,242</td>
<td>2,871</td>
<td>24,113</td>
<td>2,411</td>
</tr>
<tr>
<td>CSU San Marcos</td>
<td>14,519</td>
<td>1,687</td>
<td>16,206</td>
<td>1,621</td>
</tr>
<tr>
<td>Sonoma State</td>
<td>8,649</td>
<td>1,338</td>
<td>9,987</td>
<td>999</td>
</tr>
<tr>
<td>Stanislaus State</td>
<td>10,614</td>
<td>1,276</td>
<td>11,890</td>
<td>1,189</td>
</tr>
<tr>
<td>Office of the Chancellor</td>
<td>0</td>
<td>673</td>
<td>673</td>
<td>67</td>
</tr>
<tr>
<td><strong>CSU System-Wide</strong></td>
<td><strong>480,541</strong></td>
<td><strong>53,763</strong></td>
<td><strong>534,304</strong></td>
<td><strong>53,430</strong></td>
</tr>
</tbody>
</table>

*Note: Enrollment figures do not include non-specific CSU campus International Programs (455 students) or CALStateTEACH Program (933 students).*

While the case numbers of COVID-19 have been significantly lower (about 1% of the total CSU population) than those in the 10% scenario, the degree of virulence and resultant morbidity and mortality caused by COVID-19 have led to widespread campus shutdowns, educational disruption, and economic harm to the CSU system. In short, the real-time COVID-19 communicable disease outbreak scenario has proven far more devastating than the 10% simulated scenario.
Identified Data Limitations

There is a wealth of technical information available for communicable disease. However, there is also limited non-COVID-19 communicable disease data available regarding risk or vulnerability of specific populations throughout the CSU. Much of the data that does exist is protected by privacy policies, and therefore cannot be obtained for more specific populations. As a result, performing a detailed quantitative assessment for this hazard is difficult.

Data that could be collected prior to the next update in order to improve this methodology includes:

- Data regarding infection rates at the campus level and for specific populations;
- Data regarding communicable disease case numbers and outcomes, by CSU campus;
- Data regarding projected population changes;
- Data regarding absenteeism; and
- Data regarding increased operating costs as a result of absenteeism (i.e., temporary shifting of duties resulting in business interruption).


*Dam and Levee Failure*

**Description of the Hazard**

A dam failure represents the structural collapse of a dam that stores water in a reservoir behind the dam. These failures are typically the result of structural age, damage to the structure caused by earthquake or flooding, inadequate discharge or spillway capacity, inadequate maintenance, improper construction materials, or extreme inflow of water into the reservoir. Prolonged precipitation may result in overtopping of the dam resulting in structural compromise. The tremendous energy generated by a sudden breach of the dam will have significant downstream effects. Flood damage resulting from dam failures potentially will result in economic losses, environmental damage, destruction of agriculture, and human casualties. This type of incident is extremely dangerous as it can occur rapidly, with no warning resulting in an inability to effectively evacuate threatened communities.

A levee failure is similar to dam failures, as the result will be a breach causing flooding on the dry side of the levee. Levees are embankments whose primary purpose is to furnish flood protection from seasonal high water or divert the flow of water. Most levees in California are intended to withstand peak water levels generated by heavy precipitation or rapid snowmelt in a watershed. Other levees are designed to withstand fluctuating water levels on a continuous basis such as those in the California Delta exposed to tidal influences. Levees routinely extend for lengthy distances immediately protecting communities. Levees can be found throughout the state but are most prominent in the Sacramento and San Joaquin Valleys.

Levee failures can vary from overtopping to small uncontrolled discharge to catastrophic failure. Areas downstream of the failure will be subject to inundation dependent on the volume of water released. These levee failures are also typically the result of structural age, damage to the structure caused by earthquake or flooding, slumping, seepage underneath the levee, high velocity flows eroding the levee, inadequate capacity, inadequate maintenance, improper construction materials, or extreme inflow of water into the system. Flood damage resulting from levee failures potentially will result in economic losses, environmental damage, destruction of agriculture, and human casualties.

Dam or levee failure flooding will vary depending on a number of factors including the extent of the collapse or breach, the volume of water behind the structure, and the nature of the exposed downstream features. This unpredictable flooding presents a threat to life and property in addition to critical infrastructure. Lifelines and supply routes will likely be damaged or made impassible by flood erosion or standing water. Water quality and health concerns would likely be cascading effects of dam or levee failures.
Location of the Hazard

The closest dam facility in proximity to Cal Maritime is the Swanzy Reservoir dam. This facility is an earthen dam that has a capacity of holding 107af of water. The dam sits in a valley ½ mile northeast of the campus. The height of the dam is higher in elevation than the campus but discharges its water to the northwest away from the campus. The access route into the campus (Maritime Academy Drive and Sonoma Blvd.) and the campus Aquatic Center are located within the dam inundation zone. There are no other dam facilities that are in proximity to the campus.

There are other Solano County dams that may have indirect effects to the Cal Maritime campus. The Lake Chabot Dam is 4 miles to the north of the campus affecting State Route 37 and north Vallejo neighborhoods. The Summit Dam and Reservoir is 5 miles north of the campus also affecting State Route 37 and north Vallejo neighborhoods. The Lake Herman Dam is 4 miles to the east of the campus and affects Interstate 680. A failure of these dams would likely cause significant disruptions across multiple transportation routes in Vallejo and Benicia.

There are no levees in the proximity of the Cal Maritime campus.
Figure 14-3: Dams and Levees Located Near CSU Maritime

Extent of the Hazard

Dams are classified according to the hazard that they pose to life and property in the event of failure, rather than the likelihood of that failure.

- **High hazard potential dams** may result in loss of human life, and will likely result in economic, environmental, or lifeline losses.
- **Significant hazard potential dams** are not expected to result in loss of life, but are expected to cause economic, environmental, and lifeline losses.
- **Low hazard potential dams** are not expected to result in loss of life, and there is a low expectation of economic, environmental, or lifeline losses. What losses do occur are generally limited to the dam owner.

Dams classified as high hazard are required to have Emergency Action Plans (EAP). EAPS are formal documents that identify potential emergency conditions at the dam and specify preplanned actions to be followed in case of failure. An EAP is required for all high hazard dams and is recommended for all significant hazard dams.
Table 14-12: Solano County Dams in Proximity to Cal Maritime

<table>
<thead>
<tr>
<th>River</th>
<th>Dam</th>
<th>Storage</th>
<th>Hazard Severity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blue Rock Springs</td>
<td>Lake Chabot</td>
<td>504af</td>
<td>High Hazard</td>
</tr>
<tr>
<td>Sulphur Springs</td>
<td>Lake Herman</td>
<td>2,210af</td>
<td>High Hazard</td>
</tr>
<tr>
<td>Off Stream</td>
<td>Summit</td>
<td>220af</td>
<td>High Hazard</td>
</tr>
<tr>
<td>Carquinez</td>
<td>Swanzy</td>
<td>107af</td>
<td>High Hazard</td>
</tr>
</tbody>
</table>

The Swanzy river dam discharges its water to the northwest away from the campus. It has the smallest capacity of all dams in the area. However, the access route into the campus (Maritime Academy Drive and Sonoma Blvd.) and the campus Aquatic Center are located within the dam inundation zone. Members of the campus community who reside or are employed in this area would be most impacted, while the campus would primarily experience interruptions to transportation routes. Based on these factors, and the fact that the dam undergoes regulated monitoring, maintenance and inspections, the planning committee ranks the extent of the hazard as Low to Moderate.

Extent – Levee Failure

There are no levees in proximity to the Cal Maritime campus. Therefore, the campus is outside of any levee protected zone. Based on these factors, the planning committee ranks the extent of the hazard as Low.

History of the Hazard

There are no records of dam or levee failures in areas that present a threat to the Cal Maritime campus. Solano County has no record of dam failures.

Table 14-13: Solano County Dam Failures

<table>
<thead>
<tr>
<th>Date</th>
<th>Dam</th>
<th>Release</th>
<th>Damage</th>
</tr>
</thead>
<tbody>
<tr>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
</tr>
</tbody>
</table>

Potential Impacts of the Hazard

Dam Failure Impacts - Water that is released due to a dam that has failed generates tremendous energy and force causing a flood that will be catastrophic to life and property. Water levels from the failed dam could be significantly higher than those experienced in worst case scenario flood events. Areas closer to the failed dam will be more likely to experience complete devastation while other areas within the inundation zone will see varying levels of flood waters. The extent of the impacts of a failed dam would vary based on a number of factors such as the volume of water released, the base flow of the river, the time of the failure, the amount of warning...
provided, and the distance from the dam. Impacts resulting from a dam failure include:

- Loss of life
- Property destruction or damage
- Loss of property contents
- Infrastructure damage
- Flooded or destroyed lifelines/supply routes
- Damaged or destroyed utilities
- Loss of community economic base
- Employment losses
- Agricultural (crops and livestock) damages or destruction
- Environmental damage
- Floods generating threats to public health
- Flood generated debris

**Levee Failure Impacts**

A levee failure may result in substantial amounts of water to enter into developed areas protected by the levee. The force and volume of water that is generated by a levee failure may cause extensive structural damage in close proximity to the breach and effects of flooding spreading well beyond the point of the failure. The extent of the impacts would vary based on a number of factors such as the volume of water released, the time of the failure, the amount of warning provided, the location of the breach, elevation, and distance from the breach. Potential impacts resulting from a levee failure include:

- Loss of life
- Property destruction or damage
- Loss of property contents
- Infrastructure damage
- Public health hazards resulting from mold, mildew, and disease due to flood water
- Flooded or destroyed lifelines/supply routes
- Damaged or destroyed utilities
- Loss of community economic base
- Employment losses
- Agricultural (crops and livestock) damages or destruction
- Environmental damage
- Prolonged periods of necessary dewatering
- Disruptions to education delivery to community

**Probability of Future Occurrence of the Hazard**

Solano County remains at risk from dam and levee failure. The facility most likely to impact Cal Maritime campus operations is the Swanzy Reservoir Dam. The facility is located ½ mile northeast of the campus. However, the location of the majority of the
Cal Maritime campus is located outside of identified dam inundation zone. There are no identified levees in proximity to the campus and thus the campus is outside of any levee protected zone. There are no official recurrence intervals that have been calculated for dam or levee failures. Based on no historical occurrences, and regulated dam maintenance and inspection protocols, the likelihood of this hazard is low, and the probability of future occurrence for both dam and levee failures is Unlikely.

**Vulnerability to the Hazard**

Given high priority monitoring and maintenance practices in place, a catastrophic dam or levee failure is highly unlikely. In addition, the campus does not lie within an inundation zone with the exception of the Aquatic Center and campus access routes. As such, the campus is not considered to be truly vulnerable on a daily basis. However, in the unlikely event of a catastrophic failure of the Suanzy dam, the effects of flooding on campus would most likely be limited to indirect or secondary effects in terms of disruption to regional transportation networks and services, and the amount of time to respond to the needs of the campus community prior to inundation will be limited.

Any breach along a levee is impossible to predict where a failure may occur. It is likely that response action will not be fully implemented until the incident situational intelligence provides adequate information as to compromised locations. These variables place all those working and living within the dam inundation and flood protection zones in vulnerable locations in the event of a low probability, catastrophic event.

Vulnerability to a dam or levee failure on the Cal Maritime campus will vary depending on the degree of breach or structural failure and when the failure were to occur. The risk to the campus population will be lessened during periods when classes are not in session or during periods of breaks. Conversely, during the days and hours that classes are in session and staff are at their workplaces, the human vulnerability increases. However, in region-wide events this vulnerability may be shared with the homes and workplaces of members of the campus community and their families.

Certain campus populations will experience greater challenges to a post-flood / failure environment. Vulnerable populations will likely need to navigate through flood generated debris, face extreme health safety issues from flood waters, experience extreme stresses of a disaster, an inability to communicate to or gain access to support networks, and find difficulty in accessing equipment or supplies to aid in a specific need.

**Estimate of Potential Losses**

Estimates of potential losses will be influenced by a variety of factors. The volume and force of the water will determine the scale of damages affecting campus
infrastructure, equipment, and other impacted features. The proximity to the failure and elevation above flood waters will affect the level of damage and individuals exposed. The time of the academic year, the day of week, and hour in which the failure was to occur will influence the number of people on campus and potential casualties. Losses will be generated by the physical damages, the loss of revenue, loss of academic research, loss of building contents, and community wide economic reductions.

Based on estimate replacement costs of facilities and structures on campus, the total replacement costs are $83,596,545. This estimate is not inclusive of the entire campus as 31 campus facilities were included with cost estimates. However, it is unlikely for a dam or levee failure event to cause catastrophic destruction at Cal Maritime.

Vulnerability Assessment Conclusions

While the occurrence of dam and levee failures have not been historically relevant near the Cal Maritime campus, the potential for hazards related to the region’s levees and dams still exist. However, the presence of earthquake faults in proximity to the existing dam and levee structures presents a valid danger to downstream locations in the event of an earthquake. In the unlikely event of a high priority dam’s total failure, the consequences could be catastrophic within inundation zones. The potential for dam or levee failure further generates the added potential for a number of cascading effects such as disruptions to the local economy, utility failures, disruptions to providing for the needs of the community, and development of public health hazards. These effects would be exacerbated by effects of seasonal flooding, ongoing heavy precipitation, or excessive run-off from the watershed contributing to the river system. The potential for widespread flooding and damage of structures due to the force of water has exponentially powerful impacts on particular populations among the campus community including those with access or functional needs, international students, the homeless, and students residing in the residence halls.
Identified Data Limitations

Data limitations include missing campus structural replacement costs, and an incomplete inventory of both building construction features and mitigation efforts to lessen the impact due to flood inundation.

Drought

Description of the Hazard

Drought is defined as a condition where moisture levels fall significantly below normal for an extended period of time over a large area that adversely affects plants, animal life, and humans. Drought is a gradual phenomenon. Although droughts are sometimes characterized as emergencies, they differ from typical emergency events. Most natural disasters, such as floods or forest fires, occur relatively rapidly and afford little time for preparing for disaster response. Droughts occur slowly, over a multi-year period, and it is often not obvious or easy to quantify when a drought begins and ends.

Throughout California, one dry year does not normally constitute a drought. California’s extensive system of water supply infrastructure (reservoirs, groundwater basins, and conveyance assets) mitigates the effect of short-term dry periods for most water users. Defining when a drought begins is a function of drought impacts to water users. Drought in one location may not constitute a drought for all water users, as some users in relative proximity may have a different water supply. For example, individual water suppliers may use a combination of sources such as rainfall/runoff, water in storage, or expected supply from a water wholesaler to define their water supply conditions.

Drought can be characterized as one or more of the four following types:

- **Meteorological drought** is defined on the basis of the degree of dryness (in comparison to some “normal” or average amount) and the duration of the dry period. A meteorological drought must be considered as region-specific since the atmospheric conditions that result in deficiencies of precipitation are highly variable from region to region.

- **Hydrological drought** is associated with the effects of periods of precipitation (including snowfall) shortfalls on surface or subsurface water supply (e.g., streamflow, reservoir and lake levels, ground water). The frequency and severity of hydrological drought is often defined on a watershed or river basin scale. Although all droughts originate with a deficiency of precipitation, hydrologists are more concerned with how this deficiency plays out through the hydrologic system. Hydrological droughts are usually out of phase with or lag the occurrence of meteorological and agricultural droughts. It takes longer for precipitation deficiencies to show up in components of the hydrological
system such as soil moisture, streamflow, and ground water and reservoir levels. As a result, these impacts are out of phase with impacts in other economic sectors.

- **Agricultural drought** focus is on soil moisture deficiencies, differences between actual and potential evaporation, reduced ground water or reservoir levels, and so forth. Plant water demand depends on prevailing weather conditions, biological characteristics of the specific plant, its stage of growth, and the physical and biological properties of the soil.

- **Socioeconomic drought** refers to when physical water shortage begins to affect health, well-being, and quality of life of people, or when the drought starts to affect the supply and demand of an economic product that relies on water.

The drought issue in California is further compounded by water rights. The central challenge is how to prioritize water usage among a broad variety of contexts. It is for this reason that water is a commodity possessed and utilized under a variety of legal doctrines. As such, many competing sets of interests create a dynamic prioritization process between, for example, farming and federally protected fish habitats and water supply for municipal/public use (including usage for CSU – Maritime) versus water usage for wildfire abatement or natural resource protection.

**Location of the Hazard**

Drought conditions have been identified throughout Solano County where CSU - Maritime is located. Drought is not a location-specific hazard and affects the entire planning area equally. Drought location is not isolated to the campus footprint but occurs as a geographic sub-set of drought conditions occurring at larger scales. From 2000-2020, drought conditions existed continuously somewhere in the state, with 80-100% of the state impacted for 12 of the last 20 years. 26

**Extent of the Hazard**

Given the historical occurrence of severe drought impacts across the state and the potential future impact exacerbated by climate change, the CSU Planning Committee recognizes that drought will continue to pose a high degree of risk statewide, potentially impacting crops, livestock, water resources, the natural environment at large, buildings and infrastructure (from land subsidence), and local economies.

In addition, although drought affects the entire CSU system-wide planning area, the extent of the hazard may be variable and specific to each campus/jurisdiction, depending on contextual factors such as the degree of assets and activities historically or potentially impacted by drought within each jurisdiction. More specifically, drought impacts have not been reported for CSU – Maritime.

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In addition, land subsidence has occurred state-wide and will continue in areas where the groundwater basin has been subject to overdraft and long-term recharge is inadequate to maintain the water table elevation, leaving underground voids. Subsidence levels have been measured up to 30-feet with subsidence bowls covering hundreds of square miles. As such, drought-related subsidence may result in serious structural damage to buildings, roads, irrigation ditches, underground utilities, and pipelines, and the committee recognizes the possibility that CSU system-wide resources could be affected as long as drought conditions occur in the future.

For CSU – Maritime Academy, the extent of the hazard is Low (corresponding to D0-D1 on the extent scale below). However, the campus planning committee recognizes that the potential for more severe conditions exists and is tied to regional water resource vulnerabilities.

The U.S. Drought Monitor developed tables of impacts reported during past droughts in California in order to depict the extent of drought risk for each level of drought on the U.S. These possible extent conditions for California complement the general impacts column of the U.S. Drought Monitor Classification Scheme.

Table 14-14: Impacts of Drought Levels as Determined by US Drought Monitor

<table>
<thead>
<tr>
<th>Category</th>
<th>Impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>D0</td>
<td>Soil is dry; irrigation delivery begins early</td>
</tr>
<tr>
<td></td>
<td>Dryland crop germination is stunted</td>
</tr>
<tr>
<td></td>
<td>Active fire season begins</td>
</tr>
<tr>
<td></td>
<td>Winter resort visitation is low; snowpack is minimal</td>
</tr>
<tr>
<td>D1</td>
<td>Dryland pasture growth is stunted; producers give supplemental feed to cattle</td>
</tr>
<tr>
<td></td>
<td>Landscaping and gardens need irrigation earlier; wildlife patterns begin to change</td>
</tr>
<tr>
<td></td>
<td>Stock ponds and creeks are lower than usual</td>
</tr>
<tr>
<td>D2</td>
<td>Grazing land is inadequate</td>
</tr>
<tr>
<td></td>
<td>Producers increase water efficiency methods and drought-resistant crops</td>
</tr>
<tr>
<td></td>
<td>Fire season is longer, with high burn intensity, dry fuels, and large fire spatial extent; more fire crews are on staff</td>
</tr>
<tr>
<td></td>
<td>Wine country tourism increases; lake- and river-based tourism declines; boat ramps close</td>
</tr>
<tr>
<td></td>
<td>Trees are stressed; plants increase reproductive mechanisms; wildlife diseases increase</td>
</tr>
</tbody>
</table>

| D3 | Water temperature increases; programs to divert water to protect fish begin |
|    | River flows decrease; reservoir levels are low and banks are exposed |
|    | Livestock need expensive supplemental feed, cattle and horses are sold; little pasture remains, producers find it difficult to maintain organic meat requirements |
|    | Fruit trees bud early; producers begin irrigating in the winter |
|    | Federal water is not adequate to meet irrigation contracts; extracting supplemental groundwater is expensive |
|    | Dairy operations close |
|    | Marijuana growers illegally tap water out of rivers |
|    | Fire season lasts year-round; fires occur in typically wet parts of state; burn bans are implemented |
|    | Ski and rafting business is low, mountain communities suffer |
|    | Orchard removal and well drilling company business increase; panning for gold increases |
|    | Low river levels impede fish migration and cause lower survival rates |
|    | Wildlife encroach on developed areas; little native food and water is available for bears, which hibernate less |
|    | Water sanitation is a concern, reservoir levels drop significantly, surface water is nearly dry, flows are very low; water theft occurs |
|    | Wells and aquifer levels decrease; homeowners drill new wells |
|    | Water conservation rebate programs increase; water use restrictions are implemented; water transfers increase |
|    | Water is inadequate for agriculture, wildlife, and urban needs; reservoirs are extremely low; hydropower is restricted |
|    | Fields are left fallow; orchards are removed; vegetable yields are low; honey harvest is small |
|    | Fire season is very costly; number of fires and area burned are extensive |
|    | Many recreational activities are affected |
|    | Fish rescue and relocation begins; pine beetle infestation occurs; forest mortality is high; wetlands dry up; survival of native plants and animals is low; fewer wildflowers bloom; wildlife death is widespread; algae blooms appear |
|    | Policy change; agriculture unemployment is high, food aid is needed |
|    | Poor air quality affects health; greenhouse gas emissions increase as hydropower production decreases; West Nile Virus outbreaks rise |

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Water shortages are widespread; surface water is depleted; federal irrigation water deliveries are extremely low; junior water rights are curtailed; water prices are extremely high; wells are dry, more and deeper wells are drilled; water quality is poor;

History of the Hazard

Historically, drought has been so prevalent in California that its presence is almost continuous. According to the US Drought Monitor, Solano County has experienced 8 periods of drought covering about 12 years between 2000-2021 and it includes the CSU - Maritime footprint, although drought impacts have not been identified for the campus.

Figure 14-4: Periods of Drought in Solano County, California, 2000 – 2021

According to the National Drought Mitigation Center, over 3,500 reports and publications covering 370 drought-related events took place across the state (many of which were statewide events) between 2000-2020. In addition, the National Center for Environmental Information (NCEI) reports more than 500 events statewide during this same time period. These events produced a comprehensive range of impacts to water supply, regulations and allocations to businesses and municipalities, budgets and resources for firefighting, water law and policy, and physical impacts to built and natural environments. As such, data records of previous occurrences can be viewed as separate time and event demarcations for a hazard almost continuously in effect across the state with cascading impact potential.

According to the Department of Water Resources, droughts exceeding three years are relatively common in Southern California, but relatively rare in Northern California - the region is the geographic source of much of the state’s developed water supply.

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The 1929-34 drought established the criteria commonly used in designing storage capacity and yield of large Northern California reservoirs. 30

According to the US Drought Monitor’s time series data, from 2000-2021 (with the exception of a 2- to 3-month period in 2000 and 2011), some degree of drought conditions have been continuously in effect somewhere in California. In fact, 80% - 100% of the state has been subjected to drought conditions for 12 of the last 20 years, with the most severe drought being the 100% state-wide event from 2012-2017.

Figure 14-5: Periods of Drought in State of California, 2001 – 2021 31

Given the extent of the drought risk in California, the following drought event was selected as an exemplar due to its broad and significant impacts on the state, (and according to the US Drought Monitor’s Time Series data) on Solano County and the city of Vallejo, which surrounds the CSU - Maritime campus planning area:

2012 – 2017 – Drought produced severe impacts to water wells throughout the state of California, with a high number of wells running dry. Land subsidence due to increased groundwater pumping also occurred in numerous areas of the state such as the San Joaquin and Central Valleys. Crop damage was widespread as well. Water allotments were drastically reduced in many towns and water agencies, with extremely high costs for procuring water. In addition, job loss occurred with many families requiring food supply assistance, and water supply assistance provided to home-owners with dry wells. According to a report released by UC Davis Center for Watershed Sciences, the 2012-2017 period of the California drought cost the state’s agriculture industry about $1 billion in lost revenue, with a total statewide economic cost of the drought calculated to be $2.2 billion. The report says, “it is responsible for the greatest water loss ever seen in California agriculture - about one third less than normal”. The report calls the groundwater situation in California "a slow-moving train wreck." Spring snowpack at Donner Summit reached record low levels in 2014, exceeded in 2015 by a

remarkable April 1 snow-water-equivalent value of only 5% of average. Decreased precipitation since contributed to near-record low levels in the Shasta Reservoir. The ongoing drought has contributed to declines in crop values across the state. For example, crops including cotton, corn silage and barley (the field crop category) fell by 42 percent.  

**Potential Impacts of the Hazard**

Drought impacts are wide-reaching and may be economic, environmental, and/or societal. This assessment of its impact recognizes that historic occurrences of drought throughout the planning area are a sub-set of larger and inter-connected local and regional droughts, and that the (related) historic impacts provide a sound basis for understanding potential (future) impacts.

The most significant potential impact associated with drought across the CSU - Maritime campus planning area is a reduction in water availability for the municipal area tied to the campus. Other potential impacts include crop loss and damage to trees and other natural resources (See Tree Mortality below). The footprint of CSU - Maritime to some extent includes these vulnerable resources based on the campus landscape (trees).

As a secondary impact of drought, wildfire is directly attributable to dry atmospheric conditions. Wildfires almost always coincide with drought in California, though not limited to such. However, the wildfire hazard is analyzed separately in this plan. (See wildfire hazard).

In reviewing the occurrences of drought for Solano County and the city of Vallejo, (where CSU - Maritime is located), the US Drought Monitor and the National Drought Mitigation Center report that tens of millions of trees died during the (2012 - 2017) state-wide drought disaster. Though data sources do not provide data for tree mortality specific to CSU - Maritime, the broad geographic extent of the impact makes it likely that tree mortality occurred to some degree on the campus. Due to the lasting and ongoing effects of drought on the landscape, trees will continue to be impacted within the municipalities, counties and regions wherein lies the CSU campus system as long as drought conditions continue to occur in the future.

Given the absence of data, in order for the CSU Committee to assess the impact of tree mortality, it is useful to view it as a risk sub-set to the probability, location, extent, severity and duration of the drought hazard within each campus-located municipality, county and region. Regarding potential impacts, standing dead trees could fall, posing a risk to people, buildings, power lines, roads and other infrastructure. In addition, drought-impacted trees become susceptible to diseases and insect infestations (bark beetle) further adding to the risk of tree mortality and related potential impacts. No

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data is currently available for tree mortality on campus; however, the CSU Planning Team will pursue data on this issue in the future.

As a potential tertiary impact, prolonged and repeated drought conditions over time can produce land subsidence and the risk of damage to building foundations and infrastructure on campus resulting from ground instability and collapse. Land subsidence is defined as the vertical sinking of the land over manmade or natural underground voids. Subsidence is often the direct result of groundwater over-extraction in response to drought conditions, as well as oil and gas extraction. Weight can accelerate the process of subsidence resulting from surface development and infrastructure such as roads and buildings, vibrations from construction blasting and heavy truck or train traffic. For example, the State Water Project’s 444-mile-long California Aqueduct has required repairs such as the raising of canal linings, bridges, and water control structures on the Aqueduct – in the Central Valley a five-mile reach of the Eastside Bypass was impacted by subsidence, and the Department of Water Resources estimated that it may cost in the range of $250 million to acquire flowage easements and levee improvements to restore the design capacity of the subsided area.  

At present, drought related damage to campus buildings and infrastructure at CSU - Maritime has not been reported, but the potential for such impacts is possible. With regard to overall potential impact, water supply/availability for CSU - Maritime is ultimately tied to broader inter-dependent, and more intensive modes of water use at local and regional scales such as agriculture and ranching, wildfire protection, larger metropolitan/municipal usage, manufacturing and commerce, tourism, recreation, and wildlife preservation. During drought periods, the State of California’s regulated water allocations are modified and often reduced, which can result in reduced water availability for all usage contexts, including CSU - Maritime. A reduction of electric power generation and water quality deterioration are also potential impact factors.

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Table 14-15: Summary of Drought Impacts on Water Resources

<table>
<thead>
<tr>
<th>Resource</th>
<th>Type of Impact</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sea Level</td>
<td>Direct</td>
<td>Sea level is rising and will likely impact coastal areas</td>
</tr>
<tr>
<td>Soil Moisture</td>
<td>Direct</td>
<td>Prolonged dry seasons can lead to decreases in soil moisture; drier vegetation</td>
</tr>
<tr>
<td>Vegetation</td>
<td>Indirect</td>
<td>Longer and more intense fire season with increased extent of area burned</td>
</tr>
<tr>
<td>Stream Conditions</td>
<td>Direct</td>
<td>Increases in water temperature; potential effects on fish</td>
</tr>
<tr>
<td>Snowpack</td>
<td>Indirect</td>
<td>Increases in temperature will lead to decreases in snowpack</td>
</tr>
<tr>
<td>Runoff</td>
<td>Direct</td>
<td>Warmer temperatures are likely to lead to a shift in peak runoff from spring to winter and a likely decrease in summer base flow</td>
</tr>
<tr>
<td>Hydropower</td>
<td>Indirect</td>
<td>Decreased summer flows resulting from earlier snowmelt and a shift in peak runoff could affect hydropower generation during summer months</td>
</tr>
<tr>
<td>Precipitation</td>
<td>Direct</td>
<td>Warmer winter temperatures will result in a greater percentage of precipitation falling as rain rather than as snow</td>
</tr>
<tr>
<td>Groundwater</td>
<td>Indirect</td>
<td>Reduction in snowpack and extended periods of drought are likely to increase dependency on groundwater</td>
</tr>
</tbody>
</table>

**Probability of Future Occurrence of the Hazard**

**Highly Likely** — The US Drought Monitor’s time series data (2000-2020) indicates that some degree of drought has nearly a 100% probability of occurrence somewhere in the state in any given year. Given that CSU - Maritime lies within a drought impacted region, it is prudent to extend this likelihood of occurrence to the planning area.

**Vulnerability to the Hazard**

In California, rising temperatures are projected to increase the average lowest elevation at which snow falls, reducing water storage in the snowpack, particularly at

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those lower mountain elevations which are now on the margins of reliable snowpack accumulation. Higher spring temperatures will also result in earlier melting of the snowpack. The shift in snow melt to earlier in the season is critical for California’s water supply because flood control rules require that water be allowed to flow downstream and that water cannot be stored in reservoirs for use in the dry season. As such, state-level drought risk factors that have led to drought’s state-wide severity and extent, and potential impacts also create drought vulnerabilities at the level of the CSU - Maritime campus.

Moreover, climate change will likely adversely impact the vulnerability of watersheds and ecosystems in their ability to deliver important ecosystem services. These changes may limit the natural capacity of healthy forests to capture water and regulate stream flows. Sierra Nevada mountain winters and springs are warming, and on average, precipitation as snowfall relative to rain is decreasing. A warming climate with reduced snowpack will result in earlier snowmelt and will subsequently reduce downstream water availability during summer and early fall.

As such, the state and the CSU - Maritime planning area stakeholders potentially have less capacity to address future drought risks due to projected temperature increases and shortages in water; ground-water withdrawals have been occurring at a deficit rate of 1 – 2 million acre-feet per year, where the impacts of drought include decreased availability of water for agriculture and environmental uses. In forested and other vegetated areas, prolonged drought decreases the moisture content of forest fuels and increases the risk of high severity wildfires.

It should be pointed out that California is the single most productive agricultural state and its agricultural industry relies heavily on reservoir water supplied by snowmelt and rainfall runoff. Yearly variations in snowpack depths have implications for water availability as snowmelt from the winter snowpack feeds a network of reservoirs. Spring snowpack at Donner Summit reached record low levels in 2014, exceeded in 2015 by a remarkable April 1 snow-water-equivalent value of only 5% of average. Decreased precipitation since 2011 has contributed to near-record low levels in the Shasta Reservoir.

**Vulnerability of Populations**

The historical and potential impacts of drought on California’s population include agricultural sector job loss, secondary economic losses to local businesses and public recreational resources, increased cost to local and state government for large-scale water acquisition and delivery, and water rationing and water wells running dry for individuals and families. As drought is often accompanied by prolonged periods of extreme heat, negative health impacts such as dehydration can also occur, where children and elderly are most susceptible. Air quality often declines in times of

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37 National Oceanic and Atmospheric Administration National Centers for Environmental Information. *State Climate Summaries: California.* Retrieved 05.04.2021 from: [https://statesummaries.ncics.org/chapter/ca/](https://statesummaries.ncics.org/chapter/ca/)
drought which can affect those with respiratory ailments. These same vulnerabilities apply to the students, faculty and staff of the CSU - Maritime campus.

Property Vulnerability

Drought vulnerabilities include crop loss, injury and death of livestock and pets, and damage to infrastructure, homes and other buildings resulting from the secondary drought impact of land subsidence. The related drought impacts of tree mortality and land subsidence pose risks to vulnerable critical infrastructure and property. These same vulnerabilities apply to the properties of the CSU - Maritime campus.

Natural Environment Vulnerability

The historical and potential impacts of drought on the natural environment are widespread throughout public and private lands within the state, including tree mortality, impacts to all flora and fauna, and destabilization (subsidence) of land along streams and rivers, and within watersheds.

The core issue shaping drought vulnerabilities throughout California is water supply and demand. Several factors play into the issue including groundwater basins, surface water run-off, public and agricultural demand, and surface water storage water sheds. A USGS led analysis was first conducted in 2010 through the Forest and Rangeland Assessment and ongoing through the USGS Forest and Rangeland Ecosystem Science Center to identify threats and assets where water supply would benefit from environmental management designed to protect or enhance water resources, the key effort which, in part, both defines and mitigates the severity of drought risk and vulnerabilities.

With regard to overall threat and asset findings shaping the potential severity of drought, the watersheds in the Sierra region contribute most greatly to the state’s water supply, but are under threat from climate change, wildfire and development. In addition, groundwater basins in the San Joaquin Valley and Sacramento Valley bioregions are an abundant resource that is heavily threatened by over pumping. 38

Critical Facilities Vulnerabilities

Drought vulnerabilities at CSU - Maritime’s critical facilities include water shortfalls for facility operations and critical functions, and potential structural destabilization and damage resulting from land subsidence.

Estimate of Potential Losses

An estimate of potential losses from drought has not been calculated for the campus or the CSU system as a whole. However, drought related losses to the City of Vallejo and the surrounding region such as crop loss and cost increases for water resources

have re-occurred over time. Please consult city and county level government, and/or state agricultural agencies for data on the financial impacts from drought.

Vulnerability Conclusions

The CSU Planning Committee understands that the high degree of vulnerability posed by drought will be exacerbated by greater climate variation in the future and therefore greater variation and uncertainty regarding the availability of water supplies which are already under tremendous stress. In response to such vulnerability, state legislation passed in 2014 requires local governments to regulate pumping and recharge to better manage groundwater supplies, and groundwater-dependent regions are required to halt overdraft and bring basins into sustainable levels of pumping and recharge by the early 2040s. That said, the Committee will continue to work with local, regional and state partners and stakeholders to explore solutions for mitigating the drought hazard on its campuses by accessing the best available data and resources on climate change and its relationship to drought.

Identified Data Limitations

Data is limited concerning campus-related agricultural assets as well as data on campus tree mortality.

**Earthquake**

Description of the Hazard

An earthquake is a sudden motion or shaking caused by the release of pressure accumulated along the edge of tectonic plates covering the earth. These huge plates are constantly moving and move ever so slowly under, over, or by passing one another. This movement is gradual however the plates may lock together accumulating enormous amounts of energy. When this energy builds, stress develops, and the adjoining plates will eventually break free and result in ground shaking – an earthquake.

Large earthquakes may result in fissuring, ground settlement, and/or vertical or horizontal displacement. Earthquakes occur without warning and can result in extensive damages and human casualties. Damages associated to earthquake generated ground shaking is normally confined to a narrow area along fault trend from the earthquake epicenter. However, seismic waves may generate ground shaking resulting in damages in areas outside of the fault trend.

**Fault Rupture** – The rupture of faults is the differential movement of the two sides of the earth’s plates at the point of the fault. Horizontal or vertical displacement may be significant and occur over great distances. The movement and energy that occurs along a fault is released in waves resulting in ground shaking. The intensity of ground shaking varies based on the magnitude of the earthquake, the proximity to the earthquake epicenter, the composition of the ground sediment or rock the waves travel through, and the depth of the earthquake.
**Liquefaction** – In addition to the primary fault rupture that occurs right along a fault during an earthquake, the ground many miles away can also fail during intense shaking. As seismic waves travel through saturated granular soil; the soil begins to liquefy and act as a fluid. Soil strength and stability is lost causing the effects of ground shaking to intensify and for ground deformation to occur. These water saturated soils when shaken quickly lose the ability to support buildings, bridges, utilities, and other structures. Areas susceptible to liquefaction include places where sandy sediments have been deposited by rivers along their course or by wave action along beaches. The greater the magnitude of an earthquake and longer duration of strong ground shaking will result in an enhanced potential for liquefaction to occur. Settlement can cause damage when the amount settlement varies significantly across the length of a structure. Lateral spreading occurs when liquefaction occurs on gently sloping ground and the liquefied material at depth allows the area to slide, often toward a vertical discontinuity or “free face” such as a creek or stream channel. Liquefaction can occur in susceptible soils below bodies of water, and settlement and lateral spreading can damage structures built on or adjacent to these areas. Transportation bridges across water bodies, wharves, piers and other structures at ports and harbors, and underwater utility lines can be severely damaged by this hidden hazard.

**Subsidence** - Changes in the local environment that cause subsidence or sinkholes are called triggering mechanisms. Water is the primary factor that affects the local environment and causes subsidence. Water level decline, changes in groundwater flow, increased loading, and deterioration (such as abandoned mines) are all triggering mechanisms. Water level decline may occur naturally, or it may be the result of human action. Factors that lead to water decline are pumping (from wells), localized drainage (for construction activities), dewatering, or drought. Changes in groundwater flow can result from an increase in the velocity of groundwater movement, and increase in the frequency of water table fluctuations, and changes in discharge (either increase or decrease). Increased loading can cause pressure in the soil, leading to the failure of underground cavities and space, such as caves. Vibrations from earthquakes, heavy machinery, and blasting may result in structural collapse, followed by surface resettlement.

**Location of the Hazard**

The State of California is particularly vulnerable to earthquake activity due to California’s location residing between two large tectonic plates. Cal Maritime Academy is located in the northern area of the San Francisco Bay region. In general, fault systems surround and traverse throughout the Bay Area and Solano County including the area of Cal Maritime. Throughout the populated areas of Solano County and surrounding cities, the ground is saturated with sediment eroded from the hills by means of multiple stream channels. Liquefaction zones rated at moderate susceptibility exist on all sides of the campus.

The Pacific Plate and the North American Plate come together at the San Andreas Fault 27 miles west of the Cal Maritime campus. In addition to the San Andreas Fault, Solano County is home to or near additional fault systems with the potential to
generate strong ground shaking. The campus is additionally in close proximity to more fault systems. The Franklin Fault traverses south to north along Mare Island less than ¾ mile west of the Cal Maritime campus. The Contra Costa Shear Zone extends south to north 20 miles in length from Walnut Creek through Vallejo 2 miles east of the Cal Maritime campus. The 80-mile-long Hayward Fault stretches from Milpitas to Sonoma County 9 miles west of the campus. The entire San Francisco Bay Area is saturated with numerous additional faults mostly paralleling the San Andreas Fault to the northwest. These fault systems are located on each side of the campus.

Figure 14-6: Fault Lines near CSU Maritime Academy

Extent of the Hazard
The extent or severity of earthquake damage is expressed in terms of magnitude, intensity, and duration. The amount of energy released during an earthquake is normally conveyed as a magnitude measured from a seismogram. Magnitude is expressed in numbers and decimals representing the physical size of the earthquake. The strength and effect of the shaking on the surface of the earth is classified as the intensity. Intensity is further defined from the effects the earthquake has on people,
structures, and the natural environment. The intensity of an earthquake in terms of measuring magnitude and evaluating its effects is generally expressed using the Modified Mercalli (MM) Intensity Scale. Duration is the length of time the earthquake’s energy is released.

The Richter magnitude scale was developed in 1935 by Charles F. Richter of the California Institute of Technology as a mathematical device to compare the size of earthquakes. The Richter Scale is the best-known scale for measuring the magnitude of earthquakes. The magnitude value is proportional to the logarithm of the amplitude of the strongest wave during an earthquake. A recording of 7, for example, indicates a disturbance with ground motion 10 times as large as a recording of 6. The energy released by an earthquake increases by a factor of 31 for every unit increase in the Richter scale.

Table 14-16: Earthquake Intensity and Frequency Comparisons

<table>
<thead>
<tr>
<th>Magnitude</th>
<th>Mercalli Intensity</th>
<th>Potential Damage</th>
<th>Global Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 2.0</td>
<td>I</td>
<td>None</td>
<td>Continually</td>
</tr>
<tr>
<td>2.0 - 2.9</td>
<td>I to II</td>
<td>None</td>
<td>&gt; 1M per year</td>
</tr>
<tr>
<td>3.0 - 3.9</td>
<td>II to IV</td>
<td>Light</td>
<td>&gt; 100,000 per year</td>
</tr>
<tr>
<td>4.0 - 4.9</td>
<td>IV to VII</td>
<td>Light</td>
<td>10K to 15K per year</td>
</tr>
<tr>
<td>5.0 - 5.9</td>
<td>VI to VII</td>
<td>Moderate</td>
<td>1K to 1,500 per year</td>
</tr>
<tr>
<td>6.0 - 6.9</td>
<td>VII to X</td>
<td>Heavy</td>
<td>100 to 150 per year</td>
</tr>
<tr>
<td>7.0 - 7.9</td>
<td>VII &lt;</td>
<td>Very Heavy</td>
<td>10 - 20 per year</td>
</tr>
<tr>
<td>8.0 - 8.9</td>
<td>VII &lt;</td>
<td></td>
<td>1 per year</td>
</tr>
<tr>
<td>&gt; 9.0</td>
<td>VII &lt;</td>
<td></td>
<td>1 per 10-50 years</td>
</tr>
</tbody>
</table>

The Modified Mercalli Intensity Scale provides descriptive values of earthquake intensity that may provide greater meaning to the broader population as the description of intensity refers to the effects actually experienced. This scale uses an arbitrary ranking based on observed earthquake effects. The scale is composed of increasing levels of intensity ranging from shaking that is not recognizable to intense shaking resulting in catastrophic damages and casualties. The Modified Mercalli Intensity Scale is demonstrated below:
Table 14-17: Modified Mercalli Intensity Scale

<table>
<thead>
<tr>
<th>Intensity</th>
<th>Shaking</th>
<th>Description / Damage</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Not felt</td>
<td>Not felt except by a very few under especially favorable conditions.</td>
</tr>
<tr>
<td>II</td>
<td>Weak</td>
<td>Felt only by a few persons at rest, especially on upper floors of buildings.</td>
</tr>
<tr>
<td>III</td>
<td>Weak</td>
<td>Felt quite noticeably by persons indoors, especially on upper floors of buildings. Many people do not recognize it as an earthquake. Standing motor cars may rock slightly. Vibrations similar to the passing of a truck. Duration estimated.</td>
</tr>
<tr>
<td>IV</td>
<td>Light</td>
<td>Felt indoors by many, outdoors by few during the day. At night, some awakened. Dishes, windows, doors disturbed; walls make cracking sound. Sensation like heavy truck striking building. Standing motor cars rocked noticeably.</td>
</tr>
<tr>
<td>V</td>
<td>Moderate</td>
<td>Felt by nearly everyone; many awakened. Some dishes, windows broken. Unstable objects overturned. Pendulum clocks may stop.</td>
</tr>
<tr>
<td>VI</td>
<td>Strong</td>
<td>Felt by all, many frightened. Some heavy furniture moved; a few instances of fallen plaster. Damage slight.</td>
</tr>
<tr>
<td>VII</td>
<td>Very strong</td>
<td>Damage negligible in buildings of good design and construction; slight to moderate in well-built ordinary structures; considerable damage in poorly built or badly designed structures; some chimneys broken.</td>
</tr>
<tr>
<td>VIII</td>
<td>Severe</td>
<td>Damage slight in specially designed structures; considerable damage in ordinary substantial buildings with partial collapse. Damage great in poorly built structures. Fall of chimneys, factory stacks, columns, monuments, walls. Heavy furniture overturned.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Magnitude</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>IX</td>
<td>Violent</td>
</tr>
<tr>
<td>X</td>
<td>Extreme</td>
</tr>
</tbody>
</table>

*IX* Damage considerable in specially designed structures; well-designed frame structures thrown out of plumb. Damage great in substantial buildings, with partial collapse. Buildings shifted off foundations.

*X* Some well-built wooden structures destroyed; most masonry and frame structures destroyed with foundations. Rails bent.

The graph below illustrates the increasing intensity of energy that is released and as the measured magnitude increases. While each whole number increases in magnitude represents a tenfold increase in the measured amplitude, it represents an increasing rate of 32 times more energy released in the same increase in magnitude. As the magnitude of an earthquake is measured higher, the intensity of the earthquake worsens progressively from one category to the next.

Figure 14-7: Earthquake Magnitude and Equivalent Energy Release

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Numerous fault systems surround and traverse throughout the Bay Area and Solano County including the area of Cal Maritime, including the powerful San Andreas fault. Liquefaction zones rated at moderate susceptibility exist on all sides of the campus. Though only 1 extreme event (Loma Prieta, 1989) has struck the area, the planning committee ranks the extent of the hazard for the campus as Moderate.

History of the Hazard

One federally declared earthquake event has occurred in Solano County since 1950. The Loma Prieta earthquake struck the San Francisco Bay Area on October 17, 1989. The earthquake was caused by a slip along the San Andreas Fault. The duration of earthquake was 10 to 15 seconds and measured 6.9 on the Moment Magnitude (Mw) Scale. The earthquake caused the deaths of 63 people, injured 3,757 people, and left approximately 3,000-12,000 people homeless. Direct losses from this earthquake amounted to approximately $10 billion.

Potential Impacts of the Hazard

The shaking of the ground from earthquakes can result in building collapse, bridge failure, utility disruptions and other structural collapse. Large earthquakes can additionally cause natural gas lines to break resulting in structure fires. The proximity to the unstable soils on the campus and surrounding the campus presents a potential for liquefaction creating greater ground instability during seismic events. A major earthquake in Solano County area would likely result in region-wide social disruptions in addition to structural damages. The region-wide structural damages may disrupt lifelines and supply chain routes limiting the campus from effective evacuation routes and receiving necessary supplies or equipment.

Most injuries resulting from earthquakes are from collapsing walls, flying glass, or other objects moved by ground shaking. The lack of warning allows individuals minimal time to react and find areas of safety. A moderate earthquake occurring near Vallejo could cause injuries or fatalities to members of the campus community or support networks the campus relies on. These earthquake effects might be aggravated by collateral incidents such as fire, flooding, hazardous material spills, dam/levee compromises, and other cascading events. A catastrophic earthquake near Solano County could result in extensive casualties, expansive structural damages, panic, widespread utility outages, communication failures, and secondary emergencies such as fire. A catastrophic earthquake would certainly affect the broader northern San Francisco Bay region limiting immediate assistance that the campus may normally expect.

Local impacts to the Cal Maritime campus caused by an earthquake could include:

- Potential hazardous material releases on and off campus
- Infrastructure damage to freeway and roadway system
- Compromised transportation routes for access, supplies, services, and evacuation
- Structural damage to bridges
- Damage to flood control and drainage system
- Environmental damage to waterways and streams
- Structural damage to waterfront facilities
- Potential isolation of campus from community
- Potential isolation among on-campus residents
- Damage to on-campus utility infrastructure
- Damage to campus reclaimed water system and capability to support fire suppression system
- Release of airborne asbestos from damaged older buildings
- Structural damage to campus academic and support buildings
- Structural damage to residence halls resulting in displaced student populations
- Structural damage to nearby apartment complexes and residences
- Community members arriving on campus for refuge from damaged homes
- Damaged university communications, computer systems, and networks
- Considerable stress and fear among community
- Closure or reduction of service to campus operations
- Reduction of campus revenue

**Probability of Future Occurrence of the Hazard**

The Working Group on California Earthquake Probabilities (WGCEP), a collaboration between the United States Geological Survey (USGS), the Southern California Earthquake Center (SCEC), and the California Geological Survey (CGS) develops Uniform California Earthquake Forecasts (UCERFs) using the best currently available science and technology. The UCERF version 3 provides a three-dimensional view of the likelihood a region in California will experience a Magnitude 6.7 or greater earthquake in the next 30 years. The likelihood for the Solano County fault systems surrounding the North Bay region is included in the following table.
The Solano County Hazard Mitigation Plan Update describes the probability of an earthquake Magnitude of 6.7 or greater in the San Francisco Bay Area over the next 30 years is 63%. The Plan further demonstrates that these estimations are being updated continuously to address updated analyses. There is a 31% probability of one or more magnitude 6.7 earthquakes striking the Hayward Fault within 30 years.51

Based on the earthquake shaking potential in the Solano County area, the proximity to the fault systems illustrated above, the probability of seismic ground shaking that would generate damage is considered Possible.

**Vulnerability to the Hazard**

A considerable challenge regarding earthquakes is they generally occur without warning. The fault systems surrounding the region all cross major transportation routes potentially reducing the availability of access and the supply chain. The geographic location of Cal Maritime places the campus in a suburban community near residential, commercial, and industrial areas that is moderately populated. Earthquake effects experienced in the neighboring local community will potentially spill over onto the campus.

The known fault systems generating the threat to the San Francisco Bay region generally surround the area and some cross near the Cal Maritime campus. The campus resides in a region that is exposed to fault systems on all sides. The proximity and potential for large earthquake development from these surrounding systems expose significant vulnerabilities. The potential for earthquake damaged structures being left uninhabitable including campus residence halls will result in numerous displaced individuals and households. The lack of earthquake insurance will cause extreme financial burdens on those affected.

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**Table 14-18: Major Potentially Active Faults in Proximity to Cal Maritime Academy**

<table>
<thead>
<tr>
<th>Fault Zone</th>
<th>Recurrence</th>
<th>Maximum Magnitude</th>
<th>UCERF3 Likelihood</th>
</tr>
</thead>
<tbody>
<tr>
<td>Contra Costa Shear Zone</td>
<td>Historic: 150-200 years</td>
<td>6.2 to 7.2</td>
<td>1-3%</td>
</tr>
<tr>
<td>Franklin</td>
<td>Historic: Unknown</td>
<td>&gt;6.7</td>
<td>1-4%</td>
</tr>
<tr>
<td>Green Valley</td>
<td>Historic: Unknown</td>
<td>&gt;6.7</td>
<td>4-11%</td>
</tr>
<tr>
<td>Hayward</td>
<td>Varies: 20-300 years</td>
<td>6.8 to 7.0</td>
<td>13-21%</td>
</tr>
<tr>
<td>Rodgers Creek</td>
<td>Historic: Unknown</td>
<td>&gt;6.7</td>
<td>7-14%</td>
</tr>
<tr>
<td>San Andreas</td>
<td>Historic: 150-200</td>
<td>6.8 to 8.0</td>
<td>15-22%</td>
</tr>
<tr>
<td>West Napa</td>
<td>Historic: 150-200</td>
<td>7.8</td>
<td>2%</td>
</tr>
</tbody>
</table>
Elements of the vulnerability to a major earthquake on the Cal Maritime campus will vary depending on when the earthquake were to strike. The primary basis of vulnerability is based on the population affected and the built environment exposed. In general, newer construction will be more earthquake resistant than older buildings as building codes and construction technology have improved. A locally centered earthquake, even from moderate events, would have the potential for more damaging results when associated with the moderate liquefaction zones of the city. This would particularly be seen with greater damages to unreinforced masonry buildings.

The risk to the campus population will be lessened during periods when classes are not in session or during periods of breaks. Conversely, during the days and hours that classes are in session and staff are at their workplaces, the human vulnerability increases. Generally, people are safer when at home in wood frame structures as earthquakes tend to generate less structural damage to wood construction than in commercial or industrial facilities. The greater number of people on campus at the time of an earthquake will result in more people being exposed to effects from damaged campus facilities or equipment and require greater evacuation assistance. However, in region-wide events this vulnerability may simply shift to the homes and workplaces of members of the campus community and their families.

The aftermath of a major earthquake will likely result in widespread search and rescue operations for trapped and injured individuals. The demand on emergency services will be great, potentially requiring the campus community to be prepared for these scenarios and initiate response actions as needed. There will be needs for emergency medical care, shelter, water, and food for individuals who have been displaced by the earthquake. In earthquakes causing significant damages, there may be a necessity to provide assistance with identification and support to local agencies in mass fatality management.

There may be a need to evacuate members of the campus community from the campus and to other locations that are deemed to be safer locations. This may be heightened in the southwestern portions of the campus as this area has been identified as being within a liquefaction zone. As the Cal Maritime campus is downstream from dam facilities, the decision to evacuate will need to take into account whether flood control facilities are filled with water and the actual threat to the dam or levees.

The San Francisco Bay Area and Vallejo in particular are moderately populated and attract commuter employees to the commercial cores. The road and freeway network becomes easily congested in normal situations. Solano County relies on Interstates 80 and 680 as the primary overland transportation routes combined with state highway alternatives. Bridges connect the North Bay to the East Bay communities. A major earthquake has the potential for rendering these critical lifelines and supply routes inoperable and forcing the campus community to be self-reliant for a period of time.
Certain campus populations will experience greater challenges to a post-earthquake environment. Vulnerable populations including those that rely on specific services, require electrical power, homeless students, experience disabilities, non-English speakers, those whose age make evacuating difficult, and others will be most affected. These individuals will likely need to navigate through earthquake generated debris, extreme stresses of a disaster, an inability to communicate to or gain access to support networks, and find difficulty in accessing equipment or supplies to aid in a specific need.

**Estimate of Potential Losses**

Estimates of potential losses will be influenced by a variety of factors. The intensity of the earthquake will determine what scale of damages affecting campus infrastructure, equipment, and other impacted features. Losses will be generated by the physical damages, the loss of revenue, loss of academic research, loss of building contents, and community wide economic reductions.

Based on estimate replacement costs of facilities and structures on campus, the maximum total replacement costs due to earthquake are $83,596,545.

Table 14-19: HAZUS Peak Ground Acceleration Zone (PGA) Estimated Losses

<table>
<thead>
<tr>
<th>PGA Zone Designation</th>
<th>Intensity</th>
<th>No of Buildings</th>
<th>Maximum Replacement Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Extreme</td>
<td>X+</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Violent</td>
<td>IX</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Severe</td>
<td>VIII</td>
<td>16</td>
<td>$83,596,545</td>
</tr>
<tr>
<td>Very Strong</td>
<td>VII</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Strong</td>
<td>VI</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Moderate</td>
<td>V</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Light</td>
<td>IV</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Weak</td>
<td>II-III</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Not Felt</td>
<td>I</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>NA</td>
<td>NA</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>No Building Value</td>
<td>NA</td>
<td>31</td>
<td>Unknown</td>
</tr>
</tbody>
</table>

*Buildings with no value defined are also included in the respective Zones they are found in.

**Vulnerability Assessment Conclusions**

It is difficult to predict the severity of casualties, property, and cascading impacts generated by future seismic events affecting the greater San Francisco Bay region, the North Bay, and the Cal Maritime campus. Each of the earthquake generated effects will vary widely based on the intensity of the earthquake, location of the epicenter, proximity to people and development, time of day and year, the soil composition under the impacted structures, building construction, among others. In any case, the
potential for a major earthquake exists affecting the campus and causing extensive challenges to the Cal Maritime University campus and community.

In the event that a major earthquake was to strike along the many fault systems surrounding Vallejo, the effects could be significant to the campus community and campus operations. The widespread impacts generated by a major earthquake would extend the effects of casualties, damages, and other impacts to the broader San Francisco Bay region creating large-scale regionwide needs for critical assistance and a heavy demand on limited emergency resources. The threat and impacts presented to the campus will be shared with the campus community from their homes and places of work. The campus will likely be required to address critical needs independently during early phases of the disaster.

The campus population is additionally vulnerable to the effects of major ground shaking that are far reaching. The psychological and social impacts a major earthquake will give rise to will potentially harm individuals and cause tremendous fear. The willingness to return indoors may be hampered especially as after-shocks continue. These effects are magnified for populations having specific vulnerabilities or access limitations. Populations having various limitations or specific needs may be vulnerable to reduced or eliminated access to essential services that have been rendered incapable to respond.

Identified Data Limitations

Data limitations include missing campus structural replacement costs, and lack of a complete inventory of building construction types to include status of earthquake retrofitting. HAZUS generated analysis is focused on the broader community level versus fine-tuning the analysis to the micro-level for facilities such as a university campus.

**Erosion**

Description of the Hazard

The US Geological Survey (USGS) defines erosion as “the process whereby materials of the earth’s crust are loosened, dissolved, or worn away and simultaneously moved from one place to another”. Erosion may occur in areas of streams and rivers, along bluffs, around immovable objects (such as buildings or bridge abutments), or as a cascading result of other natural hazards, such as earthquakes or wildfires. When erosion occurs along bodies of water, the removal of material causes the shore to move further landward.

Forces such as sea level rise and changes in sediment supply impact erosion gradually and can be difficult to recognize. In contrast, the impacts of short-term events, such as

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storms and flooding, can be severe and are immediately recognizable. Along the Pacific coast, rain, wind, and waves can induce significant short-term erosion.

Location of the Hazard

Erosion is a relatively non-spatial hazard that can occur in any location with conducive soil structure and a source of movement such as water or wind. An area’s potential for erosion is determined by several factors, including rainfall, topography, soil characteristics, and vegetative cover. Streambank and bluff erosion can occur near any riverine area. For the purpose of this campus-level analysis, the erosion hazard poses a consistent risk across the terrain of the CSU Monterey Bay campus with erosion-prone characteristics.

Erosion is a severe hazard in coastal communities, where sea level rise and storms contribute to de-sedimentation and the retreat of coastal cliffs, bluffs, and beaches. While coastal erosion can happen in any storm, it is more likely during El Nino events, which occur every 5-7 years.

Extent of the Hazard

Erosion is occurring on the Pacific coastline west of CSU Maritime. While there is no published scale of severity or extent for this geologic hazard on the CSU Maritime campus, erosion is likely to occur if conditions are favorable. Given the fact that there are no recorded incidents of erosion on campus, an no specific sites known to be imminently at threat of erosion impacts, the planning committee ranks the extent of this hazard as Low.

History of the Hazard

There are no recorded incidents of erosion on the CSU Maritime campus.

Potential Impacts of the Hazard

Coastal erosion can result in severe impacts to local infrastructure, including the undermining of foundations, exposure of underground infrastructure, and breaches of natural or constructed protections. The latter can expose communities to the destructive forces of floodwaters, surge, and debris impacts. On campus, areas of erosion can create pedestrian and transportation hazards, and structures may become unsafe if erosion is not controlled. Public health and safety, structures, and infrastructure can all be negatively impacted, damaged, or destroyed by the erosion hazard.
Probability of Future Occurrence of the Hazard

Erosion is an on-going and dynamic process that occurs regularly. As climate change raises sea levels and induces more frequent and intense weather events, coastal and other erosion may generally become more widespread or severe. These events can cause erosion or exacerbate areas already experiencing erosion. As a result, and in consideration of the potential extent of erosion on campus, the probability of at least a limited degree of erosion taking place somewhere on the campus in the future is high over the long-term.

Vulnerability to the Hazard

Topography, soil structure, land use, and precipitation are all factors of erosion. CSU Maritime infrastructure and buildings located on steep slopes, in areas with little vegetation, or in areas with conducive soil types are more vulnerable to erosion.

In the wider Vallejo community, erosion vulnerabilities include agricultural sector job loss, degradation of riverine ecosystems and coastlines, and loss of water quality.

Estimate of Potential Losses

The historic and potential impacts of erosion on property statewide include reduced agricultural productivity, lower surface water quality, and damaged drainage networks.

Current modeling is not precise enough to allow for an assessment of potential losses to buildings and infrastructure on campus.

Vulnerability Assessment Conclusions

While the ability to predict future erosion on the CSU Maritime campus is limited, the core issues shaping erosion vulnerability on campus are flora and landscaping. If left unchecked, erosion can cause significant damage to campus infrastructure and the surrounding environment.

Identified Data Limitations

The complex interactions between soil erosion factors make predictive modeling, determination of hazard areas, and quantification of loss difficult. Localized data on this hazard is also limited, resulting in more generalized findings.
**Flood**

Description of the Hazard

The incredible geographic diversity in California presents tremendous challenges for flood planning and response. The state is home to extensive mountain ranges such as the Sierra Nevada, Cascades, Klamath, Coastal Ranges, and the Southern California Transverse Range all creating tremendous watersheds. Large river systems drain the mountains traveling through populated communities including the Sacramento and San Joaquin Rivers draining into the California Delta. The state has a complex system of reservoirs, dams, and levees providing water storage and flood protection. Finally, California’s 840-mile coastline exposes the coastal regions to tidal influences.

Floods are characterized by the rising and overflowing of excess water from a water source such as a stream, river, lake, canal, or coastal body onto an area of normally dry floodplain. A floodplain is a lowland area downstream and adjacent to water bodies that are subject to flood events. Flooding is a naturally occurring event that become hazardous when populations and property are affected.

Flooding can result from excessive precipitation from weather systems generating prolonged rainfall, excessive snowmelt from watersheds upstream from the floodplain, infrastructure failure, exceeding the capacity of dams or levees, tidal influences, or a combination from any of the previous factors.

Flooding represents one of the costliest and most frequent natural disasters that influences human suffering and economic impact in the United States. Flooding will likely result in significant damage to structures, infrastructure, utilities, landscapes, and the environment. Erosion of stream banks, roadways, other feature may result from the movement of flood waters. The saturated ground resulting from standing flood waters may cause ground instability, collapse, erosion, or other damages. Further, floods will often generate substantial debris that will accumulate and be deposited throughout the flooded areas.

Flooding can be either slow-rise or rapid onset floods. With slow rise floods, there is often warning preceding water rise by hours or days before dangerous conditions present themselves. Slow rise floods that are expected to enter into populated areas generally allow for some time to initiate evacuation and sand bagging efforts. Flooding that occurs rapidly conversely are water events that present with extremely limited warning times and a limited ability to take response actions until flooding has already begun to occur.

Flooding may take on different forms:

- **Flash Flooding** – Flash flooding is typically characterized by a rapid rise, short duration, and large volume of water in a localized area. Heavy rainfall in areas that have limited drainage capacities often contribute to flash flooding conditions. These flooding events frequently occur with limited notice requiring immediate evacuation or rapid response efforts such as sand bagging. Flash
flooding may arrive with fast moving water creating added hazardous conditions.

- **Riverine Flooding** – Riverine flooding is usually caused by prolonged rainfall or rainfall combined with heavy snowmelt. When soils are already saturated, the ability for the ground to absorb water is minimized. In a riverine flood, the water way exceeds channel capacity and extends into areas outside of the channel, often in developed communities. In California, riverine flooding is most likely to occur from November through April. The duration of riverine floods may vary from a period of hours to weeks.

- **Localized Flooding** – Localized flooding is commonly the result of stormwater drainage systems being overwhelmed by unusually heavy rainfall. These flooding events frequently occur in areas that are urbanized or developed with greater amounts of impervious surfaces not allowing ground absorption. This generates added runoff into the drainage systems and onto roadways creating backups.

- **Infrastructure Failure** – Failures of dams or levees presents a serious flooding concern for areas downstream from the compromised structure. This situation may result in a catastrophic flood with limited warning time and widespread areas affected.

- **Coastal Flooding** – Coastal flooding can occur in multiple areas along the California coastline. Flooding may result from intense storms coming from the Pacific Ocean that generate elevated water levels or storm surge. The size, duration, winds generated, and intensity of the storm will influence the effect the waves will have on the shoreline. Periods of high tide can aggravate the conditions allowing greater wave impingement into coastal areas.

**Atmospheric Rivers**

California, including the location of this campus, is subject to the effects of a phenomenon referred to as atmospheric rivers. These weather events consist of long, narrow regions in the atmosphere transporting tremendous amounts of water vapor from the tropics. These weather regions behave like rivers in the sky. They can carry heavy volumes of water vapor compared to the amount of water flow at the mouth of the Mississippi River. As these atmospheric rivers arrive into California they tend to generate significant rain and snow.

Atmospheric rivers can arrive in many different shapes and sizes. The larger events are able to generate extreme rainfall amounts resulting in flooding. They can stall over watersheds vulnerable to flooding, often saturated with heavy snow amounts. The atmospheric rivers known as a “Pineapple Express” coming from the tropics and arriving with warmer air may produce heavy rains that will melt ground snow adding to the water volume that will be added in the flood runoff.
These events can produce heavy amounts of precipitation creating extensive damages. However, these events may present as weaker systems that produce precipitation that is enough to be beneficial for the local water supply. At the higher elevations in the California mountains, these events have the potential to generate a tremendous snowpack providing a source of water during the dry summer months.

Figure 14-8: The Science Behind Atmospheric Rivers

**The science behind atmospheric rivers**

An atmospheric river (AR) is a flowing column of condensed water vapor in the atmosphere responsible for producing significant levels of rain and snow, especially in the Western United States. When ARs move inland and sweep over the mountains, the water vapor rises and cools to create heavy precipitation. Although many ARs are weak systems that simply provide beneficial rain or snow, some of the larger, more powerful ARs can create extreme rainfall and floods capable of disrupting travel, inducing mudslides and causing catastrophic damage to life and property. Visit www.research.noaa.gov to learn more.

Location of the Hazard

Vallejo is located in Solano County on the north side of the San Francisco Bay. Solano County can experience flooding from overflowing streams and heavy precipitation events in low lying areas. These areas often experience shallow flooding impacting roadways and other areas where drainage is inadequate. The western side of Solano County is a coastal plain adjacent to the San Francisco Bay that gradually rises to the north and east at the Benicia Hills. The communities in western Solano County are densely populated with extensive residential neighborhoods. Within 2 miles of the campus are large industrial zones containing a variety of land uses including chemical facilities and distribution centers shipping different materials.

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The Cal Maritime campus is located on the San Francisco Bay waterfront with hillside elevation limiting the flooding potential that exists in the low-lying areas. The campus is situated in a ravine rising into rolling hills 20-200 feet higher than the waterfront. Creek beds that have been carved into valleys among the hills surround the campus with Interstate 80 providing the northern and western borders. The entire Cal Maritime campus sits within a Special Flood Hazard Area (SFHA) Zone X: Area of Minimal Flood Risk designation on the Flood Insurance Rate Map.

Extent of the Hazard

The Cal Maritime campus is located entirely in a designated Zone X: Area of Minimal Flood Hazard. The access routes into and out of the campus servicing locations to the south and east are found in areas primarily designated as Zone X: Area of Minimal Flood Hazard, access routes to and from the north are primarily located in Zone X: Area with Reduced Flood Risk but portions of Interstate 80 cross into Zone AE: Areas with 1% Annual chance of Flooding. Based on these factors, and no history of flooding on campus, the planning committee ranks the extent of the hazard as Low.
In support of the NFIP, FEMA identifies those areas that are more vulnerable to flooding by producing Flood Hazard Boundary Maps (FHBM), Flood Insurance Rate Maps (FIRM), and Flood Boundary and Floodway Maps (FBFM). Several areas of flood hazards are commonly identified on these maps, including the 1% annual chance flood zone. Flood zones are further delineated by risk and are assigned a letter signifier. The flood zone designations are defined and described in the following table.

Table 14-20: Flood Zone Designations and Descriptions

<table>
<thead>
<tr>
<th>Zone Designation</th>
<th>Percent Annual Chance of Flood</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Zone V</td>
<td>1%</td>
<td>Areas along coasts subject to inundation by the 1% annual chance of flooding with additional hazards associated with storm-induced waves. Because hydraulic analyses have not been performed, no BFEs or flood depths are shown.</td>
</tr>
<tr>
<td>Zones VE and V1-30</td>
<td>1%</td>
<td>Areas along coasts subject to inundation by the 1% annual chance of flooding with additional hazards associated with storm-induced waves. BFEs derived from detailed hydraulic analyses are shown within these zones. (Zone VE is used on new and revised map in place of Zones V1-30.)</td>
</tr>
<tr>
<td>Zone A</td>
<td>1%</td>
<td>Areas with a 1% annual chance of flooding and a 26% chance of flooding over the life of a 30-year mortgage. Because detailed analyses are not performed for such areas, no depths or base flood elevations are shown within these areas.</td>
</tr>
<tr>
<td>Zone AE</td>
<td>1%</td>
<td>Areas with a 1% annual chance of flooding and a 26% chance of flooding over the life of a 30-year mortgage. In most instances, BFEs derived from detailed analyses are shown at selected intervals within these zones.</td>
</tr>
<tr>
<td>Zone AH</td>
<td>1%</td>
<td>Areas with a 1% annual chance of flooding where shallow flooding (usually areas of ponding) can occur with average depths between 1 – 3 feet.</td>
</tr>
<tr>
<td>Zone AO</td>
<td>1%</td>
<td>Areas with a 1% annual chance of flooding, where shallow flooding average depths are between 1 – 3 feet.</td>
</tr>
<tr>
<td>---------</td>
<td>----</td>
<td>---------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Zone X (shaded)</td>
<td>0.2%</td>
<td>Represents areas between the limits of the 1% annual chance flooding and 0.2% chance flooding.</td>
</tr>
<tr>
<td>Zone X (unshaded)</td>
<td>Undetermined</td>
<td>Areas outside of the 1% annual chance floodplain and 0.2% annual chance floodplain, areas of 1% annual chance sheet flow flooding where average depths are less than one (1) foot, areas of 1% annual chance stream flooding where the contributing drainage area is less than one (1) square mile, or areas protected from the 1% annual chance flood by levees. No BFEs or depths are shown within this zone.</td>
</tr>
</tbody>
</table>

**History of the Hazard**

A number of areas in unincorporated Solano County have a long history of seasonal flooding, often resulting in significant damage. Localized and regional flooding in the County has been a continuous occurrence dating back to 1862 when “The Great Flood” in Davis, Rio Vista, Elmira, and Dixon wiped out the entire area. Major Disaster Declarations at the Federal level have occurred 13 times as a result of major regional flooding caused by severe storms and heavy rains in California. State Emergency Disaster Proclamations for flood damage as result of severe storm and heavy rains have been declared 6 times from 1950 to present. In addition to the declared disasters within Solano County, the computer aided dispatch information was used to develop a list of flooding events by year.

Data from the Solano County Computer-Aided Dispatch System has recorded approximately 14 different flood incidents from 2001 to 2011. Table below provides a summarized list of the dispatch information by year, cause of hazard, date of event, number of calls regarding that event and the area affected. No history of flood events are reported for the campus.

**The Winter Storms of 2005 and 2006**

As one can see in the table, flooding from the winter storms of December, 2005 and January, 2006 generated large call volumes across the entire unincorporated county. These storms also caused flood damage to approximately 121 different properties in unincorporated Solano County. Total damage estimated by the county was in excess of $4 million dollars. Some residents had over 3 feet of flood water enter areas of their home. Septic tanks were flooded and some residents experienced contamination issues with their drinking wells. The 2005-2006 winter storms also affected the Solano County municipal complex. Due to the amount of precipitation and tidal action in a City of Fairfield drainage canal, floodwaters overtopped the nearby protecting
embankment and caused extensive flooding to the municipal complex. Flooding occurred in the Solano County Court House, Jail, Sheriff’s 911 Dispatch Center, Office of Emergency Services, Facilities Operations, Communications, and Grounds Building. Many County services were displaced temporary, including the 911 Dispatch Center and County court house services. The County was self-insured. Damages for the 2005-2006 flood incident totaled more than $286,000; the cost of displacement was not included.

Potential Impacts of the Hazard

A flood will potentially result in extensive amounts of water entering onto developed areas. The force and volume of water that is generated by a flood may cause extensive structural damage in areas subject to standing or moving water. The effects of flooding may spread over significant distances covering large areas of land. The extent of the impacts would vary based on a number of factors such as the volume of water flooding, the time of the flood event, the amount of warning provided, the location and extent of the flood boundary, facility elevation, and distance from the flood source. Potential impacts resulting from flooding include:

- Injuries or loss of life
- Property destruction or damage
- Loss of property contents
- Infrastructure damage including roadways, bridges, other transportation means
- Public health hazards resulting from mold, mildew, and disease due to flood water
- Flooded or destroyed lifelines/supply routes
- Damaged or destroyed utilities
- Loss of community economic base
- Employment losses
- Agricultural (crops and livestock) damages or destruction
- Environmental damage
- Prolonged periods of necessary dewatering
- Flooding erosion may alter natural drainage channels
- Societal and community impacts
- Psychological impacts of impacted populations
- Disruptions to education delivery to community

Additionally, individuals who are unable to evacuate in time or refuse to leave will likely need assistance or rescue from the flooded area. Remaining in or being trapped
by flood waters places individuals in significant risk of injury or death. The impacts extend beyond the danger placed upon the affected individual and places greater resource demands on agencies and organizations making efforts to rescue trapped individuals.

Probability of Future Occurrence of the Hazard

Solano County has numerous areas that are determined to be at risk from flooding. The location of the Cal Maritime campus resides outside of any Special Flood Hazard Area and is along the waterfront and elevated in the hills south of Vallejo. Areas designated as a Special Flood Hazard Area remain at a distance from the campus. The potential exists for urban flooding due to heavy precipitation that overwheels drainage systems on campus.

Based on the (above) factors, the planning committee ranks the probability of future occurrence for flooding as Unlikely.

Vulnerability to the Hazard

The Cal Maritime campus is subject to the effects of limited and isolated flooding and small pockets of ponding primarily resulting from potential urban flooding due to heavy precipitation that overwheels drainage systems on campus, excessive precipitation during isolated heavy storms, river/levee overflow, or a combination of these. Creeks are located close to the campus and flow through the campus however present minimal potential for flooding and damage on campus and surrounding residential areas. The creek channels that surround the campus have limited storage or volume capacities and may present vulnerabilities to the transportation network servicing the campus.

Vulnerability to flooding on the Cal Maritime campus will vary depending on when the flood was to occur and the location of people and assets in any low lying areas. The risk to the campus population will be lessened during periods when classes are not in session or during periods of breaks. Conversely, during the days and hours that classes are in session and staff are at their workplaces, the human vulnerability increases. Members of the campus community located in a low lying ponding area may become trapped on campus depending on the level of flooding occurring on surface streets. However, in rare, region-wide events this vulnerability may be extended to the homes and workplaces of members of the campus community and their families.

The Cal Maritime campus is in proximity to a variety of industrial and commercial facilities in the surrounding communities. When these facilities are inundated with flood water, the potential for chemical or other hazardous materials release exists presenting possible exposures to individuals from the campus community. These facilities additionally line many of the primary access routes in and out of the campus.

During low probability, severe flood events, some campus buildings and infrastructure in low lying areas might be vulnerable to large-scale flooding if it
reaches the university. Campus utilities and communication capabilities would be impacted by flood waters rendering them disabled. A rare flood covering a large portion of the City of Vallejo might affect communication capabilities well beyond the boundaries of the campus. Remaining flood waters will leave behind molds and other health concerns in affected campus buildings and facilities likely requiring extensive restoration or demolishing. The residents of the on-campus residence halls in low lying areas may have transportation limitations requiring evacuation and alternative housing procedures to be implemented if populated. In such areas, flood waters may result in damage to campus equipment, communication systems, protected documents, artwork, academic materials, computer systems, research, and other critical activities on lower levels of buildings.

Certain campus populations will experience greater challenges to a post-flood / failure environment. Vulnerable populations will likely need to navigate through flood generated debris, face extreme health safety issues from flood waters, experience extreme stresses of a disaster, an inability to communicate to or gain access to support networks, and find difficulty in accessing equipment or supplies to aid in a specific need. Students remaining on campus such as those residing in the residence halls would be particularly vulnerable especially those without access to adequate transportation.

**Estimate of Potential Losses**

Estimates of potential losses will be influenced by a variety of factors. The volume and force of the water will determine the scale of damages affecting campus infrastructure, equipment, and other impacted features. The location and elevation above flood waters will affect the level of damage and individuals exposed. The time of the academic year, the day of week, and hour in which the flooding was to occur will influence the number of people on campus and potential casualties. The severity of the storms producing precipitation, the speed of the storms moving across the area, the level of snowpack in the higher elevations, and amount of resulting snowmelt will produce varying effects on damages produced and costs incurred. Losses will be generated by the physical damages, the loss of revenue, loss of academic research, loss of building contents, and community wide economic reductions.

Based on estimate replacement costs of facilities and structures on campus, the maximum total replacement costs due to flood are $83,596,545. However, it is unlikely for flood to cause destructive losses to the entire campus.

**Table 14-21: Special Flood Hazard Area (SFHA) Estimated Losses**

<table>
<thead>
<tr>
<th>Zone Designation</th>
<th>No of Buildings</th>
<th>Maximum Replacement Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Zone V</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Zone VE &amp; V 1-30</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Zone A</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Zone AE</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>----------</td>
<td>-----</td>
<td>-----</td>
</tr>
<tr>
<td>Zone AH</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Zone AO</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Zone X .2%</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Zone X Minimal Risk</td>
<td>47</td>
<td>$83,596,545</td>
</tr>
<tr>
<td>Not in a SFHA</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>No Building Value Data Provided*</td>
<td>31</td>
<td>Unknown</td>
</tr>
</tbody>
</table>

*Buildings with no value defined are also included in the respective Zones they are found in.

Vulnerability Assessment Conclusions

While the campus is located in an area of minimal flood potential (Zone X), the primary vulnerabilities to flood on campus are people and assets in low lying areas exposed to mostly localized flooding and ponding from overflow of campus creeks or low probability, large-scale storms that produce heavy amounts of precipitation directly over the campus and surrounding neighborhoods.

The potential for flooding on campus, although limited, generates potential for a number of cascading effects such as disruptions to the local economy, utility failures, disruptions to providing for the needs of the community, and development of public health hazards. These effects would be exacerbated by effects of seasonal flooding, ongoing heavy precipitation, or excessive run-off from the watershed contributing to the river system. The potential for widespread flooding and damage of structures due to the force of water, while unlikely, has exponentially powerful impacts on particular populations among the campus community including those with access or functional needs, international students, the homeless, and students residing in the residence halls.

Identified Data Limitations

Data limitations include missing campus structural replacement costs, and an incomplete inventory of both building construction features and mitigation efforts to lessen the impact due to flood inundation. HAZUS generated analysis is focused on the broader community level versus fine-tuning the analysis to the micro-level for facilities such as a university campus.
**Hazardous Materials**

**Description of the Hazard**

A hazardous material is defined in California’s State Hazardous Materials Incident Contingency Plan (1991) as “a substance or combination of substances which, because of quantity, concentration, physical, chemical, or infectious characteristics may: cause, or significantly contribute to an increase in deaths or serious illnesses; and/or pose a substantial present or potential hazard to humans or the environment.”43 Hazardous materials are one or more of the following: flammable, corrosive or an irritant, oxidizing, explosive, toxic (poisonous or infectious), thermally unstable or reactive, or radioactive. Hazardous materials are ubiquitous in modern society and may be found at all stages of production, consumption, and disposal.

Federal and state laws permit the intentional release of some hazardous materials into the environment such that the risk to human health and the environment is thought to be acceptable. However, sometimes releases are unintentional, resulting from leaks, accidents, or natural hazards. This section focuses on such accidental releases and fall into the following key categories:

**Fixed Hazardous Materials Incident:** A fixed hazardous materials incident is the accidental release of chemical substances or mixtures during production or handling at a fixed facility.

**Transportation Hazardous Materials Incident:** A transportation hazardous materials incident is the accidental release of chemical substances or mixtures during highway, waterway or air transport. Populations, built and natural environments are potentially impacted.

**Pipeline Incident:** A pipeline transportation incident occurs when a break in a pipeline creates the potential for an explosion or leak of a dangerous substance (oil, gas, etc.) possibly requiring evacuation. An underground pipeline incident can be caused by environmental disruption, accidental damage, or sabotage. Incidents can range from a small, slow leak to a large rupture where an explosion is possible. Inspection and maintenance of the pipeline system along with marked gas line locations and an early warning and response procedure can lessen the risk to those near the pipelines.

Hazardous materials can also be classified according to worker safety and health.44 Information provided by California Division of Safety and Health includes guidelines related to:

- **Safety hazards:** fire and fire byproducts, electricity, flammable gases, unstable structures, demolition, sharp or flying objects, excavations)

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- **Health hazards**: carbon monoxide ash, soot and dust; asbestos; hazardous liquids; other hazardous substances; heat illness)

**Natural-Technological Incidents (Natechs):** During the past two decades, increasing attention has been given to hazardous materials releases resulting from Natechs or a natural disaster event that triggers a technological hazard event. Natechs are of particular concern for the following reasons:

- They can produce a simultaneous effect on many industrial facilities
- Can overwhelm response capacity
- Containment systems may fail
- May produce cascading disasters
- Response may be hindered by a disaster’s impact on the physical environment

**Location of the Hazard**

Hazardous materials and infrastructure such as fuel tanks, rail lines, chemicals, hazardous waste sites and gas pipelines to varying degrees are located within the CSU system and/or within its surrounding communities. Please refer to the map (below) identifying the types and locations of hazardous materials and infrastructure on or near the CSU – Maritime campus. The planning committee has not identified specific locations of hazardous materials on campus, although identifying such locations (if present) is a campus priority. At larger scales (beyond the campus planning area) hazardous materials and infrastructure are located throughout the City of Vallejo and Solano County, and reflect different types, configurations and scales dispersed across these geographic areas.

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Extent of the Hazard

There is no comprehensive statewide vulnerability assessment available at this time. As such, the true extent of the hazardous materials risk in California and its communities is not known, meaning no overarching conclusions have been reached which have been able to integrate all qualitative and quantitative risk factors to produce a comprehensive measure of the extent of the hazard.

However, for the CSU – Maritime planning committee, although spills have not been identified on campus, based on the types and levels of hazardous materials in the larger community, it is prudent to rank the extent of the hazard for the campus as Low to Moderate, and to consider worst case scenarios as the main driver of policy in order to fully mitigate all possible hazardous materials event outcomes.

For example, according to the 2018 CA State Hazard Mitigation Plan, 400 hazardous materials problems are tied to 32 past earthquakes, including over 150 problems from
the Loma Prieta Earthquake alone.\footnote{US Geological Survey. \textit{The Loma Prieta, California, Earthquake of October 17, 1989 – Fire, Police, Transportation and hazardous Materials}. Retrieved 04.19.2021 from: \url{https://pubs.usgs.gov/pp/pp1553/pp1553c/}} That said, the plan indicates that it is likely that many such hazardous materials releases have received little attention in the past because public authorities, the media, and the public have overlooked them in the rush to address and recover from immediate disaster threats, and that responsible parties may have an incentive to understate the extent of releases or not to report them at all.

**History of the Hazard**

According to the CA Governor’s Office of Emergency Services’ Hazardous Materials Spill Report, the state experiences from 10 to 30 spill events daily. As of April 20\textsuperscript{th}, 2021 already 2096 spill events had occurred. Such events have occurred in all the cities and/or counties where CSU campuses are located.\footnote{Cal OES. \textit{Spill Report View}. Retrieved 04.21.2021 from: \url{https://w3.calema.ca.gov/operational/malhaz.nsf$defaultView?OpenView&Start=121&ExpandView}}

According to the 2018 CA State Hazard Mitigation Plan, with regard to natural-technological hazard events (Natechs), 400 hazardous materials events are tied to 32 past earthquakes, including over 150 Natech events from the Loma Prieta Earthquake alone.

For more details on specific hazmat events, please refer to the local, county and/or multi-jurisdictional hazard mitigation plans where CSU campuses are located at: \url{https://www.caloes.ca.gov/cal-oes-divisions/hazard-mitigation/hazard-mitigation-planning/local-hazard-mitigation-program}

According to the campus planning committee, no chemical spills have taken place on the campus.

**Potential Impact of the Hazard**

A large hazardous materials release could affect an entire community or city under certain conditions related to direction of air flow (air-based chemical release) and population density or the contamination of a community’s main water supply. Either type of release could necessitate large scale evacuation. By contrast, in the rural unincorporated areas where population densities are low, even in the event of a large release, the number of homes that may need to be evacuated would be significantly lower than in an urban environment. The occurrence of a hazmat incident can also result in the shut-down of transportation corridors which can last for hours at a time while the impacted area is stabilized.

The release of some toxic gases may cause immediate death, disablement, or sickness if absorbed through the skin, injected, ingested, or inhaled. Contaminated water resources become unsafe and unusable, depending on the amount of contaminant. Some chemicals cause painful and damaging burns if they come in

direct contact with skin. Prolonged and concentrated exposure to such chemicals can produce severe long-term impacts to respiratory, endocrine and nervous systems, heart and brain health.

The potential impacts of chemicals and toxic gases discussed here also apply to the students, staff and environment on the CSU – Fresno campus.

With regard to the natural environment overall, contamination of air, ground, or water may result in harm to fish, wildlife, livestock, and crops. The release of hazardous materials into the environment may cause debilitation, disease, or birth defects over a long period of time. Loss of livestock and crops may lead to economic hardships within the community.

Recent California examples include the 2016 Aliso Canyon methane gas leak\(^50\), which caused evacuation of nearby residents, many of whom experienced temporary health problems such as difficulty breathing and eye irritation; and the 2016 Fruitland metal recycle plant fire in Maywood, which released heavy metals such as lead, magnesium, copper, aluminum, antimony, calcium, iron, sulfur, tin, potassium, and zinc which pose severe risks to public health. Health effects from exposure to these metals included short-term symptoms such as irritation to the eyes, nose, throat, and lungs.\(^51\)

**Potential Impact of the Hazard (Natechs)**

Natural disasters, including earthquake, flood, and fire also pose risks to public health and the environment. For example, following the Northridge Earthquake, California State University (CSU) Northridge laboratories and chemical storage rooms experienced multiple chemical spills. Such incidents, triggered by a natural disaster, pose a significant risk to students, faculty, staff, and first responders. At a minimum, all CSU campuses are at some degree of risk from a natural-technological (combined impact) event.

In a severe flood event, floodwaters are often contaminated with hazardous materials posing a threat to public and animal health, groundwater, and other parts of the environment. These hazardous materials may be released from damaged or flooded underground tank sites (e.g., gas stations or chemical storage facilities), propane tanks, manure or human waste handling facilities, fertilizer and pesticide storage, agricultural sites, and household hazardous waste.

In a fire event, (such as the October 2017 Northern California firestorms which destroyed approximately 6,000 residences) entire neighborhoods can be burned to the ground. Hazardous material release creates public health concerns which can delay the initial steps of fire recovery, including reopening burned areas to residents and initiating debris removal activities. The post-fire “toxic sweep” poses a risk of coming


into contact with toxic substances due to the presence of synthetic and hazardous materials.

**Probability of Future Occurrence of the Hazard**

The probability of occurrence for a hazmat event on the CSU – Maritime campus can be viewed in two different ways: the history of occurrence serves as a sound predictor of future probability assuming current risk and vulnerability factors remain somewhat constant. For the purposes of the current estimate, no current data clearly indicates otherwise. As such, the probability of occurrence is Low. That said, hazmat occurrences are largely based on human error, and any changes in risk and vulnerability factors such as a decreased vigilance in materials oversight and handling practices or changes in the amount of chemicals or exposure will likely increase the probability on campus.

**Vulnerability to the Hazard**

Hazardous materials pose a risk to the campus. As identified on the hazmat map (see Location section), the following vulnerabilities are present on campus: a gas pipeline and a rail line are located close to the East and South borders of the campus footprint. Gases and chemicals being transported, if spilled or released, could severely impact human health and campus operations.

Although it is quite difficult to produce a quantitative measure of vulnerability because (unlike natural hazards) the probability of occurrence is dependent on human error, which itself is variable based upon a fluctuating set of interrelated factors, some of which lack prediction or control, given the complexity of how all natural and built environments and hazmat risks factors interrelate at the local or campus level, it is prudent to assume for planning purposes that the campus’ vulnerability is a sub-set of the larger community’s vulnerability. As such, the CSU – Maritime leadership maintains vigilance to mitigate the campus’ vulnerabilities identified above at a minimum.

**Estimate of Potential Losses**

As discussed previously, it is difficult if not impossible to produce an accurate quantitative measure of vulnerability because of the variable nature of a hazardous materials spill. For example, the release of a toxic airborne chemical in a populated area has severe impact potential, whereas the impact potential of a small chemical spill in a remote or rural area is most likely limited to remediation of soil. And, in both cases, the probability of occurrence is dependent on human error, which itself is variable based upon a fluctuating set of interrelated factors, some of which lack prediction or control. In all cases, different types and amounts of hazardous materials interact with fluctuating combinations of human error to produce different event outcomes with variable impact costs.
Vulnerability Assessment Conclusions

It is well understood that with regards to hazmat vulnerability, each campus and its surrounding community (including CSU – Maritime) operates through a complex and dynamic interaction between industrial and commercial inputs and outputs and the natural and built environment. Such activity produces hazardous materials that move through the environment along both convergent and divergent routes and across all levels of land-use from site to campus to city and county and beyond. It is also clear from a review of the Solano County hazard mitigation plan and Cal OES’ records of hazardous material spills, that such events occur with great frequency and varying degrees of severity across jurisdictions statewide. As such, in assessing the vulnerability of the CSU – Maritime campus, campus-level risks and vulnerabilities are not discreet or isolated but can become exacerbated or augmented through connections to broader community-level hazmat risks and vulnerabilities.

Finally, in order to draw conclusions on vulnerability, it should be noted that any identified vulnerabilities at the campus level and/or community level are circumscribed and potentially reduced by targeted policy and program interventions. Numerous policies and programs have been established in recent years in response to California’s widespread and complex and integrated hazardous materials risks - California established the Unified Program which consolidates and integrates the administrative requirements, permits, inspections, and enforcement activities of the following environmental and emergency response programs: the Aboveground Petroleum Storage Act (APSA) Program, Area Plans for Hazardous Materials Emergencies, the California Accidental Release Prevention (CalARP) Program, the Hazardous Materials Release Response Plans and Inventories (Business Plans), Hazardous Material Management Plan (HMMP) and Hazardous Material Inventory Statement (HMIS) requirements (California Fire Code), the Hazardous Waste Generator and Onsite Hazardous Waste Treatment (tiered permitting) Programs, and the Underground Storage Tank Program.

Identified Data Limitations

The CSU – Maritime planning committee has not provided complete information on campus-level hazmat materials and risks. Data limitations pertain to a comprehensive understanding of human activity and error related to hazardous materials control on campus over the long term.
**Landslide**

Description of the Hazard

A landslide is a down-slope movement of soil, rock, or other debris, and can also be referred to as a mass movement or slope failure. These geological hazards can range in size from a few feet to over a mile in length and width and, when heavy and rapidly moving, can cause serious damage and loss of life.

Landslides are classified based on the type of material and type of movement involved. They can range from slow-moving earth flows to fast-moving debris flows, though many large slope failures involve more than one type of movement. The primary natural triggers of slope failures are water, seismic activity, and volcanic activity. Slope saturation by water can occur from intense rainfall, snowmelt, changes in ground-water levels, and surface-water level changes along coastlines. In winter months, El Nino storms or other high rainfall events may saturate soils and trigger slope failure.

**Deep-Seated Landslides**

Deep-seated landslides, ranging in depth from ten to several hundred feet, occur as a result of geologic and hydraulic changes, such as earthquakes or increased levels of groundwater. These landslides can move slowly or quickly and can cause extensive property damage, but rarely result in loss of life.

**Debris Flows Related to Shallow Landslides**

Shallow landslides may mobilize into rapidly moving debris flows and typically occur after sudden saturation of the ground. These types of debris flows are typically more dangerous because they move rapidly, causing both property damage and loss of life.

Debris flows may also occur as a result of post-fire conditions, where wildfires have left barren ground exposed to heavy rainfall. Intense rainfall, generally greater than .5 inch per hour, has the potential to trigger a post-fire debris flow. These landslides may impact lives and properties within its deposition zone, and can result in downstream flooding. These post-fire debris flows often occur during the fall and winter following major summer fires.

**Location of the Hazard**

The susceptibility of an area to landslides depends on several variables, including magnitude of slope gradients, water content, ground cover, presence of erosion, and slope material and structure. However, landslides are most prevalent in terrain with weak material and steep slopes, and the highest risk is found in areas with high rainfall or high earthquake potential. Slope failures are also most likely to occur in

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areas where they have occurred in the past. In California, the most landslide-prone areas are found along the coast and in the northern Franciscan Formation.

General landslide vulnerability can be estimated from the distribution of weak rocks and steep slopes as seen in Figure 14-11. The Maritime campus is located adjacent to a small area of moderate landslide susceptibility, but due to its topography is not susceptible to direct impacts to campus assets.

Figure 14-11: Deep-Seated Landslide Susceptibility Surrounding Cal Maritime

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**Extent of the Hazard**

The extent of landslide hazards in Solano County is limited to the steepest slopes found in the southeast and west. However, the indirect impacts of landslides in the region may cover a larger geographical extent. Based on these factors and the campus location, the planning committee ranks the extent of the hazard as **Low**.

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History of the Hazard

FEMA has declared 7 major disasters that involved landslides, mudslides, or mud flows since 1982 in Solano County, all of which were a result of storms or flooding. The campus has no history of landslide occurrences.

Potential Impacts of the Hazard

Cal Maritime may be impacted by the disruption of services as a result of landslides in the region. Landslides can result in physical damage to buildings and property and have the potential to significantly effect infrastructure. As a landslide moves, it distresses structural foundations by settlement, cracking, and tilting. Fast-moving flows can remove entire structures in one instance, while other types of flows can cause damage gradually.

Transportation and utility infrastructure are particularly vulnerable to landslides, since the failure of any component can disrupt service over a large area. The loss of power and communication and disruption of transportation can have cascading effects throughout an area, including impaired disposal of sewage, contamination of water supplies, and the release of flammable fuels. Transportation routes are also often expensive to clean up, and prolonged obstruction can disrupt the movement of people and goods for long periods of time.

Probability of Future Occurrence of the Hazard

Slope failures are often triggered by other natural hazards such as heavy rainfall and earthquakes, so landslide frequency is often related to the frequency of these other hazards. As climate change impacts the frequency and intensity of triggers such as rain events, fires, and coastal erosion, landslides may generally occur more often. Historically, landslides have not occurred frequently in Solano County and therefore are likely to occur only occasionally in the future. Based on the campus’ location, the planning committee ranks the probability of occurrence on campus as Unlikely.

Vulnerability to the Hazard

The vulnerability of the built environment to landslides depends on exposure and is more likely to incur damage as a result of proximity, rather than inferior structural design. The structures most vulnerable to landslides are buildings and utility/transportation lifelines, which can be impacted by either impact or ground deformation. Utilities and transportation infrastructure are particularly vulnerable, due to their geographic extent and susceptibility to physical distress.

Any population proximal to a landslide when it occurs is vulnerable to its impacts. The campus’ vulnerability is limited to secondary impacts to access routes.

Estimate of Potential Losses

There are no current models for estimating potential losses from a landslide directly impacting the campus.
Although the economic impact of landslide damage can exceed that of the direct repair costs, there are currently no applicable methods for estimating indirect costs related to Cal Maritime.

**Vulnerability Assessment Conclusions**

Community exposure to landslides varies depending on their physical locations – whether in flat plains or on steep hillsides – and on their dependence on critical infrastructure located in landslide hazard zones.

Landslides could impact the campus in a variety of ways, primarily related to indirect impacts to transportation and utilities. Utility outages can impact health, particularly for vulnerable populations, and can cause interruptions in operations. Interruptions may impact student and employee’s ability to travel to campus and the delivery of classes and events.

**Identified Data Limitations**

The ability to predict future landslides at the Cal Maritime campus is limited. However, the USGS estimates that climate change-induced shifts in weather will increase the frequency of post-wildfire landslides, which are expected to occur almost every year in California.

**Power Outage**

**Description of the Hazard**

California State University Maritime Academy (Cal Maritime) is located on the waterfront of Vallejo, California a city in Solano County. Vallejo is along the northeast shore of the San Pablo Bay, which is 30 miles north of San Francisco.

Most aspects of modern life, and almost all aspects of urban life, rely on the availability of reliable utilities, such as electricity, water, and natural gas. An interruption in the supply or distribution of these commodities can leave highly populated areas like Vallejo without basic services, such as electricity or sanitation. These interruptions can be cascading effects from other hazard events, such as windstorms, floods, wildfires and earthquakes, or they can be caused by intentional disruptions of transmission lines.

A power outage event can interrupt day-to-day operations of the Cal Maritime campus, like in-person classes, impede or limit digital, telephonic or radio communications, create traffic jams around the busy avenues and boulevards surrounding the campus, close the student health center, and close restaurants around campus and outside the campus. Additionally, thousands of Cal Maritime student residents in on-campus housing would also be affected by a power outage on campus and in the area.

Additionally, a severe outage to Solano County or the City of Vallejo would also directly affect the campus and the community creating social, economic, and potential health and safety impacts.
Electric power disruptions and outages fall into two categories: intentional and unintentional.

The four types of **intentional** disruptions are:

- Planned: Some disruptions are intentional and can be scheduled based on maintenance or upgrading needs.
- Unscheduled: Some intentional disruptions must be done "on the spot" in response to an emergency.
- **Demand-Side Management:** Some customers (i.e., on the demand side) have entered into an agreement with their utility provider to curtail their demand for electricity during periods of peak system loads.
- **Load Shedding:** When the power system is under extreme stress due to heavy demand and/or failure of critical components, it is sometimes necessary to intentionally interrupt the service to selected customers to prevent the entire system from collapsing. These intentional interruptions result in rolling blackouts.

**Unintentional** or unplanned disruptions are outages that come with essentially no advance notice or warning. This type of disruption is the most problematic. The following are categories of unplanned disruptions:

- Accident by the utility, utility contractor, or others.
- Malfunction or equipment failure.
- Equipment overload (utility company or customer).
- Reduced capability (equipment that cannot operate within its design criteria).
- Tree contact other than from storms.
- Vandalism or intentional damage.
- Weather, including lightning, wind, earthquake, flood, and broken tree limbs taking down power lines.
- **Wildfire** that damages transmission lines.

**Location of the Hazard**

Although power outages can take place within a certain area, as a hazard, it has the potential to occur and affect the entire planning area equally.

**Extent of the Hazard**

In order to anticipate outage conditions and reduce impacts, campus facility managers and others keep track of conditions and data provided by the media, municipal utilities and the California Independent System Operator (CAISO). CAISO is tasked with managing the power distribution grid that supplies most of California, except in areas served by municipal utilities and is thus the entity that coordinates statewide flow of
electrical supply. CAISO uses a series of stage alerts to the media based on system conditions. The alerts are:

- Stage 1 - reserve margin falls below 7 percent.
- Stage 2 - reserve margin falls below 5 percent.
- Stage 3 - reserve margin falls below 1.5 percent.

Rotating blackouts become a possibility when Stage 3 is reached. Utility agencies aim to advise affected areas approximately 48 hours in advance of a potential Public Safety Power Shutoff (PSPS) event and will attempt notification again approximately 24 hours before power is shut off. Campus staff respond accordingly.

Given the prevalence of rolling blackouts and other power outages in California, the campus maintains safety precautions, situational awareness, access to emergency power generators and other protocols for managing campus power outages. Given that recorded outages have taken place on campus, the planning committee ranks the extent of the power outage hazard as **Moderate**.

### History of the Hazard

Cal Maritime has not reported experiencing any power outages in recent years.

### Potential Impacts of the Hazard

Instructors, campus residents, staff, and administration rely on electricity for basic operations. During a widespread power failure, it may take anywhere from several hours to days to restore operations if a significant event occurs. Electrical power may be the only cooling source for many individuals around the campus and its community, and long-term outages can potentially put people’s health and life at risk. Disruptions in the supply of heating fuel may put people and property at risk during extremely cold weather if it relies on electric generation or heating mechanisms instead of gas. Additionally, many medical devices, communications devices, and security rely on power to maintain their functions.

### Climate Change and Energy Shortage

Climate change is expected to bring more frequent and intense natural disasters. These changes have created a variability at a rate that makes historical data a poor predictor of future climate. For example, the warmest years on record in California occurred in 2014, 2015, and 2016. The 2016-2017 year broke the record as the wettest ever recorded in the northern Sierra Nevada Mountains.

Changes in temperatures, precipitation patterns, extreme events, and sea-level rise have the potential to decrease the efficiency of thermal power plants and substations, decrease the capacity of transmission lines, render hydropower less reliable, spur an increase in electricity demand, and put energy infrastructure at risk of flooding.
With climate warming, higher costs from increased demand for cooling in the summer are expected to outweigh the decreases in heating costs in the cooler seasons. Hotter temperatures in California will mean more energy (typically measured in “cooling-degree days”) needed to cool homes and businesses both during heat waves and on a daily basis, during the daytime peak of the diurnal temperature cycle. During future heat waves, historically cooler coastal cities (e.g., San Francisco and Los Angeles) are projected to experience greater relative increases in temperature, such that areas that never before relied on air conditioning will experience new cooling demands.

Secondary impacts of energy shortages are most often felt by vulnerable populations. For example, those who rely on electric power for life-saving medical equipment, such as respirators, are extremely vulnerable to power outages. Also, during periods of extreme heat emergencies, the elderly and the very young are more vulnerable to the loss of cooling systems requiring power sources.

**Probability of Future Occurrence of the Hazard**

The probability of California experiencing a power outage can be difficult to quantify but is a hazard that occurs annually during the same seasonal periods of temperature variance throughout the calendar year. The City of Vallejo and Solano County experience such outages. As such, the probability ranking for the Vallejo area is **Likely**. Although the Cal Maritime campus has not recorded power outage events, it is connected to the power grid of the surrounding area; as a result, it is prudent to assign this same ranking (i.e., “**Likely**”) for the campus.

Climate models suggest summer global temperatures are likely to increase while changes between temperature extremes would be more pronounced. As such, it is expected that power outages will occur more frequently in the future.

**Vulnerability to the Hazard**

Based on the data available, and in consideration of the increasing effects of climate change, the probability of future occurrences prompting intentional outages and creating unintentional power outages the hazard is high for the county in different areas but not specifically influencing Cal Maritime. Nonetheless, campus leadership would be well-advised to reduce vulnerabilities through consistent use of safety and operational protocols and emergency power sources to ensure it is able to mitigate an interruption to electrical power.

**Estimate of Potential Losses**

The data provided by Cal Maritime did not report any value for potential losses due to power outage.

**Vulnerability Assessment Conclusions**

Elevators, entry ways, air filtration systems and lighting provide the campus community with the necessary infrastructure and systems to function and navigate through the campus and to maintain a safe campus environment and visibility during
nighttime hours. The primary concern for campus leadership is that a loss of power can lead to potential hazards to students, faculty, and staff at Cal Maritime. Vulnerable populations (especially students, staff, and faculty with physical disabilities) may be the most heavily affected by loss of power, as they rely on elevators, entry ways with automatic doors, and locks and lights; a power outage would impede a disabled student’s ability to travel and utilize the campus and its structures safely.

The use of communication devices, billing, records, and electrical tools may also become unusable due to a loss of electricity. Many records and billing items may have to revert to “by-hand” procedures and paper copies may have to be kept to continue operations. Additionally, classrooms may not be usable if lighting equipment is not functioning impacting a semester or quarter’s progress for the academic year.

**Identified Data Limitations**

Maritime Academy did not report any monetary or life losses due to a power outage. Also, the campus did not report any incidents involving a power outage directly affecting the campus community and operations.

**Tsunami**

**Description of the Hazard**

A tsunami is a wave triggered by any form of land displacement along the edge or bottom of an ocean or lake. Land displacement can be in the form of submarine landslides or submarine dip-slip faults. These types of faults cause ruptures that result in seafloor uplift or down-drop. This mass movement translates to a tsunami or gravity wave within the overlying water at the surface.

Tsunamis travel radially outward from the area of initiation. The size of a tsunami is proportional to the mass that moved to generate the tsunami. As a tsunami approaches the shore and the depth of the water column decreases, the energy in the wave pushes the wave crest above the water surface resulting in a larger wave height. Wave runup is the elevation above mean sea level on dry land that a tsunami reaches. Run-up is what causes inundation of coastal areas that are below the run-up height.

There are two types of source regions for tsunamis—resulting in local and distant source tsunamis as viewed from the affected shoreline. Local tsunamis are typically more threatening because they afford at-risk populations only a few minutes to find safety. California is vulnerable to, and must consider, both types. Identifying tsunami hazards requires 1) evaluating the potential for submarine mass movement both locally and at great ocean distances, and 2) identifying coastal regions within the direct or indirect path of a potential tsunami wave that are below the run-up height.

Tsunamis can travel at speeds of over 600 miles per hour in the open ocean and can grow to over 50 feet in height when they approach a shallow shoreline, potentially causing severe damage to coastal development. At the shoreline, tsunamis may take
the form of a fast-rising tide, a cresting wave, or a bore (a large, turbulent wall-like wave). The bore phenomenon resembles a step-like change in the water level that advances rapidly (from 10 to 60 miles per hour). The first wave is usually followed by several larger and more destructive waves.

**Location of the Hazard:**

According to the 2018 CA State Hazard Mitigation Plan, tsunami locations span 94 incorporated communities and 83 unincorporated areas across 20 coastal counties.

As identified on the map (below), the CSU – Maritime campus is located approximately \( \frac{1}{2} \) mile from the tsunami inundation zone. The campus is located on a bluff above the coastal inundation area.

Figure 14-12: CSU Maritime Academy Tsunami Inundation Area
Extent of the Hazard

The factors shaping the extent or severity of the hazard are a combination of geophysical forces (the amount of vertical and horizontal motion of the sea floor, the area over which it occurs, and the efficiency with which energy is transferred from the earth’s crust to the ocean water) and the geographic range of coastal development to be impacted.

More specifically, as a tsunami approaches the shore, wave run-up is the elevation above mean sea level on dry land that a tsunami reaches. A tsunami’s potential severity can be forecasted as a function of the wave’s mass along with the difference between the wave’s run-up height and the ground elevation of the affected coastal location.

There are two types of source regions for tsunamis—resulting in local and distant source tsunamis as viewed from the affected shoreline. Local tsunamis are typically more threatening because they afford at-risk populations only a few minutes to find safety. California is vulnerable to, and must consider, both types. Identifying tsunami hazards requires 1) evaluating the potential for submarine mass movement both locally and at great ocean distances, and 2) identifying coastal regions within the direct or indirect path of a potential tsunami wave that are below the run-up height.55

Although no record of tsunami losses have taken place in Vallejo CA, the infamous 2011 tsunami that devastated parts of Japan also arrived in the East Bay 10 ten hours later at just over a foot in height. Although the campus lies outside the inundation zone, the planning committee ranks the extent of tsunami as Moderate given that the campus lies close to the inundation zone and may be secondarily impacted by displaced evacuees. Moreover, since 1854, more than 71 tsunamis have been recorded in San Francisco Bay, most often generated by earthquakes in subduction zones near Russia, Japan or Alaska.

History of the Hazard:

The California Seismic Safety Commission report, the Tsunami Threat to California Findings and Recommendations on Tsunami Hazards Risks, published in December 2005, indicates that over 80 tsunamis have been observed or recorded along the coast of California in the past 150 years. That said, no tsunamis have impacted CSU campus locations.

According to the National Centers for Environmental Information (NCEI), have been eight tsunamis have caused damage to ports and harbors or coastal inundation in California since 1946. The most significant events are as follows:

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In 1964, a tsunami caused by a Magnitude 9.2 earthquake offshore from Alaska resulted in 13 deaths in California and destroyed portions of downtown Crescent City.

A 2006 tsunami (originating in the Kuril Islands region north of Japan) caused approximately $20 million in damage to Crescent City harbor.

A 2010 tsunami (originating offshore from Chile) caused millions of dollars in damage to ports and harbors in the state.

A tsunami in 2011 (caused by a Magnitude 9.0 earthquake offshore of Japan) killed one person at the mouth of the Klamath River and caused up to $100 million of damage to 27 ports, harbors, and marinas throughout the State. The most damage occurred in Crescent City, Santa Cruz and Moss Landing harbors and a federal disaster was declared in Del Norte, Santa Cruz, and Monterey Counties. Both Crescent City and Santa Cruz harbors sustained damage to all docks, and oil spills and water/sediment contamination that resulted from sunk or damaged boats. Because recovery efforts in these two harbors took several years to complete, both harbors incurred business/economic losses that have been difficult to recapture.

Tsunamis That Have Affected North Coast California

- 03/20/1855: M 6.0 Earthquake; Humboldt Bay; wave height/feet (0.0)
- 11/24/1885: Meteorological Event Eureka; wave height/feet (0.0)
- 04/01/1946: M 8.6 Earthquake, Unimak Island, AK Humboldt Bay; wave height/feet (0.0)
- 03/28/1964: M 9.2 Earthquake, Prince William Sound, AK
  - Trinidad; wave height/feet (8.9)
  - King Salmon Slough, Humboldt Bay; wave height/feet (4.5)
  - Humboldt Bay; wave height/feet (6.2)
  - North Spit, Humboldt Bay; wave height/feet (3.1)
  - Municipal Marina, Eureka; wave height/feet (5.1)
  - Pacific Gas & Elec., Humboldt Bay; wave height/feet (3.8)

- 4/25/1992: M 7.2 Earthquake, Cape Mendocino, N. CA
  - Trinidad; wave height/feet (3.0)
  - North Spit, Humboldt Bay; wave height/feet (0.7)
  - Clam Beach; wave height/feet (0.0)

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56 Global Historical Tsunami Database, National Center for Environmental Information, 2019
- 11/17/2003: M 7.8 Earthquake, Rat Islands, AK North Spit, Humboldt Bay; wave height/feet (0.2)
- 06/15/2005: M 7.2 Earthquake, N. California North Spit, Humboldt Bay; wave height/feet (0.1)

Since 1854, more than 71 tsunamis have been recorded in San Francisco Bay, most often generated by earthquakes in subduction zones near Russia, Japan or Alaska.

Finally, in 2011, a tsunami that devastated parts of Japan also arrived in the East Bay 10 ten hours later at just over a foot in height.

Potential Impacts of the Hazard:

Tsunamis can travel at speeds of over 600 miles per hour in the open ocean and can grow to over 50 feet in height when they approach a shallow shoreline, potentially causing total devastation to coastal development.

The configuration of the coastline, the shape of the ocean floor, and the characteristics of advancing waves play important roles in the destructiveness of the waves. Bays, sounds, inlets, rivers, streams, offshore canyons, islands, and flood control channels may cause various effects that alter the level of damage. Offshore canyons can focus tsunami wave energy, and islands can filter the energy. It has been estimated that a tsunami wave entering a flood control channel could reach a mile or more inland, especially if it enters at high tide. The orientation of the coastline determines whether the waves strike head-on or are refracted from other parts of the coastline.

For Solano County, potential impacts include destruction of the natural environment, destruction of boats as well as other coastal development, and loss of life. Tsunamis that impact both harbors and communities also can produce free-floating debris hazards and environmental contamination from chemical spills. Finally, an exceedance of the local emergency management and response capacity (including evacuee management) define the secondary or indirect impacts to the campus.

Probability of Future Occurrence of the Hazard:

The California Seismic Safety Commission report, the Tsunami Threat to California Findings and Recommendations on Tsunami Hazards Risks, published in December 2005, indicates that over 80 tsunamis have been observed or recorded along the coast of California in the past 150 years. If we consider historical occurrence as one data set for estimating future events, the average rate of occurrence over the past 150 years is 1 tsunami every 1.9 years. And for overall San Francisco Bay Area, 71 tsunamis over the past 165 years (1854-2019) produces an annual recurrence interval of 1 event every 2.3 years. As such, the planning committee ranks the future occurrence of the hazard as Likely over the long term.
That said, the rate of future occurrence may change and may be able to make target estimates for specific locations in the future; the California State Tsunami Program is trying to refine the accuracy of the data. In doing so, the State Tsunami Program is completing a set of Probabilistic Tsunami Hazard Analysis (PTHA) maps representing risk levels from 100-year to 3000-year average return periods. Analysis using these probabilistically based products will allow for a more common platform for comparison to other seismic and flood probabilistic analyses. 57

Vulnerability to the Hazard

With regard to CSU campus locations, direct vulnerability of assets and people to tsunami only applies to the CSU Chancellor’s Office in Long Beach, CA, as it is the only campus located in a mapped tsunami zone.

With regard to CSU – Maritime’s vulnerabilities, while no campus assets have been identified, the campus planning committee indicates that the California Geologic Survey datasets associated with Tsunami inundation zones might be utilized in the future if it is determined that any critical assets on, or owned by the campus fall within zones of vulnerability or if the campus is determined to be vulnerable to secondary impacts.

Population Vulnerability

The populations most vulnerable to the tsunami hazard are the elderly, disabled and very young who reside near beaches, low-lying coastal areas, tidal flats and river deltas that empty into ocean going waters. In the event of a local tsunami generated near the coast, little warning time would exist, so more of the population would be vulnerable, and this vulnerability may pertain to the Humboldt State University planning area. According to the campus planning committee, a tsunami could create isolated islands of people due to the inundation, and no evacuation or access to hospital services.

Property Vulnerability

The impact of tsunami waves and the scouring associated with debris that may be carried in the water could be damaging to all structures along beaches, low-lying coastal areas, tidal flats and river deltas. The most vulnerable structures are those in the front line of tsunami impact and those that are structurally unsound. According to the campus planning committee, it is thought that some degree of research equipment and research vessels are occasionally docked or moved in and around mapped tsunami zone coastal areas.

Critical Facilities and Infrastructure Vulnerabilities

The following vulnerable infrastructure is located in coastal areas of Solano County, CA:

57 2018 State of California Hazard Mitigation Plan
• Water Proximate Infrastructure—Breakwaters and piers collapse, sometimes because of scouring actions that sweep away their foundation material and sometimes because of the sheer impact of the tsunami waves.

• Flood Control Systems—Floodwaters can back up drainage systems, causing localized flooding. Culverts can be blocked by debris from tsunami events, also causing localized urban flooding.

• Utility Systems—Floodwaters can get into drinking water supplies, causing contamination. Sewer systems can be backed up, causing waste to spill into homes, neighborhoods, rivers and streams. Tsunami waves can knock down power lines and radio/cellular communication towers. Power generation facilities can be severely impacted by wave action and by inundation from floodwater.

• Fuels— Destruction of fueling infrastructure and related environmental and potable water contamination can occur.

Estimate of Potential Losses

Estimates of potential tsunami losses specific to Solano County have not been conducted yet. However, for the East Bay region (including Solano County), the HAZUS analysis indicated that 57 port systems have a replacement value of over $206B dollars. Given the potentially catastrophic nature of tsunamis, this should be considered realistic.

Vulnerability Assessment Conclusions

According to the 2018 State of California Hazard Mitigation Plan, community exposure to tsunamis in California varies considerably—some communities may experience great losses that reflect only a small part of their community and others may experience relatively small losses that devastate them. Solano County is among the 94 incorporated communities and 83 unincorporated areas that are most vulnerable to injury and life safety from tsunamis.

To improve tsunami vulnerability assessments, FEMA has developed a new tsunami loss estimation module for HAZUS using existing numerical model results for tsunami inundation, flow depth, velocity, and force. This HAZUS module allows new capability for estimation of economic losses, and site-specific analysis of content losses, casualties, infrastructure damage, and evacuation time. The module calibrates losses based on safe zones and community preparedness levels. Such technological improvements in assessment capability can be utilized for tsunami hazard analysis and planning purposes for CSU - Maritime.

Along with new probability-based tsunami maps, the HAZUS module will improve the ability to compare tsunami impacts to those of other hazards. Moreover, the probability mapping will be used for numerous applications including identifying potential tsunami hazard “zones of required investigation” under the Seismic Hazards Mapping Act and will assist state and local agencies in making land use planning
decisions and will help regional and state planners understand the flood potential from tsunamis representing different risk levels. The improved analysis and data will be utilized by Humboldt State University through its partnerships with key stakeholder organizations.\(^{58}\)

**Note:** To download the Community Exposure to Tsunami Hazards in California report visit the USGS website: [http://pubs.usgs.gov/sir/2012/5222/](http://pubs.usgs.gov/sir/2012/5222/).

**Identified Data Limitations**

As identified in the Vulnerability Summary (above), with regard to the current planning effort, the primary data limitations for assessing the tsunami hazard are comprehensive asset valuations lying within the tsunami inundation zone, and the need to apply FEMA’s new probability mapping techniques and tsunami loss estimation module to the footprint of each campus. That said, CSU leadership and planning teams intends to pursue such data in the future.

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**Volcano (Associated Air Quality)**

**Description of the Hazard**

The US Geological Service defines volcanoes as “openings or vents where lava, tephra (small rocks), and steam erupt on to the Earth’s surface. Through a series of cracks within and beneath the volcano, the vent connects to one or more linked storage areas of molten or partially molten rock (magma). This connection to fresh magma allows the volcano to erupt over and over again in the same location.”\(^{59}\)

A volcanic eruption occurs when magma, lighter than surrounding rock, is driven upwards by its buoyancy and by pressure from the dissolved gases contained within it. Gases are released from magma as it reaches the surface and pressure decreases. Magma can be erupted in several ways and violent eruptions typically cause tiny pieces of tephra (ash) to be carried away by the wind. This ash is hard, does not dissolve in water, is extremely abrasive and mildly corrosive, and conducts electricity when wet.\(^{60}\)

The gases released in an eruption include carbon dioxide, sulfur dioxide, hydrogen sulfide, and hydrogen halides. Depending on their concentration, these are potentially hazardous to people, animals, agriculture, and property.

**Location of the Hazard**

There are eight volcanic areas located throughout California. Seven of these - Medicine Lake Volcano, Mount Shasta, Lassen Volcanic Center, Clear Lake Volcanic Field, Long Valley Volcanic Region, Coso Volcanic Field, and Salton Buttes – are

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\(^{58}\) 2018 State of California Hazard Mitigation Plan


considered active volcanoes. No portion of Cal Maritime or Solano County is within a volcano hazard zone.

Extent of the Hazard

Volcanic hazards are most severe within a few miles of the volcano vent and the severity generally decreases with distance. Ash impact zones can range from tens to hundreds of miles from the vent source. The US Geological Survey has estimated zones surrounding active volcanoes wherein 2 inches or more of ashfall following an eruption is possible. While Cal Maritime does not fall within an estimated ashfall zone, lighter dustings of ash outside of those areas may directly or indirectly impact the campus. As such, the planning committee ranks the extent of the hazard for the campus as Low.

History of the Hazard

No historical eruption events in California have affected the campus. Over the last 1,000 years, there have been at least 12 eruptions in California.11 The most recent volcanic eruption in California occurred at Lassen Peak about 100 years ago, when a major explosion delivered windborne ash over 275 miles away.12

Potential Impacts of the Hazard

The specific impacts vary widely and depend on which type of volcano erupts, the style of explosion, the volume of lava, the eruption duration, and the local water conditions. As Cal Maritime is not proximal to an active volcano, only the potential impacts of ashfall and gases have been detailed. While both these hazards can be widespread, their most severe impacts are generally seen closer to the volcanic source.

Although ashfall is typically a nonlethal volcanic hazard, it is the most widespread and disruptive. Falling ash can damage crops, electronics, and machinery. It can also impact human health by irritating the respiratory tract, eyes, and skin. The particles may enter drinking water and structures and may cause structure failure if it is thick and heavy enough. Even a fine layer of ash can disrupt utilities. A portion of California’s major electric transmission lines, aerial telecommunication lifelines, transportation corridors, and water storage and conveyance lie within the state’s volcano hazard zones. Impacts to any of these can impact operations at Cal Maritime.

The potential impacts of gases released during volcanic eruptions are as follows:

- Carbon dioxide typically becomes diluted very quickly and is not life threatening. However, it can become trapped in higher concentrations in low-lying areas and has the potential to be fatal.
- Sulfur dioxide can cause acid rain and air pollution downwind of a volcano.
- Hydrogen sulfide can cause irritation of the upper respiratory tract. At high concentrations it can cause unconsciousness and death.
Hydrogen halides can coat ash particles and, once deposited, poison drinking water, agricultural crops, and grazing land.

Probability of Future Occurrence of the Hazard

The US Geological Survey, based on the record of volcanic activity in California, estimates that the probability of another small- to moderate-sized eruption in the next thirty years is about 16 percent. As such, the annual probability of future occurrence for the campus is ranked by the committee as Low.

Vulnerability to the Hazard

Populations living near volcanoes are the most vulnerable to eruptions and lava flows. However, volcanic ash can travel and affect populations miles away. The location and thickness of ash in any given area is a function of the severity of the eruption and wind speed and direction. For Cal Maritime, there is low vulnerability to the immediate impacts of volcanic eruptions due to the limited area affected and remote potential of an eruption. In the event of a widespread ashfall event, the elderly, infants, and populations with existing respiratory disease will be at higher risk.

Estimate of Potential Losses

Impacts to critical infrastructure, agriculture, and property from ashfall have the potential to cause widespread disruption, damage, and economic loss throughout the state. In the event of a widespread ashfall event, impacts will be immediate.

Current modeling is not precise enough to allow for an assessment of potential losses from ashfall to structures or infrastructure on or surrounding the campus.

Vulnerability Assessment Conclusions

Cal Maritime is unlikely to experience the direct impacts of a volcanic event. While the campus may be indirectly impacted by ashfall elsewhere in the state, direct ashfall impacts are generally unlikely but possible in a widespread event. However, the likelihood of any volcanic eruption in the state impacting the campus is very low.

Identified Data Limitations

Not all active volcanoes in California have been zoned for hazards by the US Geological Survey. This, together with the infrequent occurrence of volcanic explosions and number of factors determining type and extent of impacts, make the quantification of potential loss difficult.
**Wildfire**

Description of the Hazard

While wildfires are a natural part of California’s ecosystem, wildfires in California represent a hazard that presents one of the greatest probabilities of destruction along with a demonstrated history of catastrophic fire events in recent years. The destructive fire seasons of 2017 to 2020 illustrated the destructive forces fire presents to communities across the state. Wildfires may result in the structural loss, infrastructure loss, dangerous air quality, environmental damages, economic impacts, injuries, and loss of life. In many communities throughout California, wildfire presents greatest risk to human life and property.

Wildfires have been defined as any free burning vegetation fire that initiates from an unplanned ignition, whether natural or human caused demanding fire suppression actions to contain. These fires are prone to become uncontrolled, spreading through vegetative fuels rapidly exposing people and structures to harm. Wildfires present a significant risk to communities across the state, as evidenced by increasing trends of structural losses from wildland fires. This risk is elevated in areas where development and community growth has intersected, also known as the wildland-urban interface (WUI). In the interface setting, development itself can provide additional fuel for large fires. Recent fires have also demonstrated the ability of fire to consume populated areas in extreme conditions.

California’s Mediterranean climate in combination with its geography and vast population create a combination of factors that promotes an optimal environment for large fire growth and consequences. As there is great diversity of geographic characteristics across the state, the risks and potential consequences of wildfire must be assessed locally. The physical location, weather patterns, local fuel types and volume, extent of the WUI, topography, and additional factors will factor differently from part of the state to another.

The behavior of wildfires in California is significantly influenced by three distinct geographic factors. These factors will help shape the size, direction of spread, rate of combustion, fire intensity, and ability to pre-heat fuels. The physical factors contributing to wildfire behavior include:

- **Topography** – The rate in which wildfires spread increases with greater slopes in topography. The greater the slope will result in more pre-heating of fuel above the advancing fire. The direction that a slope faces will also influence fire behavior as south facing slopes receive greater solar radiation and thus drier vegetation that is more susceptible to combustion. Ridgetops often denote the end of fire spread as fire has greater difficulty spreading downhill.
- **Weather** – Weather factors substantially in influencing the behavior of wildfires. Wind, temperature, humidity, lightning, and lack of precipitation all contribute to a fire’s ability or inability to spread and intensify. California routinely experiences conditions in which these factors are in alignment to...
contribute to extreme fire behavior during the summer and fall seasons. High winds, low humidity, and high temperatures provide an environment promoting extreme fire activity.

- **Fuels** – Certain types of vegetation are increasingly prone to igniting and promote more intense burning. Areas with greater “fuel loading” (amount of fuel present in terms of weight of fuel per unit of area) increases the amount of fuel to fuel a fire. Greater volumes of dead or dry vegetation compared to live plants is a critical factor. Vegetation during drought conditions will experience decrease in moisture content increasing the conditions for combustion. Fuels close proximity to one another allows for rapid spread through contact or radiant exposures.

A risk assessment for wildfires should be implemented within a geospatial context focusing on the specific location features and incorporates the three components of the wildfire risk triangle – likelihood, intensity, and susceptibility.

**Location of the Hazard**

Substantial portions of the State of California are exceptionally vulnerable to wildfire activity or reside in a wildland-urban interface (WUI) area due to the vast open spaces, rangelands, forests and other lands with high susceptibility to fire occurring throughout the state. The Cal Maritime campus is located in a suburban setting along the San Francisco Bay waterfront. This plain is surrounded by hills largely covered in moderate to high fuel density areas. In general, areas considered to be within Local Fire Hazard Severity Zones defined by the Fire and Resource Assessment Program (FRAP) within the California Department of Forestry and Fire Protection (CalFire) occur east and west of the campus. These hills surrounding Solano County communities can be topographically diverse, contain heavier vegetative fuels, and often have residential development interspersed.

The Cal Maritime campus is located in the southern portion of the City of Vallejo. The area immediately surrounding the campus is predominately waterfront and developed with residential land uses. Residential neighborhoods exist to the north and west of the campus. The campus has open fields to the east of the campus and opposite of Interstate 80. The area to the east of campus has a history of wildfire events but is not designated as a Local High Fire Hazard Severity Zone. To the north of the campus, are residential neighborhoods and valleys containing creek beds and containing heavy fuels.
Extent of the Hazard

The area immediately surrounding the Cal Maritime campus is not designated as High Fire Hazard Severity Zones. However, the campus is bordered on two sides by such zones made up of hillsides and open lands containing combustible vegetation combined with residential development and a history of wildfire activity. Cal Maritime also has a history of wildfire activity occurring both within proximity to and directly on its campus. As a result, the planning committee ranks the extent of the wildfire hazard for the Cal Maritime campus as High.

The National Fire Danger Rating System (NFDRS) is the current system in use for rating and classifying the potential danger of fire. The NFDRS tracks the effects of previous weather events on both dead and live fuel loads and adjusts accordingly based on future or predicted weather conditions. These complex relationships and equations are computed, and the outputs are expressed in terms that users can

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quickly and easily understand. The current NFDRS is used by all federal and most state agencies to assess fire danger conditions.

The following table depicts the NFDRS, from the US Forest Service’s Wildland Fire Assessment System.

**Table 14-22: National Fire Danger Rating System**

<table>
<thead>
<tr>
<th>Rating</th>
<th>Basic Description</th>
<th>Detailed Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>CLASS 1: Low</td>
<td>Fires not easily started</td>
<td>Fuels do not ignite readily from small firebrands. Fires in open or cured grassland may burn freely a few hours after rain, but wood fires spread slowly by creeping or smoldering and burn in irregular fingers. There is little danger of spotting.</td>
</tr>
<tr>
<td>Danger (L)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>COLOR CODE:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Green</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CLASS 2:</td>
<td>Fires start easily and spread at a moderate rate</td>
<td>Fires can start from most accidental causes. Fires in open cured grassland will burn briskly and spread rapidly on windy days. Woods fires spread slowly to moderately fast. The average fire is of moderate intensity, although heavy concentrations of fuel – especially draped fuel -- may burn hot. Short-distance spotting may occur but is not persistent. Fires are not likely to become serious and control is relatively easy.</td>
</tr>
<tr>
<td>Moderate Danger (M)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>COLOR CODE:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Blue</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CLASS 3:</td>
<td>Fires start easily and spread at a rapid rate</td>
<td>All fine dead fuels ignite readily, and fires start easily from most causes. Unattended brush and campfires are likely to escape. Fires spread rapidly and short-distance spotting is common. High intensity burning may develop on slopes or in concentrations of fine fuel. Fires may become serious and their control difficult, unless they are hit hard and fast while small.</td>
</tr>
<tr>
<td>High Danger (H)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>COLOR CODE:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yellow</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CLASS 4:</td>
<td>Fires start very easily and spread at a very fast rate</td>
<td>Fires start easily from all causes and immediately after ignition, spread rapidly and increase quickly in intensity. Spot fires are a constant danger. Fires burning in light fuels may quickly develop high-intensity characteristics - such as long-distance spotting - and fire whirlwinds when they burn into heavier fuels. Direct attack at the head of such fires is</td>
</tr>
<tr>
<td>Very High Danger (VH)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>COLOR CODE:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Orange</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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Due to the impacts of wildfires on public health, agencies across the nation have adopted the use of the Air Quality Index (AQI) to communicate and provide a consistent approach to air quality measurements and categorization. The AQI primarily focuses on the health effects caused by pollutants in the air such as smoke. The goal of the AQI is to provide advisories to assist the public in determining when to reduce exposures to inhalation of air pollution as pollution levels rise.

Figure 14-14: Air Quality Index for Ozone and Particulate Pollution\(^63\)

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\(^63\) AirNow. *Air Quality Index (AQI) Basics.* Retrieved 05.05.2021 from: [https://www.airnow.gov/qaq/aqi-basics/](https://www.airnow.gov/qaq/aqi-basics/)
History of the Hazard

Wildfire events are of major concern to Solano County fire districts and residents. Since 1952, 90 wildfire events have occurred in the unincorporated areas of Solano County. These events range from 6 acres to more than 30,000 acres (CAL FIRE 2011). Of these documented occurrences, two were more than 30,000 acres. The first, known as the Atlas Peak wildfire, caused $36 million in damage and destroyed 65 structures, 39 near Atlas Peak, 16 on Soda Canyon Road, and one on Silverado Trail. Though the Atlas Peak fire was mostly in Napa County, parts of the fire spread into Solano County. No one was killed in the blaze and the cause of the fire was arson (Napa Valley Register 2006). The second, known as the Miller Canyon wildfire, took place in 1988. Nine homes, three outbuildings and $7 million worth of telecommunications equipment were burned. Transmission equipment owned by MCI, AT&T, PG&E, Pacific Bell, and several local government agencies was damaged (Los Angeles Times 1988). The Miller Canyon wildfire event caused by arson, burned 34,564 acres, was declared a FEMA Presidential Disaster (FEMA-DR-815) was enacted as a result of the damage.

Most recently, in 2008, the “Wild” wildfire event burned 4,102 acres due to arson. The wildfire event ignited near Wild Horse Valley Road in Napa County, spreading through dry grass, oak trees, and brush toward the area of Lake Madigan in Solano County (CAL FIRE 2011). One of the last major wildfire occurrences in unincorporated Solano County was the 2011 Beacon Fire. The Beacon Wildfire burned more than 700 acres and threatened 40 homes at the northeastern edge of the City of Fairfield.
In 2019, Cal Maritime suffered property losses when a wildfire jumped Interstate 80 in Vallejo and entered the campus, destroying a maintenance building, storage containers, vehicles, equipment, and trees. (There were no injuries.)

Potential Impacts of the Hazard

Because the location of the Cal Maritime campus is removed from areas designated as high fire hazard severity zones, the threat of flame, ember, and smoke exposure from wildfire to the campus is minimized. However, there are hillsides with a history of fires occurring within proximity to the campus. There is potential for fire to occur from north and east of the campus. The surrounding hillsides and valleys are composed of light to moderate fuels. The threat from fire and the impacts fire would have on the university is due to the campus being located adjacent to open hillsides and field susceptible to fire spread.

Potential impacts to the campus community resulting from wildfires include:

- Injuries or loss of life
- Campus property destruction or damage
- Residential property destruction or damage
- Commercial property destruction or damage
- Loss of property contents
- Infrastructure damage
- Damaged or destroyed lifelines/supply routes
- Damaged or destroyed utilities
- Damaged or destroyed critical facilities supporting campus emergency support needs
- Threat or damage to power plant
- Loss of community economic base
- Employment losses
- Loss to ground supporting vegetation on hillsides resulting in erosion or landslides in future precipitation events
- Agricultural (crops and livestock) damages or destruction
- Environmental damage
- Societal and community impacts
- Damage to organizations and facilities providing support services to vulnerable populations

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- Greater evacuation challenges for those most vulnerable
- Psychological impacts of impacted populations
- Disruptions to education delivery to community

Potential impacts resulting from wildfire generated smoke include:

- Dangerous levels of air pollution
- Human Health Effects
- Similar health impacts to pets
- Air conditioning systems overwhelmed
- Greater demands on air filtration systems
- Greater demands on healthcare systems
- Reduced outdoor work productivity
- Closures of academic sessions

Additionally, there remains a number of secondary impacts from wildfires that could affect the campus community. Utilities feeding areas of Solano County including the campus may be damaged resulting in power outages. Fire related damage in the watersheds will likely cause future landslides, degradation to plants supporting hillsides, and impact the hydroelectric power capabilities. Fires may present threats to areas of recreation, scenic value, and wildlife that are a part of the culture of the campus community. Finally, the campus may experience effects of evacuated individuals arriving on campus from other areas as a location of refuge.

Probability of Future Occurrence of the Hazard

Based on the wildfire threat potential in the area on and surrounding the Cal Maritime campus, including the immediate proximity to hillsides with extensive vegetative growth, and the historic occurrences of fires, the probability of wildfire related damage and impacts from smoke is considered Possible.

Based on the wildfire threat potential in the area surrounding the campus and the San Francisco North Bay region, including the volume of areas in elevated Fire Hazard Severity Zones throughout the Solano and Contra Costa Counties, the past occurrences of wildfire generated smoke from areas beyond Solano County, the probability of wildfire generated smoke impacts to air quality is considered Possible.

Vulnerability to the Hazard

The Cal Maritime campus is not identified to reside in a designated local High or Very High Fire Hazard Severity Zone. However, the campus is subject to direct impact from wildfire due to the campus location within a wildland-urban interface zone. The
The campus is bordered on two sides by hillsides and open lands containing combustible vegetation combined with residential development and a history of wildfires. Additionally, vulnerabilities to the effects of wildfire pertain to any members of the campus community who may reside or work in locations that are exposed to the Fire Hazard Severity Zones in other parts of the surrounding region. Wildfires occurring in other areas of the region may result in the displacement of large numbers of people. These effects may spill onto the campus in the form of evacuees or facility support to emergency resources.

Fire directly threatening the campus would likely take the form of vegetation fires along the hillsides and extending onto the campus or localized fires involving single structures or small areas. Smaller vegetation fires are possible surrounding the campus in the urban forest or fields surrounding the city. These incidents would likely have a significant impact on the campus.

The primary basis of vulnerability is based on the population affected and the built environment exposed. In general, newer construction will be more fire resistant than older buildings as building and fire codes and construction technology have improved. Density of buildings and proximity of fuels to buildings or equipment at risk of combustion would additionally influence the fire’s ability to spread to structures. Structures with vegetation and other combustibles near the structure increase the ability of fire to spread to buildings.

Access to the north using Sonoma Blvd or Maritime Academy Drive servicing access to Vallejo and Interstate 80 could become cutoff during fire incidents. Country Lane Road exiting the back of campus may also be impacted by fire, making it impassable. The university is limited by these routes for access to and from the campus. Access for supplies, equipment, and emergency services in addition to evacuation away from the campus would likely be forced to use alternative routes into Vallejo.

The greater concerns regarding vulnerabilities to wildfire are related to the smoke that fires in the area would produce. The recent summer seasons have clearly demonstrated the reality of large wildfires producing enough smoke to fill the Bay Area even from substantial distances away. These recent fires have displayed how the effects of this smoke impact the general population and especially vulnerable populations. Cal Maritime students, faculty, and staff both on campus and off campus face these same vulnerabilities related to smoke filled air.

Smoke generated from large wildfires pose a threat in terms of diminished air quality that would be exposed to the population within the area of smoke distribution. Individuals with existing health problems such as respiratory or cardiac illnesses are increasingly vulnerable to wildfire generated smoke. Staff who work in roles requiring outdoor activity will be increasingly exposed during days where the air quality index is considered unhealthy or worse. Student athletes participating in outdoor sports and engaging in aerobic activities are increasingly vulnerable to the effects of wildfire.
The vulnerability to members of the campus community in which wildfire generated smoke on the Cal Maritime campus will vary depending on when the air quality was to reach unhealthy levels. The risk to the campus population will be lessened during periods when classes are not in session or during periods of breaks. Conversely, during the days and hours that classes are in session and staff are at their workplaces, human vulnerability increases. However, in region-wide events this vulnerability may be shared with the homes and workplaces of members of the campus community and their families.

Vulnerable populations will likely face disproportionate health safety issues from smoke filled air, experience increased stresses, may require the need to remain away from the campus enclosed at home, and may find difficulty in accessing equipment or supplies to aid in a specific need.

Estimate of Potential Losses

Estimates of potential losses will be influenced by a variety of factors. Costs would also be likely to include mitigation or repairs of HVAC systems, sealing of doors and windows, and other methods of keeping smoke from entering buildings. Secondary costs would include lost academic days during campus closures, lost staff on campus productivity, and health and medical interventions for affected members of the campus community.

Based on estimate replacement costs of facilities and structures on campus, the maximum total replacement costs due to wildfire are $83,596,545. However due to the lack of a complete inventory of building and facility costs, the total replacement estimate is likely much higher.

Table 14-23: Wildfire Hazard Potential (WHP) Zone Estimated Losses

<table>
<thead>
<tr>
<th>WHP Zone</th>
<th>No of Buildings</th>
<th>Maximum Replacement Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Extreme</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Very High</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>High</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Moderate</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Low</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Very Low</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Non-Burnable</td>
<td>47</td>
<td>$83,596,545</td>
</tr>
<tr>
<td>No Building Value Data Provided*</td>
<td>31</td>
<td>Unknown</td>
</tr>
</tbody>
</table>

*Buildings with no value defined are also included in the respective Zones they are found in.

Vulnerability Assessment Conclusions

The occurrence of wildfires has been a frequent event in Solano County, including wildfire incidents that have threatened the Cal Maritime campus. The location of the
Cal Maritime campus exposed to open hillsides with light to moderate vegetative fuels along the eastern edges presents a threat of fire to the campus community and campus assets. These environments are ideal for the development of wildfire activity in the right conditions. The consequences of fires in these areas would present primary and secondary consequences to the Cal Maritime campuses and expose vulnerabilities on the campus and to the campus community.

The topography and weather conditions of the region allows for smoke filled air to linger in the valleys of San Francisco Bay Area with the potential for unhealthy air quality depending on wind conditions. Large fires burning from even far away locations in northern California have demonstrated to fill expansive areas with smoke filled air.

Communities located within or near the Wildland Urban Interface throughout the Bay Area may be subject to damaging fires. These same communities may be home to members of the campus community. The potential for large-scale wildfires in the region further generates the added potential for a number of cascading effects such as disruptions to the local economy, utility failures, disruptions to providing for the needs of the community, and development of public health hazards. The potential for large-scale wildfires and resulting damage of homes and businesses has exponentially powerful impacts on particular populations among the campus community including those with access or functional needs, international students, and homeless students.

Identified Data Limitations

Data limitations include missing campus structural replacement costs, and lack of both a complete inventory of building construction types and mitigation efforts to lessen the impact due to fire activity. HAZUS generated analysis is focused on the broader community level versus fine-tuning the analysis to the micro-level for facilities such as a university campus.

Severe Weather (Wind, Tornado, Hail, Lightning)

Description of the Hazard

Severe weather can be described as a variety of weather or climate events that are beyond or near the ends of the range of observed weather patterns and behavior. These events can include high or extreme winds, storms, lightning, hail, tornadoes, heat waves, unusually cold temperatures, extreme rainfall, and flooding. According to the Intergovernmental Panel on Climate Change (IPCC), to be classified as severe (or extreme), the occurrence of each value of a climate or weather variable (e.g., wind, hail, heat waves, extreme rainfall, unusual cold temperatures) needs to be rare or extreme.

lightning, tornado, etc.) must be “above (or below) a threshold value near the upper (or lower) ends of the range of observed values of the variable.”

Severe weather in California can be generated by local, regional, and/or global weather and climate influences. From the individual thunderstorm to the Santa Ana wind event to the strong El Niño, damaging weather elements that are produced by and accompany severe weather and climate phenomena (e.g., damaging winds, hail, lightning, and tornadoes) occur throughout California and the California State University (CSU) system.

**Global Scale Influences on Severe Weather in California: El Niño, La Niña, and ENSO**

The El Niño-Southern Oscillation (ENSO) is a recurring climate pattern involving changes in the temperature of waters in the central and eastern tropical Pacific Ocean. On periods ranging from about three (3) to seven (7) years, the surface waters across a large swath of the tropical Pacific Ocean warm or cool by anywhere from 1°C to 3°C, compared to normal. This oscillating warming and cooling pattern, referred to as the ENSO cycle, directly affects rainfall distribution in the tropics and can have a strong influence on weather across the United States and other parts of the world.

El Niño and La Niña are extreme phases of the ENSO cycle, with a third phase occurring between them called the Neutral phase. The El Niño phase is characterized by unusually warm ocean temperatures and weaker-than-normal east winds in the Equatorial Pacific, while the La Niña phase is characterized by unusually cold ocean temperatures and stronger-than-normal east winds in the Equatorial Pacific. Both extreme ENSO phases lead to significant differences from the average ocean temperatures, winds, surface pressure, and rainfall across parts of the tropical Pacific. The Neutral phase indicates that conditions are near their long-term average.

The extreme ENSO phases affect the frequency and intensity of weather events across the world, including in California. On average, areas across California experience exceptionally stormy winters with increased precipitation under El Niño conditions, but

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69 Retrieved on 07.17.2021 from https://www.climate.gov/news-features/understanding-climate/el-ni%C3%B1o-and-la-ni%C3%B1a-frequently-asked-questions

70 Retrieved on 07.16.2021 from https://www.pmel.noaa.gov/elnino/what-is-el-nino
experience less stormy and drier winters under La Niña conditions. This variability in storminess and precipitation brought on by El Niño and La Niña events affects the both the frequency and intensity of severe weather conditions experienced by all CSU campuses, including CSU Maritime Academy (Cal Maritime).

Regional Climate Influences on Severe Weather across California

Most of the weather in California is influenced by the wet-winter/ dry-summer Mediterranean climate pattern. In the summer months, Pacific storm tracks are deflected north due to the position of the Pacific High (i.e., a large-scale atmospheric circulation over the Northeast Pacific Ocean), preventing Pacific storms from reaching California. As a result, most summer storms are generated due to the incursion of moist air from the Gulf of Mexico or the Gulf of California, and occur as scattered, locally heavy showers in the desert and mountain regions of the state. In the winter months, the Pacific High decreases in intensity and moves south, permitting powerful Pacific storms to move into and across the state; these storms can produce extreme winds, heavy rains (including “atmospheric river” events), and widespread coastal and inland flooding. (Please see the Flood Hazard profile in this document for information on Floods.) As a result, storm events accompanied by precipitation in California are far more frequent in the winter months than they are in the summer months.

While the Mediterranean climate pattern influences the seasonal frequency, intensity, geographic spread, and type of some severe weather events CSU campuses experience (including Cal Maritime), other severe weather phenomena may occur in California at any time of the year. For example, near the coast and over the Central Valley, there appears to be no defined seasonality to thunderstorms, and these storms are usually light and infrequent. Thunderstorms are more intense and more frequent in the intermediate and higher elevations of the Sierra Nevada, and occur with greater frequency during the summer months.

Types of Storms in California

The 2018 California State Hazard Mitigation Plan (SHMP) defines a storm as a violent atmospheric disturbance occurring over land and/or water that is distinguished by its strength, characteristics, and the scale of the resulting damage. The SHMP also lists the following types of storms that produce hazardous conditions and potential damage:

72 Retrieved on 07.17.2021 from https://wrcc.dri.edu/Climate/narrative_ca.php
73 Retrieved on 07.17.2021 from https://wrcc.dri.edu/Climate/narrative_ca.php
throughout the state of California. These storms affect (in varying degrees) all CSU campuses, including Cal Maritime.

- **Thunderstorm**: A rain-bearing cloud that also produces lightning. Thunderstorms can produce some of nature’s most destructive and deadly weather including tornadoes, hail, strong winds, lightning and flooding. Thunderstorms are caused by an atmospheric imbalance from warm unstable air rising rapidly into the atmosphere. Lightning, which occurs during all thunderstorms, can strike anywhere. Thunderstorms can produce some of nature’s most destructive and deadly weather including tornadoes, hail, strong winds, lightning and flooding. *Severe thunderstorms* are more intense, violent, and dangerous thunderstorms. The National Oceanic and Atmospheric Administration (NOAA) defines a severe thunderstorm as any storm that produces one or more of the following elements: Damaging winds or speeds of 58 mph (50 knots) or greater, hail 1 inch in diameter or larger, and/or a tornado.

- **Hailstorm**: a type of storm that precipitates round chunks of ice. Hailstorms usually occur during regular thunderstorms.

- **Wind storm**: marked by high wind with little or no precipitation.

- **Winter storm**: A storm that can produce a combination of freezing rain, sleet, heavy snow, and/or strong winds.

- **Coastal storm**: large wind-driven waves and/or storm surge that strike the coastal zone.

- **Ice storm**: Ice storms are one of the most dangerous forms of winter storms. When surface temperatures are below freezing, but a thick layer of above-freezing air remains aloft, rain can fall into the freezing layer and freeze upon impact into a

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79 Retrieved on 07.15.2021 from [https://www.weather.gov/safety/thunderstorm](https://www.weather.gov/safety/thunderstorm)

80 Retrieved on 07.15.2021 from [https://www.weather.gov/safety/thunderstorm](https://www.weather.gov/safety/thunderstorm)


glaze of ice. In general, 8 millimeters (0.31 inch) of accumulation is all that is required, especially in combination with breezy conditions, to start downing power lines as well as tree limbs. Ice storms also make unheated road surfaces too slick to drive on. Ice storms can vary in time range from hours to days and can cripple small towns and large urban centers alike.\(^85\)

- **Snowstorm:** A heavy fall of snow accumulating at a rate of more than 5 centimeters (2 inches) per hour that lasts several hours. Snowstorms, especially ones with a high liquid equivalent and breezy conditions, can down tree limbs, cut off power, and paralyze travel over a large region.\(^86\)

**Severe Weather Hazard Elements: Wind Hazards, Hail, and Lightning**

This hazard profile concentrates on the following types of severe weather hazards: **wind hazards** (including tornadoes), **hail**, and **lightning**. These hazards are produced by a variety of weather phenomena, including thunderstorms, coastal storms, winter storms, and topographically-enhanced downslope winds. While storm and downslope wind hazards are responsible for severe weather events across the CSU system, only the wind, tornado, hail, and lightning elements generated by these hazards are covered in this profile. (Storm-related hazards such as flooding and extreme temperatures are covered in other sections of this document.)

**Wind Hazards**

**Wind** is the horizontal movement of air past any given point. Wind begins with differences in air pressures; pressure that is higher at one point than another sets up a force, pushing the high towards the low pressure.\(^87\) Wind gusts are defined as “rapid fluctuations in the wind speed with a variation of 10 knots or more between peaks and lulls.”\(^88\)

Wind hazards in California take several forms: High Wind, Strong Winds, Thunderstorm Winds, Mountain-Valley (Downslope) Winds, and Tornadoes. These hazards are encountered across California, and have the potential to cause harm to or loss of life and/or property throughout California and the CSU system (including Cal Maritime).

**High Winds, Strong Winds, and Thunderstorm Winds**

The National Weather Service reports three (3) types of wind events that occur areas over land: High Winds, Strong Winds, and Thunderstorm Winds. Collectively, these reports are

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used to determine the frequency with which wind hazard events have affected areas across the U.S., including California.

**High Winds**

High winds are defined as sustained non-convective winds of 35 knots (40 mph) or greater lasting for 1 hour or longer, or gusts of 50 knots (58 mph) or greater for any duration (or otherwise locally/regionally defined). In some mountainous areas, the above numerical values are 43 knots (50 mph) and 65 knots (75 mph), respectively.\(^8^9\)

**Strong Winds**

Strong winds are defined as non-convective winds gusting less than 50 knots (58 mph), or sustained winds less than 35 knots (40 mph), resulting in a fatality, injury, or damage.\(^9^0\)

**Thunderstorm Winds**

Thunderstorm winds are winds that arise from thunderstorm convection (occurring within 30 minutes of lightning being observed or detected), with speeds of at least 50 knots (58 mph). They can also be winds of any speed (non-severe thunderstorm winds below 50 knots (58 mph)) producing a fatality, injury, or damage.\(^9^1\)

Please note: **Straight-line wind** is a term used to define any thunderstorm wind that is not associated with rotation. It is used mainly to differentiate from the rotational winds found in tornado-producing storms.\(^9^2\) However, it is not a term used in the NCEI Storm Events Database, and therefore cannot be used to determine severe weather history of or potential impacts to CSU campuses.

**Tornadoes**

A tornado is an extreme severe weather wind hazard. A tornado is a rapidly rotating column of air extending from a thunderstorm to the surface of the Earth.\(^9^3\) This column extends between cloud and the Earth’s surface. The damage from tornadoes comes from the strong winds they contain and the flying debris they create. It is generally believed that rotational wind speeds can be as high as 300 mph in the most violent tornadoes.\(^9^4\) On a local scale, tornadoes are the most violent and most destructive of all atmospheric phenomena.\(^9^5\)

**Mountain-Valley (Downslope) Wind Systems: Santa Ana, Diablo, and Sundowner Winds.**

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\(^9^3\) Retrieved on 07.15.2021 from [https://www.earthnetworks.com/tornado/](https://www.earthnetworks.com/tornado/)


\(^9^5\) Retrieved on 07.15.2021 from [https://www.weather.gov/bgm/severedefinitions](https://www.weather.gov/bgm/severedefinitions)
**Santa Ana Winds.** A type of wind hazard that is peculiar to Southern California is called a *Santa Ana Wind*. Santa Ana winds are strong, topographically-enhanced, extremely dry downslope winds that originate inland and affect coastal southern California and northern Baja California (Mexico). They occur when air from a region of high pressure over the dry, desert region of the southwestern U.S. flows westward towards low pressure located off the California coast. This creates dry winds that flow east to west through the mountain passages in Southern California. These winds have a strong seasonal component; they are most common during the cooler months of the year, occurring from September through May. Santa Ana winds typically feel warm (or even hot) because as the cool desert air moves down the side of the mountain, it is compressed, which causes the temperature of the air to rise. If strong enough, Santa Ana winds can cause major property damage, and may present difficulties for airborne and seagoing transportation. They also may increase wildfire risk because of the dryness of the winds and the speed at which they can spread a flame across the landscape. (Note: The Wildfire hazard is profiled elsewhere in this document.)

Figure below illustrates the mechanisms involved in the generation of Santa Ana winds across Southern California.

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**Diablo Winds.** The Diablo wind is another type of topographically-enhanced downslope wind phenomenon that occurs in the North-Central areas of California. Diablo winds are offshore wind events that flow northeasterly over Northern California’s Coast Ranges, often creating high wind speeds downwind of major canyons and over ridges, and extreme fire danger for the San Francisco Bay Area. Diablo winds are driven by a surface pressure gradient that forms in response to an inverted pressure trough that develops over California.  

**Sundowner Winds.** Sundowner winds are significant and potentially damaging downslope wind and warming events that periodically occur along a short segment of the southern California coast in the vicinity of Santa Barbara, CA. The unique topography of this coastal region promotes the development of Sundowner wind events: over a length of about 100 km, the coastline is oriented approximately west–east, with the adjoining narrow coastal plain bounded by a steeply rising (to elevations greater than 1200 m) and

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coast-parallel mountain range. Called Sundowner winds because they often begin in the late afternoon or early evening, their onset is typically associated with a rapid rise in temperature and decrease in relative humidity, and the winds tend to blow from the north from the Santa Ynez Mountains to the coast of Santa Barbara County, California. During the more intense Sundowner wind events, wind speeds can be of gale force 39-54 miles per hour or higher, and can even reach hurricane force (≥ 74 miles per hour) in the most extreme cases. Temperatures over the coastal plain, and even at the coast itself, can rise significantly above 37.8°C (100°F). Seasonally, Sundowner winds peak in March, April, and May, with a minimum during summer and a secondary peak in winter that often corresponds with Santa Ana winds. In addition to causing a dramatic change from the more typical marine-influenced local weather conditions, Sundowner wind episodes have produced significant wind-related property and agricultural damage, as well as conditions of extreme fire danger.100 101 102

**Hail**

Hail is a form of precipitation consisting of solid ice that forms inside thunderstorm updrafts.103 It is roughly round in shape and at least 0.2’ in diameter. Hail develops in the upper atmosphere as ice crystals that are bounced about by high velocity updraft winds; the ice crystals accumulate frozen droplets and fall after developing enough weight. The size of hailstones varies and is a direct consequence of the severity and size of the storm that produces them – the higher the temperatures at the Earth’s surface, the greater the strength of the updrafts and the amount of time hailstones are suspended, and therefore the greater the size of the hailstone.104

**Lightning**

Lightning is an electrical discharge produced by a thunderstorm. Lightning rapidly heats the air in its immediate vicinity to about 50,000°F - about five times the temperature of the surface of the sun. This compresses the surrounding air and creates a supersonic shock wave, which decays to an acoustic wave that is heard as thunder.105

The discharge may occur within or between clouds, between the cloud and air, between a cloud and the ground, or between the ground and a cloud.106 Lightning that is produced

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from thunderstorms in which precipitation evaporates before reaching the ground is called “dry lightning.”

Location of the Hazard

Severe weather is a non-spatial hazard, and can occur anywhere in the CSU system, including on the Cal Maritime campus. No one area of the campus – or of the surrounding community – is subject to experiencing severe weather more than any other area.

There is geographic variability among the different types of mountain and valley wind events (as a sub-category of the severe weather hazard). Santa Ana winds occur in Southern California, Diablo winds occur in North-Central California, and Sundowner winds occur almost exclusively in Santa Barbara County, California.

Extent of the Hazard

Severe weather hazards are non-spatial hazards that potentially affect all Cal Maritime campus areas equally. However, the smallest geographic unit of measurement for almost all official severe weather event data is at the county level. Because the severe weather data used do not exist at the campus level, it is assumed that the same (or similar) severe weather risks to Cal Maritime reflect those of the surrounding community and County. As a result, all assets and people at Cal Maritime are at risk from the effects of severe weather and can expect to experience at least some (or the complete range of) endemic severe weather hazards. In consideration of the campus’ design, layout, and operations, the severe weather history and degree of severity in the Vallejo area, and the history and degree of severity of each severe weather sub-type identified by the extent scales (below), the campus planning committee ranks the overall extent of the Severe Weather hazard as MODERATE. See each sub-hazard below for the planning committee’s sub-type extent ranking.

Wind Hazard: Non-Rotational

The Beaufort Scale is an empirical measure that relates wind speed to observed conditions at sea or on land. Its full name is the Beaufort wind force scale. First developed in 1805, it is still used today to estimate wind strengths. 

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107 Retrieved on 07.15.2021 from https://www.rmets.org/resource/beaufort-scale
<table>
<thead>
<tr>
<th>Force</th>
<th>Speed (mph)</th>
<th>Speed (knots)</th>
<th>Description</th>
<th>Specifications for use at sea</th>
<th>Specifications for use on land</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0-1</td>
<td>0-1</td>
<td>Calm</td>
<td>Sea like a mirror.</td>
<td>Calm; smoke rises vertically.</td>
</tr>
<tr>
<td>1</td>
<td>1-3</td>
<td>1-3</td>
<td>Light Air</td>
<td>Ripples with the appearance of scales are formed, but without foam crests.</td>
<td>Direction of wind shown by smoke drift, but not by wind vanes.</td>
</tr>
<tr>
<td>2</td>
<td>4-7</td>
<td>4-6</td>
<td>Light Breeze</td>
<td>Small wavelets, still short, but more pronounced. Crests have a glassy appearance and do not break.</td>
<td>Wind felt on face; leaves rustle; ordinary vanes moved by wind.</td>
</tr>
<tr>
<td>3</td>
<td>8-12</td>
<td>7-10</td>
<td>Gentle Breeze</td>
<td>Large wavelets. Crests begin to break. Foam of glassy appearance. Perhaps scattered white horses.</td>
<td>Leaves and small twigs in constant motion; wind extends light flag.</td>
</tr>
<tr>
<td>4</td>
<td>13-18</td>
<td>11-16</td>
<td>Moderate Breeze</td>
<td>Small waves, becoming larger; fairly frequent white horses.</td>
<td>Raises dust and loose paper; small branches are moved.</td>
</tr>
<tr>
<td>5</td>
<td>19-24</td>
<td>17-21</td>
<td>Fresh Breeze</td>
<td>Moderate waves, taking a more pronounced long form; many white horses are formed.</td>
<td>Small trees in leaf begin to sway; crested wavelets form on inland waters.</td>
</tr>
<tr>
<td>6</td>
<td>25-31</td>
<td>22-27</td>
<td>Strong Breeze</td>
<td>Large waves begin to form; the white foam crests are more extensive everywhere.</td>
<td>Large branches in motion; whistling heard in telegraph wires; umbrellas used with difficulty.</td>
</tr>
<tr>
<td>7</td>
<td>32-38</td>
<td>28-33</td>
<td>Near Gale</td>
<td>Sea heaps up and white foam from breaking waves begins to be blown in streaks along the direction of the wind.</td>
<td></td>
</tr>
</tbody>
</table>

109 Retrieved on 07.15.2021 from [https://www.weather.gov/mfl/beaufort](https://www.weather.gov/mfl/beaufort)
<table>
<thead>
<tr>
<th>Wind Grade</th>
<th>Wind Speed (m/s)</th>
<th>Wind Force</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gale</td>
<td>39-46</td>
<td>34-40</td>
<td>Moderately high waves of greater length; edges of crests begin to break into spindrift. The foam is blown in well-marked streaks along the direction of the wind.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Breaks twigs off trees; generally impedes progress.</td>
</tr>
<tr>
<td>Severe Gale</td>
<td>47-54</td>
<td>41-47</td>
<td>High waves. Dense streaks of foam along the direction of the wind. Crests of waves begin to topple, tumble and roll over. Spray may affect visibility</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Slight structural damage occurs (chimney-pots and slates removed)</td>
</tr>
<tr>
<td>Storm</td>
<td>55-63</td>
<td>48-55</td>
<td>Very high waves with long overhanging crests. The resulting foam, in great patches, is blown in dense white streaks along the direction of the wind. On the whole the surface of the sea takes on a white appearance. The tumbling of the sea becomes heavy and shock-like. Visibility affected.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Seldom experienced inland; trees uprooted; considerable structural damage occurs.</td>
</tr>
<tr>
<td>Violent Storm</td>
<td>64-72</td>
<td>56-63</td>
<td>Exceptionally high waves (small and medium-size ships might be for a time lost to view behind the waves). The sea is completely covered with long white patches of foam lying along the direction of the wind. Everywhere the edges of the wave crests are blown into froth. Visibility affected.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Very rarely experienced; accompanied by widespread damage.</td>
</tr>
<tr>
<td>Hurricane</td>
<td>73+</td>
<td>64+</td>
<td>The air is filled with foam and spray. Sea completely white with driving spray; visibility very seriously affected.</td>
</tr>
</tbody>
</table>

Based on those extent ranking factors identified (above), the planning committee ranks the extent of non-rotational wind hazards as **MODERATE**.
**Extent: Tornado**

Tornadoes have their own severity/extent scale. Until 2007, tornadoes were measured and described according to the Fujita Scale.\(^{110}\)

In February 2007, use of the Fujita Scale was discontinued. In its place, the Enhanced Fujita (EF) Scale is used. The Enhanced Fujita scale considers how most structures are designed and is thought to be a much more accurate representation of the surface wind speeds in the most violent tornadoes. Like the original Fujita scale, the Enhanced Fujita scale is a set of wind estimates (not measurements) based on damage.

It is important to note the date that a tornado occurred. Tornadoes that occurred prior to February, 2007 are classified using the original Fujita scale and will not be converted to the Enhanced Fujita Scale.

Table below illustrates the Fujita Scale in use prior to February 2007.

Table 14-25: Fujita Tornado Scale (Pre-February 2007)\(^{111}\)

<table>
<thead>
<tr>
<th>F-Scale Number</th>
<th>Intensity Phrase</th>
<th>Wind Speed</th>
<th>Type of Damage</th>
</tr>
</thead>
<tbody>
<tr>
<td>F0</td>
<td>Gale tornado</td>
<td>40-72 mph</td>
<td>Some damage to chimneys; breaks branches off trees; pushes over shallow-rooted trees; damages sign boards.</td>
</tr>
<tr>
<td>F1</td>
<td>Moderate tornado</td>
<td>73-112 mph</td>
<td>The lower limit is the beginning of hurricane wind speed; peels surface off roofs; mobile homes pushed off foundations or overturned; moving autos pushed off the roads; attached garages may be destroyed.</td>
</tr>
<tr>
<td>F2</td>
<td>Significant tornado</td>
<td>113-157 mph</td>
<td>Considerable damage. Roofs torn off frame houses; mobile homes demolished; boxcars pushed over; large trees snapped or uprooted; light object missiles generated.</td>
</tr>
<tr>
<td>F3</td>
<td>Severe tornado</td>
<td>158-206 mph</td>
<td>Roof and some walls torn off well-constructed houses; trains overturned; most trees in forest uprooted.</td>
</tr>
</tbody>
</table>

\(^{110}\) Retrieved on 07.19.2021 from [https://www.weather.gov/tae/ef_scale](https://www.weather.gov/tae/ef_scale)

<table>
<thead>
<tr>
<th></th>
<th>Description</th>
<th>Wind Speed (mph)</th>
</tr>
</thead>
<tbody>
<tr>
<td>F4</td>
<td>Devastating tornado</td>
<td>207-260</td>
</tr>
<tr>
<td></td>
<td>Well-constructed houses leveled; structures with weak foundations blown off some distance; cars thrown and large missiles generated.</td>
<td></td>
</tr>
<tr>
<td>F5</td>
<td>Incredible tornado</td>
<td>261-318</td>
</tr>
<tr>
<td></td>
<td>Strong frame houses lifted off foundations and carried considerable distances to disintegrate; automobile sized missiles fly through the air in excess of 100 meters; trees debarked; steel reinforced concrete structures badly damaged.</td>
<td></td>
</tr>
<tr>
<td>F6</td>
<td>Inconceivable tornado</td>
<td>319-379</td>
</tr>
<tr>
<td></td>
<td>These winds are very unlikely. The small area of damage they might produce would probably not be recognizable along with the mess produced by F4 and F5 wind that would surround the F6 winds. Missiles, such as cars and refrigerators would do serious secondary damage that could not be directly identified as F6 damage. If this level is ever achieved, evidence for it might only be found in some manner of ground swirl pattern, for it may never be identifiable through engineering studies.</td>
<td></td>
</tr>
</tbody>
</table>

Table below illustrates the Enhanced Fujita (EF) Scale, currently in use. Tornadoes that have occurred since February, 2007 are classified using the Enhanced Fujita Scale.
<table>
<thead>
<tr>
<th>Enhanced Fujita Category</th>
<th>Wind Speed</th>
<th>Potential Damage</th>
</tr>
</thead>
<tbody>
<tr>
<td>EF0</td>
<td>65-85 mph</td>
<td>Light damage. Peels surface off some roofs; some damage to gutters or siding; branches broken off trees; shallow-rooted trees pushed over.</td>
</tr>
<tr>
<td>EF1</td>
<td>86-110 mph</td>
<td>Moderate damage. Roofs severely stripped; mobile homes overturned or badly damaged; loss of exterior doors; windows and other glass broken.</td>
</tr>
<tr>
<td>EF2</td>
<td>111-135 mph</td>
<td>Considerable damage. Roofs torn off well-constructed houses; foundations of frame homes shifted; mobile homes completely destroyed; large trees snapped or uprooted; light-object missiles generated; cars lifted off ground.</td>
</tr>
<tr>
<td>EF3</td>
<td>136-165 mph</td>
<td>Severe damage. Entire stories of well-constructed houses destroyed; severe damage to large buildings such as shopping malls; trains overturned; trees debarked; heavy cars lifted off the ground and thrown; structures with weak foundations blown away some distance.</td>
</tr>
<tr>
<td>EF4</td>
<td>166-200 mph</td>
<td>Devastating damage. Well-constructed houses and whole frame houses completely leveled; cars thrown and small missiles generated.</td>
</tr>
<tr>
<td>EF5</td>
<td>&gt;200 mph</td>
<td>Incredible damage. Strong frame houses leveled off foundations and swept away; automobile-sized missiles fly through the air in excess of 100 m (107 yd); high-rise buildings have significant structural deformation; incredible phenomena will occur.</td>
</tr>
</tbody>
</table>

Based on the extent ranking factors identified (above), the planning committee ranks the extent of tornados as **LOW**.

**Extent: Hail**

The National Oceanic and Atmospheric Administration and the Tornado and Storm Research Organization (TORRO) have combined efforts to create the Hailstorm Intensity Scale. Table below provides details of this scale.

Table 14-27: Combined NOAA/TORRO Hailstorm Intensity Scale

<table>
<thead>
<tr>
<th>Size Code</th>
<th>Intensity Category</th>
<th>Typical Hail Diameter</th>
<th>Approximate Size</th>
<th>Typical Damage Impacts</th>
</tr>
</thead>
<tbody>
<tr>
<td>H0</td>
<td>Hard Hail</td>
<td>Up to 0.33”</td>
<td>Pea</td>
<td>No damage</td>
</tr>
<tr>
<td>H1</td>
<td>Potentially Damaging</td>
<td>0.33” – 0.60”</td>
<td>Marble or Mothball</td>
<td>Slight damage to plants and crops</td>
</tr>
<tr>
<td>H2</td>
<td>Potentially Damaging</td>
<td>0.60” – 0.80”</td>
<td>Dime or grape</td>
<td>Significant damage to fruit, crops, and vegetation</td>
</tr>
<tr>
<td>H3</td>
<td>Severe</td>
<td>0.80” – 1.20”</td>
<td>Nickel to Quarter</td>
<td>Severe damage to fruit and crops, damage to glass and plastic structures, paint and wood scored</td>
</tr>
</tbody>
</table>

---

<table>
<thead>
<tr>
<th>Extent</th>
<th>Hailstorm Type</th>
<th>Diameter</th>
<th>Size Description</th>
<th>Damage Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>H4</td>
<td>Severe</td>
<td>1.20” – 1.60”</td>
<td>Half Dollar to Ping Pong Ball</td>
<td>Widespread glass damage, vehicle body damage</td>
</tr>
<tr>
<td>H5</td>
<td>Destructive</td>
<td>1.60” – 2.0”</td>
<td>Silver Dollar to Golf Ball</td>
<td>Wholesale destruction of glass, damage to tiled roofs, significant risk of injuries</td>
</tr>
<tr>
<td>H6</td>
<td>Destructive</td>
<td>2.0” – 2.4”</td>
<td>Lime or Egg</td>
<td>Aircraft body dented; brick walls pitted</td>
</tr>
<tr>
<td>H7</td>
<td>Very Destructive</td>
<td>2.4” – 3.0”</td>
<td>Tennis Ball</td>
<td>Severe roof damage, risk of serious injuries</td>
</tr>
<tr>
<td>H8</td>
<td>Very Destructive</td>
<td>3.0” – 3.5”</td>
<td>Baseball to Orange</td>
<td>Severe damage to aircraft body</td>
</tr>
<tr>
<td>H9</td>
<td>Super Hailstorms</td>
<td>3.5” – 4.0”</td>
<td>Grapefruit</td>
<td>Extensive structural damage, risk of severe or fatal injuries to persons caught in the open</td>
</tr>
</tbody>
</table>

Based on those extent ranking factors identified (above), the planning committee ranks the extent of the hail hazard as **LOW**.
**Extent: Lightning**

The National Weather Service (NWS) uses a Lightning Activity Level (LAL) scale to indicate the frequency and character of cloud-to-ground (C/G) lightning. The scale uses a range of 1 – 6, with 6 being the high end of the scale. Table below provides details of the LAL scale.

Table 14-28: Lightning Activity Level (LAL) Scale

<table>
<thead>
<tr>
<th>Rank</th>
<th>Cloud and Storm Development</th>
<th>Areal Coverage</th>
<th>Counts C/G per 5 Minutes</th>
<th>Counts C/G per 15 Minutes</th>
<th>Average C/G per Minute</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>No Thunderstorms</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>2</td>
<td>Cumulus clouds are common but only a few reaches the towering stage. A single thunderstorm must be confirmed in the rating area. The clouds mostly produce virga, but light rain will occasionally reach ground. Lightning is very infrequent.</td>
<td>&lt;15%</td>
<td>1-5</td>
<td>1-8</td>
<td>&lt;1</td>
</tr>
<tr>
<td>3</td>
<td>Cumulus clouds are common. Swelling and towering cumulus cover less than 2/10 of the sky. Thunderstorms are few, but 2 to 3 occur within the observation area. Light to moderate rain will reach the ground, and lightning is infrequent.</td>
<td>15% to 24%</td>
<td>6-10</td>
<td>9-15</td>
<td>1-2</td>
</tr>
</tbody>
</table>

## Lightning Activity Level Scale

<table>
<thead>
<tr>
<th>Rank</th>
<th>Cloud and Storm Development</th>
<th>Areal Coverage</th>
<th>Counts C/G per 5 Minutes</th>
<th>Counts C/G per 15 Minutes</th>
<th>Average C/G per Minute</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>Swelling cumulus and towering cumulus cover 2-3/10 of the sky. Thunderstorms are scattered but more than three must occur within the observation area. Moderate rain is commonly produced, and lightning is frequent.</td>
<td>25% to 50%</td>
<td>11-15</td>
<td>16-25</td>
<td>2-3</td>
</tr>
<tr>
<td>5</td>
<td>Towering cumulus and thunderstorms are numerous. They cover more than 3/10 and occasionally obscure the sky. Rain is moderate to heavy, and lightning is frequent and intense.</td>
<td>&gt;50%</td>
<td>&gt;15</td>
<td>&gt;25</td>
<td>&gt;3</td>
</tr>
<tr>
<td>6</td>
<td>Dry lightning outbreak. (LAL of 3 or greater with majority of storms producing little or no rainfall.)</td>
<td>&gt;15%</td>
<td>None</td>
<td>None</td>
<td>None</td>
</tr>
</tbody>
</table>

Based on those extent ranking factors identified (above), the planning committee ranks the extent of the lightening hazard as **LOW**.

### Extent: Thunderstorms that Generate Wind, Tornado, Hail, and Lightning Hazard Events

Thunderstorms are not explicitly identified as a severe weather category for this hazard profile. However, they are responsible for most tornado, lightning, and hail hazard events – as well as a significant number of wind hazard events – across California and the CSU system. While individual thunderstorms affect relatively small areas, there are many instances in which thunderstorms can cluster together and/or travel in a line over long distances, producing significant damage over large geographic areas.

A thunderstorm is classified as “severe” when certain meteorological parameters within the thunderstorm are reached (i.e., damaging winds or speeds of 58 mph (50 knots) or greater, hail 1 inch in diameter or larger, and/or a tornado). However, there is currently no
established, objective severity scale for thunderstorms.\textsuperscript{115} \textsuperscript{116} That said, according to the \textit{Glossary of Meteorology} published by the American Meteorological Society (AMS), a thunderstorm is reported as \textit{light, medium, or heavy} according to following five (5) characteristics:

- the nature of the lightning and thunder;
- the type and intensity of the precipitation, if any;
- the speed and gustiness of the wind;
- the appearance of the clouds; and
- the effect upon surface temperature.\textsuperscript{117}

A thunderstorm may also be classified by the nature of the overall weather situation in which the thunderstorm is produced, including:

- \textbf{Airmass Thunderstorm}: A thunderstorm produced by local convection within an unstable air mass;\textsuperscript{118}

- \textbf{Frontal Thunderstorm}: An individual thunderstorm the initiation of which results from rising motion associated with a front, or a thunderstorm within a convective system generated and organized by frontal rising motion;\textsuperscript{119} or

- \textbf{Squall-line Thunderstorm}: An individual thunderstorm included within a squall line (i.e., a continuous or broken line of active deep moist convection frequently associated with thunder).\textsuperscript{120} \textsuperscript{121}

Based on the extent ranking factors identified (above) in relation to campus layout and operations, and past event low degree of severity, the planning committee ranks the extent of the thunderstorm hazard as \textbf{LOW}.

\textbf{History of the Hazard}

Severe weather hazards have been an annual occurrence in Solano County and on the Cal Maritime campus. Historical data for these hazards are presented below.

\textsuperscript{115} Retrieved on 07.15.2021 from \url{https://www.noaa.gov/explainers/severe-storms}
\textsuperscript{116} Retrieved on 07.15.2021 from \url{https://www.weather.gov/safety/thunderstorm}
Historical Storm Data Collection: NCEI Storm Events Database

Historical information regarding severe weather hazards can be found using The National Centers for Environmental Information (NCEI) Storm Events Database. The Storm Events Database contains searchable, archived National Weather Service (NWS) storm data from January 1950 to April 2021, as entered by NOAA’s National Weather Service (NWS). Due to changes in the data collection and processing procedures over time, there are unique periods of record available depending on the event type.\textsuperscript{122} For example, from 1950 through 1954, only tornado events were recorded; from 1955 through 1995, only tornado, thunderstorm wind, and hail events were introduced into the database; from 1996 to present, 45 additional event types are recorded, including high wind, strong wind, and lightning events.\textsuperscript{123} To obtain the most accurate portrayal of severe weather event frequency, searches of the Storm Events Database are conducted using data collected since 01/01/1996. As a reminder, all official severe weather event data is at the county level. Severe weather data do not exist at the campus level. That said, it may be the case that the campus to some degree experiences the severe weather events reported for the surrounding community and County.

\textit{Wind Hazards (excluding Tornadoes)}

Information obtained from the NCEI Storm Event Database website shows the number of events (or occurrences) of wind hazard events in Solano County since 1996.\textsuperscript{124} Here, wind hazard events include all “High Wind,” “Strong Wind,” and “Thunderstorm Wind” storm reports.\textsuperscript{125}

\begin{itemize}
  \item \textit{High Wind}: at least 42 events, or approximately 1.66 events per year\textsuperscript{126}
  \item \textit{Strong Wind}: at least 30 events, or 1.18 events per year\textsuperscript{127}
\end{itemize}

\textsuperscript{122} Retrieved on 07.19.2021 from https://www.ncdc.noaa.gov/stormevents/details.jsp
\textsuperscript{124} National Climatic Data Center. Storm Events Database. Retrieved 07.30.2021 from https://www.ncdc.noaa.gov/stormevents/
\textsuperscript{125} National Climatic Data Center. Storm Events Database. Retrieved 07.30.2021 from https://www.ncdc.noaa.gov/stormevents/
\textsuperscript{126} National Climatic Data Center. Storm Events Database. Retrieved 07.30.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28Z%29+High+Wind&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=SOLANO%3A95&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA
\textsuperscript{127} National Climatic Data Center. Storm Events Database. Retrieved 07.30.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28Z%29+Strong+Wind&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=SOLANO%3A95&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA
- **Thunderstorm Wind**: at least 6 events, or approximately 0.24 events per year.\(^{128}\)
- **All Wind Hazard events** (excluding Tornadoes): at least 72 events, or approximately 2.84 events per year.\(^{129}\) (Note: This was determined by conducting a simultaneous search of the component wind hazards of high wind, strong wind and thunderstorm wind.)

Overall, in Solano County, there have been at least 72 wind hazard events since 1996, excluding tornadoes.\(^{130}\) That translates to an approximate average historical frequency of occurrence of **2.84** wind hazard events per year.

Please note: Differences between the sums of individual component severe weather hazard event Database searches (i.e., 78 events) and simultaneous Database searches of all severe weather hazard events (i.e., 72 events) may be due to the following factors: (1) multiple event types are in the same record (e.g., "Thunderstorm Wind/Hail" or "Hail/Tornado;" and/or (2) severe weather hazard events such as “Thunderstorm Wind” or “Hail” that are reported for Solano County have actually taken place hundreds of miles away, but are erroneously recorded as events that have occurred in the County.\(^{131}\) When such a discrepancy arises, the more conservative aggregate hazard wind event value (i.e., 72 events) is used to determine the historical frequency of occurrence for the severe weather hazard. The origin of this discrepancy is unknown at this time.

### Historical Wind Hazard Losses for Solano County since 1996

According to the NCEI Storm Events Database, the wind hazard events that Solano County has experienced since 1996 have been costly. There have been 3 deaths and 2 injuries, and property and crop damage estimates have totaled approximately $12,938,000 and $39,000, respectively.\(^{132}\)

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\(^{128}\) National Climatic Data Center. Storm Events Database. Retrieved 07.30.2021 from [https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType%28C%29+Thunderstorm+Wind&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=SOLANO%3A95&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA](https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType%28C%29+Thunderstorm+Wind&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=SOLANO%3A95&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA)

\(^{129}\) National Climatic Data Center. Storm Events Database. Retrieved 07.30.2021 from [https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType%28Z%29+High+Wind&eventType%28Z%29+Strong+Wind&eventType%28C%29+Thunderstorm+Wind&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=SOLANO%3A95&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA](https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType%28Z%29+High+Wind&eventType%28Z%29+Strong+Wind&eventType%28C%29+Thunderstorm+Wind&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=SOLANO%3A95&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA)

\(^{130}\) National Climatic Data Center. Storm Events Database. Retrieved 07.30.2021 from [https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType%28Z%29+High+Wind&eventType%28Z%29+Strong+Wind&eventType%28C%29+Thunderstorm+Wind&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=SOLANO%3A95&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA](https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType%28Z%29+High+Wind&eventType%28Z%29+Strong+Wind&eventType%28C%29+Thunderstorm+Wind&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=SOLANO%3A95&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA)


\(^{132}\) National Climatic Data Center. Storm Events Database. Retrieved 07.30.2021 from [https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType%28Z%29+High+Wind&eventType%28Z%29+Strong+Wind&eventType%28C%29+Thunderstorm+Wind&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=SOLANO%3A95&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA](https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType%28Z%29+High+Wind&eventType%28Z%29+Strong+Wind&eventType%28C%29+Thunderstorm+Wind&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=SOLANO%3A95&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA)
**Tornado Wind Hazards**

Information from the NCEI Storm Events Database indicates that since 1996, there have been 3 reported events of tornadoes in Solano County, which translates to approximately **0.12** tornado events per year. All tornado reports in Solano County since 1996 have been of tornadoes with a severity rating of F0/EF0.

**Historical Tornado Hazard Losses for Solano County since 1996**

According to the NCEI Storm Events Database, the tornado hazard events that Solano County has experienced since 1996 have been minimal. There have been no deaths, injuries, or crop damage reported, and property damage estimates have totaled approximately $26,000.

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**Hail**

Information from the NCEI Storm Events Database indicates that since 1996, there have been four (4) reported events of hail in Solano County, which translates to approximately **0.16** hail events per year. (Note: The NCEI Storm Event Database search results for hail indicate that there has been a total of five (5) reports of hail since 1996. However, one (1) entry is for a hail event in San Diego County, hundreds of miles away from Solano County. The origin of this error is unknown at this time.)

**Historical Hail Hazard Losses for Solano County since 1996**

According to the NCEI Storm Events Database, the hail hazard events that Solano County has experienced since 1996 have been costly. While there have been no deaths, injuries, or crop damage reported, property damage estimates have totaled approximately $29,000.
$100,000.\textsuperscript{137} (Note: The San Diego County hail event that was included erroneously in the search results for hail hazard events in Solano County accounted for all injuries (i.e., 5) and crop damage estimates (i.e., $300,000) presented in the search results.)

\textit{Lightning}

Information from the NCEI Storm Events Database indicates that since 1996, there no reports of lightning hazard events in Solano County.\textsuperscript{138}

\textbf{Historical Lightning Hazard Losses for Solano County since 1996}

According to the NCEI Storm Events Database, there have been no reported lightning hazard events in Solano County since 1996.\textsuperscript{139} As a result, there are no deaths, injuries, or property or crop damages attributed to lightning in Solano County.

\textbf{All Severe Weather Hazard Events Recorded by the NCEI Storm Events Database}

Information obtained from the NCEI Storm Events Database indicates that there have been 79 occurrences of the severe weather hazard in Solano County. This translates to 3.12 severe weather hazard occurrences per year.\textsuperscript{140}

Please note: Differences between the sums of individual component severe weather hazard event Database searches (i.e., 86 events) and simultaneous Database searches of all severe weather hazard events (i.e., 79 events) may be due to the following factors: (1) multiple event types are in the same record (e.g., "Thunderstorm Wind/Hail" or "Hail/Tornado;" and/or (2) severe weather hazard events such as “Thunderstorm Wind” or “Hail” that are reported for Solano County have actually taken place hundreds of miles away, but are erroneously recorded as events that have occurred in the County.\textsuperscript{141}

\textsuperscript{137} National Climatic Data Center. Storm Events Database. Retrieved 07.30.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Hail&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=SOLANO%3A95&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitButton=Search&statefips=6%2CCALIFORNIA

\textsuperscript{138} National Climatic Data Center. Storm Events Database. Retrieved 07.30.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Lightning&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=SOLANO%3A95&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitButton=Search&statefips=6%2CCALIFORNIA

\textsuperscript{139} National Climatic Data Center. Storm Events Database. Retrieved 07.30.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Lightning&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=SOLANO%3A95&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitButton=Search&statefips=6%2CCALIFORNIA

\textsuperscript{140} National Climatic Data Center. Storm Events Database. Retrieved 07.30.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Hail&eventType=%28Z%29+High+Wind&eventType=%28C%29+Lightning&eventType=%28Z%29+Strong+Wind&eventType=%28C%29+Thunderstorm+Wind&eventType=%28C%29+Tornado&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=SOLANO%3A95&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitButton=Search&statefips=6%2CCALIFORNIA

such a discrepancy arises, the more conservative aggregate hazard wind event value (i.e., 79 events) is used to determine the historical frequency of occurrence for the severe weather hazard. The origin of this discrepancy is unknown at this time.

Historical, Aggregated Severe Hazard Losses for Solano County since 1996

According to the NCEI Storm Events Database, the severe weather events that Solano County has experienced since 1996 have been costly. There have been 3 deaths and 2 injuries, and property and crop damage estimates have totaled approximately $13,064,000 and $39,000, respectively. However, it is important to note that for all Solano County severe weather hazard events recorded on the Storm Events Database, all deaths, injuries, and crop damage estimates, and approximately 99% of all property damage estimates, have been caused by wind hazard events alone.

Wind Hazards Not Included in the NCEI Storm Events Database

Santa Ana Winds

Santa Ana wind events occur at least twice per month from October through April. From 1948 to 2012, total of 2056 events on the 65-year record were recorded in the Southern California region, yielding an average of 32 occurrences per year. Typical Santa Ana wind events last 1–2 days and represent 27% of the occurrences, with events lasting up to 6 days accounting for 90% of all occurrences. The remaining 10% are made up almost entirely of events lasting between 7 and 12 days.

Figure below shows the mean monthly frequency per season of Santa Ana Wind events detected from 1948 to 2012. Extreme Santa Ana wind events are shown in dark red, and are defined as those events that are above the 90th percentile of all events on record.

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142 National Climatic Data Center. Storm Events Database. Retrieved 07.30.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Hail&eventType=%28Z%29+HighWind&eventType=%28C%29+Lightning&eventType=%28Z%29+StrongWind&eventType=%28C%29+Thunderstorm&eventType=%28C%29+Tornado&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=SOLANO%3A95&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA


Diablo Winds

Diablo wind events occur approximately **2.5 events per year**. These events are most frequent during the fall and early winter seasons, with the highest frequency of events occurring in October. As a result, the highest risk of Diablo-wind-related damage is in the fall and early winter.  

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Figure below shows the monthly frequency of Diablo winds (along with average live fuel moisture content). The Diablo Wind data are derived from a 17-year climatology of San Francisco Bay Area regional surface weather stations.\textsuperscript{149}

Figure 14-17: Monthly Frequency of Diablo Winds and Average Live Fuel Moisture Content (Dashed Line)\textsuperscript{150}

\textbf{Sundowner Winds}

Strong sundowner wind events occur approximately \textit{2-3 times per year}. These events can create sharp temperature rises, local gale force winds, and significant weather-related problems. Rare, “explosive” types of sundowner wind events occur about 6 times per century that present dangerous weather situations, generating extremely strong and hot winds that can reach gale force or higher speeds.\textsuperscript{151}

\textbf{Historical Frequency of All Severe Weather Hazards}

Table below shows the average historical frequency of severe weather hazard events for Solano County since 1996.)

\textsuperscript{149} Retrieved on 07.15.2021 from https://www.fireweather.org/diablo-winds
\textsuperscript{150} Retrieved on 07.13.2021 from https://www.fireweather.org/diablo-winds
Table 14-29: Severe Weather Hazard Event

Frequencies for Solano County since 1996.

<table>
<thead>
<tr>
<th>Severe Weather Hazard Category</th>
<th>Average Number of Hazard Events Per Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wind (Includes High, Strong and Thunderstorm Winds ONLY)</td>
<td>2.84</td>
</tr>
<tr>
<td>Tornado</td>
<td>0.12</td>
</tr>
<tr>
<td>Hail</td>
<td>0.16</td>
</tr>
<tr>
<td>Lightning</td>
<td>0</td>
</tr>
<tr>
<td>Diablo Wind</td>
<td>2.5</td>
</tr>
<tr>
<td>Santa Ana Wind*</td>
<td>32</td>
</tr>
<tr>
<td>Sundowner Wind*</td>
<td>2 to 3</td>
</tr>
</tbody>
</table>

* Note: The Santa Ana and Sundowner wind hazards are not present in Solano County. They are included here for information purposes only.

Potential Impacts of the Hazard

The significance (or priority) of a hazard’s potential impacts is based primarily on the frequency and resulting damage caused by the hazard, including deaths/injuries and property, crop, and economic damage. All assets and people within Cal Maritime campus areas are at risk from the effects of severe weather hazards.

**Wind Hazards (Including Tornadoes)**

Wind hazard events have the potential to impact people, property, and operations on campuses across the CSU system. People caught in the open during an extreme wind event are exposed to high winds and debris, and could be injured or killed.

The habitability of buildings can be compromised (by damaging roofs, windows, or other weak points in the building envelope), leading to long-term operational issues for the campus. As with most university campuses, space is always at a premium at the Cal Maritime campus, and the loss of any currently utilized space due to building or structural damage would likely disrupt operations and the University’s mission.
Extreme wind events can result in power failure, which would impact the operation of the campus. Fallen tree limbs and other potential transportation hazards may also cause disruption to the surrounding community and limit ingress/egress to the campus.

According to the 2012 Solano County Local Multi-Hazard Mitigation Plan, “severe weather,” which includes heavy rains coupled periodically accompanied by strong winds (including tornadoes), lightning, or hail, is considered to be a “high” threat to the general population and/or built environment of the County, as the potential for damage is widespread. As a result, severe weather with wind hazards (including tornadoes) is considered to have a high potential impact on the County and (by extension) on the Cal Maritime campus.

**Hail**

Hail typically impacts property by damaging structures, cars, and utilities as it falls. Dents in cars, broken glass, and holes in roofs are common impacts of hail. Injuries to people from hail are less common, though they can happen, as hail is a hard object falling in an unpredictable manner at a fairly high rate of speed.

According to the 2012 Solano County Local Multi-Hazard Mitigation Plan, “severe weather,” which includes heavy rains coupled periodically accompanied by strong winds (including tornadoes), lightning, or **hail**, is considered to be a “high” threat to the general population and/or built environment of the County, as the potential for damage is widespread. As a result, severe weather with hail is considered to have a high potential impact on the County and (by extension) on the Cal Maritime campus.

**Lightning**

Lightning strikes the United States about 20-25 million times a year. Although most lightning occurs in the summer months, people can be struck at any time of year. Since 1990, lightning has killed an average of 39 people each year in the United States, and hundreds more have been injured. Property losses due to lightning have been very costly across the U.S. For example, from 2005 through 2020, U.S. homeowner’s insurance

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claim payouts for lightning losses totaled approximately $15,334,600,000, or $958,412,500 worth of payouts per year.iii (Commercial claim payouts for lightning losses for the U.S. were not available.)

According to the 2012 Solano County Local Multi-Hazard Mitigation Plan, “severe weather,” which includes heavy rains coupled periodically accompanied by strong winds (including tornadoes), lightning, or hail, is considered to be a “high” threat to the general population and/or built environment of the County, as the potential for damage is widespread.iv As a result, severe weather with lightning is considered to have a high potential impact on the County and (by extension) on the Cal Maritime campus.v

Probability of Future Occurrence of the Hazard

Areas throughout California, including all California State University (CSU) campuses, experience severe weather events every year, and future occurrences of such events are projected to increase in both their frequency and intensity. The 2012 Solano County Local Multi-Hazard Mitigation Plan states that severe weather will continue to occur annually throughout Solano County, and that the frequency and probability of future occurrences of severe weather (including wind, tornado, hail and lightning) is “highly likely” and is expected to occur in the future.vi Also, according to the NCEI Storm Events Database, one of the severe weather hazards (i.e., wind hazards) have occurred in Solano County far more than once annually – an average of 2.84 times per year since 1996. Furthermore, while the severe weather hazard is a non-spatial hazard that affects all areas of the Cal Maritime campus equally, the smallest geographic unit of measurement for almost all official severe weather event data is at the county level. Because the severe weather data used in this assessment do not exist at the campus level, it is assumed that the severe weather probabilities for the Cal Maritime campus reflect those of the surrounding community and County identified in the Table below.

Based on the data available from both 2012 Solano County Local Multi-Hazard Mitigation Plan and the NCEI Storm Events Database, the severe weather hazard is expected to occur on (or otherwise impact) the Cal Maritime campus at least once on an annual basis. Therefore, the probability of future occurrence of the severe weather hazard for Cal Maritime is HIGHLY LIKELY. See Table below for probabilities of future occurrence for component severe weather hazards for the County and the Cal Maritime campus.
Table 14-30: Severe Weather Hazard Probabilities of Future Occurrence for Solano County and Cal Maritime

<table>
<thead>
<tr>
<th>Severe Weather Hazard Category</th>
<th>Average Number of Hazard Events Per Year</th>
<th>Probability of Future Occurrence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wind (Includes High, Strong and Thunderstorm Winds ONLY)</td>
<td>2.84</td>
<td>Highly Likely</td>
</tr>
<tr>
<td>Tornado</td>
<td>0.12</td>
<td>Possible</td>
</tr>
<tr>
<td>Hail</td>
<td>0.16</td>
<td>Possible</td>
</tr>
<tr>
<td>Lightning</td>
<td>0</td>
<td>Unlikely</td>
</tr>
<tr>
<td>Diablo Wind</td>
<td>2.5</td>
<td>Highly Likely</td>
</tr>
<tr>
<td>Santa Ana Wind**</td>
<td>32</td>
<td>Not Rated</td>
</tr>
<tr>
<td>Sundowner Wind**</td>
<td>2 to 3</td>
<td>Not Rated</td>
</tr>
</tbody>
</table>

** Note: The Santa Ana and Sundowner wind hazards are not present in Solano County, and therefore are not rated for probability of future occurrence. They are included here for information purposes only.

Vulnerability to the Hazard

People, structures, and assets on the Cal Maritime campus are all vulnerable to the impacts associated with severe weather. Infrastructure can be damaged or destroyed by hail, wind, tornadoes, thunderstorms, and lightning, which can result in service interruptions and outages. Structures can be damaged or destroyed by hail, wind, tornadoes, thunderstorms, and lightning. People can be injured or killed by lightning, flying debris, hail, or extreme wind events. The Cal Maritime campus also has vehicles, as well as off-campus conference and recreational facilities, that are all vulnerable to a severe weather event.

Estimate of Potential Losses

Severe weather is a non-spatial hazard that affects the entire Cal Maritime campus. Each of the hazards associated with severe weather can result in losses throughout the planning area.

All structures within the Cal Maritime campus are at risk from severe weather. There are approximately 78 buildings on the main campus that could be damaged by wind, hail, and/or lightning. If even a fraction of these assets were to be damaged, the resulting estimated losses would still be in the millions of dollars. The total replacement costs due
to severe weather hazard are $83,596,545 for 47 of the buildings, and unknown for the remaining 31 buildings. An analysis of projected dollar losses to campus buildings from severe weather as a percentage of building replacement costs is not currently available, though CSU leadership may pursue such data in the future.

The population at the Cal Maritime campus varies throughout the day. As of Fall, 2019, Cal Maritime had 911 students and 329 faculty and staff. All are at risk from severe weather events, with 1,240 being directly vulnerable in this scenario.

Vulnerability Assessment Conclusions

Severe weather presents a variety of hazards to the Cal Maritime campus. People, assets, infrastructure, and vehicles can all be damaged by this hazard, and losses can quickly begin to rise. In the aggregate, severe weather is a frequently occurring hazard (mostly in the form of wind hazard events) that presents a variety of risks to Cal Maritime.

It is evident that the Cal Maritime campus has vulnerabilities to and risks from severe weather hazard incidents, and that pre-event planning, communication, and mitigation efforts should be implemented. Public education and outreach regarding areas of shelter that could be used by campus populations during severe weather events is considered by campus leadership to be one viable mitigation option. The campus planning committee will continue to look for feasible and cost-effective options for the mitigation of severe weather risks going forward.

Identified Data Limitations

Numerous federal agencies maintain a variety of records regarding losses associated with hazards. Unfortunately, no single source is considered to offer a definitive accounting of all losses. The Federal Emergency Management Agency (FEMA) maintains records on federal expenditures associated with declared major disasters. The US Army Corps of Engineers (USACE) and the Natural Resources Conservation Service (NRCS) collect data on losses during the course of some of their ongoing projects and studies. Additionally, the National Oceanic and Atmospheric Administration’s (NOAA) National Centers for Environmental Information (NCEI) collects and maintains data about natural hazards in summary format, as well as occurrences, dates, injuries, deaths, and estimated costs for individual storm events. Many of these databases and other data collection services, including the NCEI, have inherent data limitations when searching for information at a scale as small as a single campus.

The best available data and records have been used throughout this section. Where no data or records exist or could be located, that deficiency is noted.
14.4 Social Resilience Assessment

Overview

While every person is vulnerable to risk, individuals from diverse populations such as those with access and functional needs are disproportionately more vulnerable and may be at a higher risk to harm in a disaster event. In addition to physical vulnerabilities, the intersectionality between physical hazard risks and population social vulnerabilities must be considered to holistically address overall campus risk.

As inclusivity is a high priority for CSU, addressing campus risk and resilience must be done through the lens of inclusion and equity. Addressing social vulnerability is an increasingly critical requirement of state and national doctrines and described in Section 4.4 of the HVRA Base Plan. Every individual of the campus’s richly diverse population group needs to have the capacity, skills, and knowledge in order to understand, access, and participate in risk reduction and disaster response in ways that are meaningful to their own unique situation. In a campus community, having strong social support networks and active involvement in community disaster responses may negatively or positively impact these opportunities and reduce the resilience-building process. This section offers a glimpse into the CSU San Jose campus’s unique social construct, population demographics, strengths and concerns and presents a high-level assessment of the resilience, coping capacities and potential social vulnerabilities of students, staff and faculty. The research variables that were asked are often considered sensitive subjects, and few are traditionally included in emergency management/hazard mitigation planning.

This social resilience assessment of college campuses is the first of its kind in the nation. The research methodology unfolded as the interviews with campuses progressed. The assessment data presented are not definitive or authoritative. The answers, analysis, and suggested trends are strictly indicators for potential social risk. They do not represent an accurate data capture as limitations on the data gathering process influenced an ability to provide accuracy. This assessment provides indications of increased risk, not accuracy of response or a true reflection of the situation of the campus. The information presented is to be considered in the context of the more detailed system-wide CSU social vulnerability assessment that is included in the baseline HVRA.

Campus-Identified Populations of Concern

During the campus interview, the following responses were provided when asked, “In considering the diverse population group(s) amongst student body, faculty and staff, which are of the most concern in your emergency management planning?”

**NOTE: No interview was conducted with campus staff so no information can be included in this section.**

Resilience Variables Related to Campus Emergency Management
The interviewees were asked to reflect on a set of 12 variables for the campus populations of student, faculty and staff: homelessness (*housing insecurity*), food security, health and wellness, disability/access and functional needs (AFN), racial equity, digital equity, communications, international students, immigrants/immigration status issues (*undocumented, DACA, etc.*), LGBTQI (Lesbian Gay Bisexual Transgender Questioning (or queer) Intersex), and transportation dependency. They were also offered an opportunity to add any other factor they wanted to include. The following two questions were asked:

1. Is this factor a particular issue of concern for emergency management on your campus? Responses were summarized as *Very High, High, Medium, Low*
2. Is this factor reflected in the emergency plans and processes for your campus? Responses were summarized as *Yes, No, In Progress, NA*

*NOTE: No interview was conducted with campus staff so no information can be included in this section.*

**Campus High Hazards and Potentially Vulnerable Populations**

This section provides a brief introduction to the link between socially vulnerable populations and a particular hazard type. While extensive research has been conducted on the impacts of hazards, not all linkages have been documented or published, and detail for finding them are beyond the scope of this assessment. It’s important to note, the intersectional nature of what makes an individual’s personal experience and resilience to an event is played out by unique factors for that individual or population. The nuanced social vulnerabilities often come from the social and physical environment in which a person is embedded.

In order to aid in further assessing campus resilience, below is a general description of the known impacts. From some hazards, the descriptions are robust, while others are only brief introductions.

**Table 14-31: CSU Maritime *Highly Likely, Likely and Possible* Hazards**

<table>
<thead>
<tr>
<th>Hazard</th>
<th>Future Occurrence Probability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Communicable Disease</td>
<td>Highly Likely</td>
</tr>
<tr>
<td>Drought</td>
<td>Highly Likely</td>
</tr>
<tr>
<td>Earthquake</td>
<td>Possible</td>
</tr>
<tr>
<td>Erosion</td>
<td>Likely</td>
</tr>
<tr>
<td>Landslide</td>
<td>Possible</td>
</tr>
<tr>
<td>Power Outage</td>
<td>Likely</td>
</tr>
<tr>
<td>Tsunami</td>
<td>Likely</td>
</tr>
<tr>
<td>---------</td>
<td>--------</td>
</tr>
<tr>
<td>Wildfire</td>
<td>Possible (Fire); Possible (Smoke)</td>
</tr>
</tbody>
</table>

**Drought**

The 2012-2016 drought had severe effects on two vulnerable sectors of our population: those in low-income brackets, and those, especially Native Americans, who rely on subsistence fishing for their livelihoods.\(^{156}\) Water bills increased throughout the state. Due to rising water prices, for the working poor, many have paid four to five percent of their income for water. Since many CSU students are commuters, and many living with families, future drought impacts may potentially affect a percentage of non-resident students. NASA’s modeling shows that future droughts are likely to last longer and be more intense, even leading to “megadroughts” in the western states.\(^ {157}\) Fresh water supplies are predicted to be full of extremes, with both droughts and extreme precipitation events being more severe. The interrelationship between drought and other hazard conditions may lead to a set of secondary impacts. Drought conditions lead to water quality issues due to loss of drinking water, increased fire danger that leads to drought-induced fires and elevated AQI levels, as well as extreme heat or prolonged heat events.

**Earthquake**

Impacts on populations from earthquakes are complex, with long-term implications on social stability for all populations. In addition to the physical impact exposure during a no-notice earthquake event and the social and logistical challenges of a recovering community, an earthquake can have lasting impacts long afterwards due to post traumatic stress disorder (PTSD).

Socioeconomic vulnerabilities of populations at risk were analyzed in the hypothetical yet scientifically realistic earthquake sequence that is being used to better understand hazards for the San Francisco Bay region during and after a magnitude-7 earthquake (mainshock) on the Hayward Fault and its aftershocks. In this study, the at-risk populations located in areas of concentrated damage are anticipated to experience longer recovery trajectories, increased long term housing displacement, and transportation impacts due to dependencies on transit dependencies. When neighborhood schools close, families with school age children may move to other areas to keep their children in schools. Persons with access and functions needs are likely to be more dependent on access to functioning medical, social and personal

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health care services that would be overwhelmed by the event and therefore increasing their vulnerabilities. For the homeless populations, the loss of social community services and damages to shelters could add to protracted relocations. For the young and mobile populations who rent, the major disruption to housing, jobs and transit will also drive relocation. Widespread housing damage and preexisting housing market constraints will make it “extremely challenging” for the socially and economically vulnerable populations to find alternative housing near their home communities. Those who utilize interim and irregular housing for months and years after a disaster are more vulnerable to physical, social, and mental disorders, including suicide, substance abuse, and physical and verbal abuse. Aftershocks and post disaster conditions delay population return and increase outmigration.\textsuperscript{158}

\textit{Erosion}

Risk from erosion relates to earthen and infrastructural losses. The degree of vulnerability to these events and their impacts depends on human behavior and the traditional social factors such as situational awareness, prior knowledge of hazards, social capital and decision-making capabilities, as well as increased vulnerability due to social factors, such as racial and economic disparities.

\textit{Landslides}

Although infrastructural losses are of secondary importance to the risk to humans themselves, research investigating the vulnerability of people to landslides is rare. The many reasons for this lack of data are related to the fact that the collapse of occupied buildings which makes it a function of structural vulnerability and therefore, indirect. The degree of vulnerability to landslides by an individual considered at high risk, or even the general populations, also depends on human behavior, including many of the traditional social factors that are difficult to measure such as situational awareness, prior knowledge of hazards, and decision-making capabilities.\textsuperscript{159}

Landslides can result in primary lifeline failures through the loss of roads or power and communication lines. Transportation routes are often expensive to clean up, and prolonged obstruction can disrupt the movement of people and goods. Risk from landslide relates to earthen and infrastructural losses. The degree of vulnerability to these events and their impacts depends on human behavior and the traditional social factors such as situational awareness, prior knowledge of hazards, social capital and


decision-making capabilities, as well as increased vulnerability due to social factors, such as racial and economic disparities.

**Power Outage/Public Safety Power Shutdowns (PSPS)**

Loss of power creates economic hardship to a region experiencing regular PSPS events, such as those experienced throughout the state over the recent years. Many businesses close, including gas stations, grocery stores, and local retail establishments. These impacts may deeply impact students dependent on support jobs, as well impacting family members of campus staff and faculty. PSPS increases risks to the public due to inability to use medical devices, spoilage of food and medicines, and disruption to infrastructure, such as supply of clean water and electricity used to run home medical equipment, such as lift chairs and ventilators.

**Tsunami**

TBD

**Wildfire**

Increased wildfire threat occurs especially in the end of fall, when conditions are driest, but before the winter rains have come; an east-to-west wind gusts exacerbate fire risk. Wildfire threats have the concomitant threat of Public Safety Power Shutoffs (PSPS). And, in the case of an actual wildfire, danger exists both from fire and from the smoke. Recent wildfires have demonstrated that some demographics are disproportionately affected. Native Americans are six times more likely to be affected than white people. Blacks and Hispanic people are 50 percent more vulnerable. These values take into account the likelihood of a community being affected and the greater difficulty of that community to recover. These statistics reflect the lack of access to resources to pay for insurance, to rebuild and recover, to implement fire safety measures, and to access other resources. Price gouging after a fire (such as documented in Sonoma County after the 2017 Tubbs Fire) further exacerbates the disparity. Furthermore, the disabled and the elderly are at particular risk from extreme wildfire conditions, as they are often not as able to effectively evacuate. Of the 85 people who died in the Camp Fire in Butte in 2018, 62 of them were at least 65 years old. Smoke from wildfires creates a significant public health threat. Especially vulnerable are individuals who have heart or lung issues, such heart disease, lung disease or asthma. Those most vulnerable include the medically fragile, elderly and children. Air

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Quality Indexes track the level of the following: particulate matter, surface levels of ozone, carbon monoxide, sulfur dioxide, and nitrogen dioxide. All of these can cause respiratory distress and harm lungs.

The California Department of Public Health reports the increased public health risks, and risk indicators that include: heat-related ED visits, populations living in wildfire areas, adults with multiple chronic conditions, populations living in poverty, race/ethnicity, outdoor workers, public transit access, air conditioner ownership and tree canopy.

Hazard Mitigation and Emergency Management Planning

The goal of this high-level assessment is to provide a starting point to encourage further exploring campus social risks and vulnerabilities, as well as to inform and to enhance holistic emergency management and hazard mitigation decision making, planning processes and future adaptive risk management strategies. By including the social resilience factors, mitigation investments may move beyond standardized planning and regulations, structure and infrastructure projects, and natural systems protections to embrace a more expanded, customized emergency operations plan and an education and outreach program unique to the campus.

A more robust social resilience inquiry is strongly encouraged to develop an accurate picture, based on methodical and scientific research-based data. Such an effort would be envisioned through both nuanced discussions with a variety of campus stakeholders and the invitation of nontraditional stakeholders to join in a collaborative resilience partnership. Such a forward-leaning effort would be directly in keeping with CSU’s commitment to inclusion and equity in risk reduction.

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Section 15
California State University, Monterey Bay

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15.1 University Profile

University History

CSU Monterey Bay’s history grew out of Fort Ord, a decommissioned Army base with a rich history going back to the early 20th century. In 1917, the U.S. Army established a military base in Monterey County, California -- Camp Gigling. Located on California’s central coast, the army installation served originally as a military training base for infantry troops. In 1940, the base was renamed Fort Ord, and seven (7) years later (in 1947) Fort Ord became a U.S. Army basic training center. Throughout the 1950s, 1960s and 1970s, Fort Ord was a major location for basic training, reaching its heyday during the Vietnam War. In all, more than 1.5 million men and women received basic training at Fort Ord. After 1975, Fort Ord’s mission changed, and light infantry troops occupied the base, operating without heavy tanks, armor, or artillery. In 1990, U.S. Secretary of Defense announced that the military would begin a process to reduce the number of nationwide military installations and Fort Ord was one of the bases named for closure. In September, 1994, Fort Ord was officially closed.

In anticipation of Fort Ord’s closure, local Monterey Bay community leaders proposed a plan that the soon-to-be decommissioned base be converted into a university. In June, 1994, that plan was approved, and the first classes at the aptly named California State University Monterey Bay (CSU Monterey Bay, Cal State Monterey Bay) began the following year, on August 28, 1995.

Since its inception, CSU Monterey Bay has grown from 654 students to well over 7,000 students. It is designated as a Hispanic-Serving Institution (HSI).

University Governance

The campus president is the chief executive officer who oversees the administration of the entire university. The president manages campus operations and fundraising, sets campus priorities, and oversees the hiring and support of staff and faculty. The president also maintains a close working relationship with the CSU’s systemwide office, reporting to the chancellor and participating in the systemwide Executive Council.

The provost is the chief academic officer of the university, overseeing all academic affairs and programs of the university. The provost reports directly to the president.

The university divides its operations into administrative divisions, each under the direction of a vice president. The current CSU Monterey Bay leadership team of president and vice presidents includes; the University President, Provost and VP for Academic Affairs, the Executive Director University Corporation at Monterey Bay & VP for Administration & Finance, Vice President for Student Affairs & Enrollment Services, and the Vice President for University Advancement.
The CSU Monterey Bay Academic Senate and its Academic Senate Executive Committee, made up of elected representatives of the faculty, recommend academic policy to the president through a shared-governance process.

University Mission

“To prepare students to contribute responsibly to California and the global community by providing transformative learning experiences in an inclusive environment.”

The Strategic Planning Committee and working groups created a strategic plan, operating on five-year action cycles. The five-year action cycles focused on student success and on what the university’s respective region requires impact the lives and future of the community. Each cycle will stay true to the campus’ values. Additionally, it will update the goals and objectives to most effectively advance the mission of the university. Additionally, the strategic plan is the framework for processes and decision making. The plan informs and aids the University’s as priorities are determined. It guides the data to collect and evaluate in order to be effective in accomplishing University goals. It is the basis for making budget decisions and it serves as a reminder of what the University values most. The university prioritizes student success, inclusiveness, regional stewardship and global engagement, and finally, organizational learning.

University Location

CSU Monterey Bay is on the central coast of California, just two hours south of San Francisco. Located in Seaside, CA, CSU Monterey Bay’s campus is close to beaches, redwood forests, tidepools, and the Fort Ord National Monument. The campus is also close to the coastal communities of Pacific Grove, Monterey, and Carmel, and lies proximal to the Salinas Valley, an area known as the “Salad Bowl of the World” for its abundant agricultural production.

University Population

CSU Monterey Bay has a population exceeding 7,500 students. In the fall of 2020, the student population was overwhelmingly made up of undergraduate students. Latino students made up 45%, with White students making up 29% of the campus population.

15.2 Interim Final Rule for Hazard Vulnerability and Risk Assessment

Requirement §201.6(c)(2): The plan shall include a risk assessment that provides the factual basis for activities proposed in the strategy to reduce losses from identified hazards. Local risk assessments must provide sufficient information to enable the
jurisdiction to identify and prioritize appropriate mitigation actions to reduce losses from identified hazards.

**Requirement §201.6(c)(2)(i):** The risk assessment shall include a description of the type, location, and extent of all natural hazards that can affect the jurisdiction. The plan shall include information on previous occurrences of hazard events and on the probability of future hazard events.

**Requirement §201.6(c)(2)(ii):** The risk assessment shall include a description of the jurisdiction’s vulnerability to the hazards described in paragraph (c)(2)(i) of this section. This description shall include an overall summary of each hazard and its impact on the community.

**Requirement §201.6(c)(2)(ii):** The risk assessment must also address National Flood Insurance Program (NFIP) insured structures that have been repetitively damaged floods.

**Requirement §201.6(c)(2)(ii)(A):** The plan should describe vulnerability in terms of the types and numbers of existing and future buildings, infrastructure, and critical facilities located in the identified hazard area.

**Requirement §201.6(c)(2)(ii)(B):** The plan should describe vulnerability in terms of an estimate of the potential dollar losses to vulnerable structures identified in paragraph (c)(2)(ii)(A) of this section and a description of the methodology used to prepare the estimate.

**Requirement §201.6(c)(2)(ii)(C):** The plan should describe vulnerability in terms of providing a general description of land uses and development trends within the community so that mitigation options can be considered in future land use decisions.

**Requirement §201.6(c)(2)(iii):** For multi-jurisdictional plans, the risk assessment must assess each jurisdiction’s risks where they vary from the risks facing the entire planning area.

### 15.3 Hazard Identification and Risk Assessment

**Overview of California State University, Monterey Bay History of Hazards**

Numerous federal agencies maintain a variety of records regarding losses associated with hazards. Unfortunately, no single source is considered to offer a definitive accounting of all losses. The Federal Emergency Management Agency (FEMA) maintains records on federal expenditures associated with declared major disasters. The US Army Corps of Engineers (USACE) and the Natural Resources Conservation Service (NRCS) collect data on losses during the course of some of their ongoing projects and studies. Additionally, the National Oceanic and Atmospheric Administration’s (NOAA) National Centers for Environmental Information (NCEI)
database collects and maintains data about natural hazards in summary format. The data includes occurrences, dates, injuries, deaths, and estimated costs. Many of these databases and other data collection services, including the NCEI, have inherent data limitations when searching for information at a university scale.

The best available data and records were used throughout this assessment.

**Hazard Identification**

As part of the initial hazard identification process, the Campus Assessment Team considered potential hazards with the most chance to significantly affect the planning area. The hazards include those that have occurred in the past and may occur in the future. A variety of sources were used to develop the list of hazards considered including national, regional, and local sources such as emergency operations plans, FEMA’s *How-To Series*, websites, published documents, databases, and maps, as well as discussion among the Campus Assessment Team members.

In the initial phase of the planning process, the Campus Assessment Team considered 14 hazards and the risks they create for the University and its material assets, population, and operations. The hazards initially considered, and the determinations as to the treatment of those hazards, are shown in Table 15-1 (following).
<table>
<thead>
<tr>
<th>Hazard</th>
<th>Determination (Yes/No)</th>
<th>Reason for Determination</th>
<th>Future Occurrence Probability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Communicable Disease</td>
<td>Yes</td>
<td>Hazard of concern for campus</td>
<td>Highly Likely</td>
</tr>
<tr>
<td>Dam and Levee Failure</td>
<td>Yes</td>
<td>Hazard of concern for campus</td>
<td>Unlikely</td>
</tr>
<tr>
<td>Drought</td>
<td>Yes</td>
<td>Hazard of concern for campus</td>
<td>Highly Likely</td>
</tr>
<tr>
<td>Earthquake</td>
<td>Yes</td>
<td>Hazard of concern for campus</td>
<td>Possible</td>
</tr>
<tr>
<td>Erosion</td>
<td>Yes</td>
<td>Hazard of concern for campus</td>
<td>Likely</td>
</tr>
<tr>
<td>Extreme Temperature</td>
<td>Yes</td>
<td>Hazard of concern for campus</td>
<td>Unlikely (Heat); Unlikely (Cold)</td>
</tr>
<tr>
<td>Flood</td>
<td>Yes</td>
<td>Hazard of concern for campus</td>
<td>Unlikely</td>
</tr>
<tr>
<td>Hazardous Materials</td>
<td>Yes</td>
<td>Hazard of concern for campus</td>
<td>Unlikely</td>
</tr>
<tr>
<td>Landslide</td>
<td>Yes</td>
<td>Hazard of concern for campus</td>
<td>Unlikely</td>
</tr>
<tr>
<td>Power Outage</td>
<td>Yes</td>
<td>Hazard of concern for campus</td>
<td>Likely</td>
</tr>
<tr>
<td>Sea Level Rise</td>
<td>No</td>
<td>Not a hazard of concern for campus</td>
<td>N/A</td>
</tr>
<tr>
<td>Tsunami</td>
<td>No</td>
<td>Not a hazard of concern for campus</td>
<td>N/A</td>
</tr>
<tr>
<td>Volcano</td>
<td>Yes</td>
<td>Hazard of concern for campus</td>
<td>Unlikely</td>
</tr>
<tr>
<td>Wildfire</td>
<td>Yes</td>
<td>Hazard of concern for campus</td>
<td>Possible (Fire); Possible (Smoke)</td>
</tr>
</tbody>
</table>
**Future Occurrence Probability**

In order to determine the probability of future occurrences of each hazard profiled, the following scale was developed:

Highly Likely- 76%-100% that the hazard would occur annually.
Likely- 50%-75% that the hazard would occur annually.
Possible- 11%-49% that the hazard would occur each annually.
Unlikely- 0%-10% that the hazard would occur each annually.
Communicable Disease

Description of the Hazard

Communicable diseases are illnesses that occur due to infectious agents or their toxic products and are infectious due to their potential of transmission from one person or species to another by a replicating agent. They may be transmitted from a reservoir to a susceptible host either directly as from an infected person or animal or indirectly through the agency of an intermediate plant or animal host, vector, or the inanimate environment. Communicable diseases are clinically evident illness resulting from the presence of pathogenic microbial agents, including pathogenic viruses, pathogenic bacteria, fungi, protozoa, multi-cellular parasites, and aberrant proteins known as prions. The degree of spread of a communicable disease depends on both the ability of an organism to enter, survive and multiply in the host and the comparative ease with which the disease is transmitted to other hosts.

Some ways in which communicable diseases spread are by:

- Travel through the air, such as tuberculosis, measles, or COVID-19;
- Physical contact with an infected person, such as through touch (staphylococcus), sexual intercourse (gonorrhea, HIV), fecal/oral transmission (hepatitis A), or droplets (influenza, TB, COVID-19);
- Contact with a contaminated surface or object (Norwalk virus), food (salmonella, E. coli), blood (HIV, hepatitis B), or water (cholera); and
- Bites from insects or animals capable of transmitting the disease (mosquito: malaria and yellow fever; flea: plague).

Collectively, the twenty-three (23) campuses and Chancellor’s Office of the California State University (CSU) system have identified nine (9) communicable disease hazards that that have had significant impacts on their respective student, faculty, and staff populations. Of these communicable diseases, COVID-19 is considered to be the most prominent and widespread agent across all CSU campuses. (See Table 15-2 below.)

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Table 15-2: Communicable Diseases Identified CSU Campuses.

<table>
<thead>
<tr>
<th>Collective List of Communicable Diseases Identified by All CSU Campuses</th>
<th>Number of CSU Campuses (Including Chancellor’s Office) Identifying Communicable Disease Having Significant Impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>COVID-19 (SARS-CoV-2)</td>
<td>24</td>
</tr>
<tr>
<td>Meningitis</td>
<td>7</td>
</tr>
<tr>
<td>Measles</td>
<td>6</td>
</tr>
<tr>
<td>Influenza (Including H1N1/Swine Flu)</td>
<td>6</td>
</tr>
<tr>
<td>Tuberculosis</td>
<td>5</td>
</tr>
<tr>
<td>Norovirus</td>
<td>4</td>
</tr>
<tr>
<td>Mumps</td>
<td>2</td>
</tr>
<tr>
<td>E. Coli</td>
<td>2</td>
</tr>
<tr>
<td>Sexually Transmitted Diseases (STDs)</td>
<td>2</td>
</tr>
</tbody>
</table>

(Source: Interviews with CSU campus staff at CSU campuses and at CSU Chancellor’s Office.)

With the exception of COVID-19, there is variability among CSU campuses regarding which communicable diseases have had the greatest impact on individual campus communities. Table 15-3 shows the communicable disease hazards that have had the greatest impact on each CSU campus.

Table 15-3: Communicable Disease Hazards at CSU Campuses with Greatest Impact

<table>
<thead>
<tr>
<th>CSU Campus</th>
<th>Identified Communicable Disease Hazards with the Greatest Impact on CSU Campus</th>
</tr>
</thead>
<tbody>
<tr>
<td>CSU Bakersfield</td>
<td>COVID-19, Meningitis</td>
</tr>
<tr>
<td>CSU Channel Islands</td>
<td>COVID-19, Measles</td>
</tr>
<tr>
<td>CSU Chico (Chico State)</td>
<td>COVID-19, Tuberculosis</td>
</tr>
<tr>
<td>CSU Dominguez Hills</td>
<td>COVID-19</td>
</tr>
<tr>
<td>Cal State East Bay</td>
<td>COVID-19, Meningitis</td>
</tr>
<tr>
<td>Fresno State</td>
<td>COVID-19, Meningitis, Tuberculosis</td>
</tr>
<tr>
<td>Cal State Fullerton</td>
<td>COVID-19, Influenza</td>
</tr>
<tr>
<td>Humboldt State</td>
<td>COVID-19, Measles, Norovirus, Influenza, STDs</td>
</tr>
</tbody>
</table>
Cal State Long Beach | COVID-19
---|---
Cal State LA | COVID-19, E. coli, Measles
Cal Maritime | COVID-19
**CSU Monterey Bay** | COVID-19
CSUN (Northridge) | COVID-19, Measles
Cal Poly Pomona | COVID-19, Influenza (Swine Flu - H1N1)
Sacramento State | COVID-19
Cal State San Bernardino | COVID-19, Tuberculosis
San Diego State | COVID-19, Meningitis, Mumps
San Francisco State | COVID-19
San José State | COVID-19, H1N1
Cal Poly San Luis Obispo | COVID-19, Meningitis, Norovirus
**CSU San Marcos** | COVID-19
Sonoma State | COVID-19, H1N1, Norovirus
Stanislaus State | COVID-19, Tuberculosis
**Office of the Chancellor** | COVID-19
**CSU System-Wide** | COVID-19, Meningitis, Measles, Tuberculosis, Influenza-Swine Flu-H1N1, Mumps, Norovirus, E. coli, STDs

(Source: Interviews with CSU campus staff at CSU campuses and at CSU Chancellor’s Office.)

**Descriptions of Identified Communicable Disease Hazards at CSU Monterey Bay**

CSU Monterey Bay has identified one (1) communicable disease hazard that has had the greatest impact on campus – COVID-19. The following is a brief description of the communicable disease hazard at CSU Monterey Bay.

**COVID-19 (SARS-CoV-2)**

Coronaviruses are a family of viruses that can cause illnesses such as the common cold, severe acute respiratory syndrome (SARS) and Middle East respiratory syndrome (MERS). In 2019, a new coronavirus was identified as the cause of a disease outbreak that originated in China. This virus is now known as the **severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2)**. The disease it causes is called Coronavirus Disease 2019 (COVID-19). In March 2020, the World Health Organization (WHO) declared the COVID-19 outbreak a pandemic.
Signs and symptoms of coronavirus disease 2019 (i.e., COVID-19) may appear two to 14 days after exposure. Common signs and symptoms can include fever, cough, and tiredness. Early symptoms of COVID-19 may also include a loss of taste or smell.

The virus that causes COVID-19 spreads easily among people, and more continues to be discovered over time about how it spreads. Data has shown that the COVID-19 virus spreads mainly from person to person among those in close contact (within about 6 feet, or 2 meters). The virus is transmitted by respiratory droplets being released when someone with the virus coughs, sneezes, breathes, sings or talks. These droplets can be inhaled or land in the mouth, nose or eyes of a person nearby. In some situations, the COVID-19 virus can spread by a person being exposed to small droplets or aerosols that stay in the air for several minutes or hours (i.e., airborne transmission). It’s not yet known how common it is for the virus to spread this way. The COVID-19 virus can also spread if a person touches a surface or object with the virus on it and then touches his or her mouth, nose or eyes; however, this is not considered to be a main way it spreads.

The severity of COVID-19 symptoms can range from very mild to severe. Some people may have only a few symptoms, and some people may have no symptoms at all. However, some people may experience worsened symptoms, such as worsened shortness of breath and pneumonia. People who are older have a higher risk of serious illness from COVID-19, and the risk increases with age. People who have existing medical conditions also may have a higher risk of serious illness from COVID-19. In some cases, the disease can cause severe medical complications and may even lead to death. ⁵

Location of the Hazard

Communicable diseases have the potential to affect the entire CSU Monterey Bay planning area equally. As a result, the communicable disease hazard can be found at the CSU Monterey campus, which straddles the border of two (2) Monterey County communities – Marina, CA and Seaside, CA. Because of the ubiquitous nature of many communicable diseases, students, faculty, staff at (and visitors to) CSU Monterey are at risk of exposure to the communicable disease hazard.⁶

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⁶ California State University. *About CSU.* Retrieved on 4.29.2021 from: https://www2.calstate.edu/csu-system/about-the-csu
CSU Student Housing Locations and Populations

Although CSU-campus-owned student housing opportunities have been severely limited due to the COVID-19 pandemic, this situation is temporary. Eventually, students will be allowed back on campus at full capacity, and many of these students will be living in campus-owned housing. When this occurs, over 53,000 students (i.e., just over 11% of the CSU total enrollment) will be at increased risk of exposure to communicable disease hazards, owing to the “close-quarters” living arrangements in student housing. For CSU Monterey Bay, approximately 46% of its 7,123 enrolled students (or 3,277 students) reside in student housing. 7,8

Extent of the Hazard

Various communicable diseases are categorized by the Center for Disease Control and Prevention (CDC) by levels of containment called Biosafety Levels (or BSLs). The higher the BSL, the greater the level of containment and level of effort necessary to prevent transmission of the disease, and therefore the greater the hazard. Biosafety Levels prescribe procedures and levels of containment for a particular microorganism or material (including research involving recombinant or synthetic nucleic acid molecules) and procedures associated with that containment. BSLs also consider primary barriers (e.g., biosafety cabinets), secondary barriers, facility design, air handling, laboratory security, etc. BSLs are graded from 1 to 4; as the BSL increases so does the relative risk of the agent/procedures as well the stringency of procedures and facility design.

Figure 15-1 describes the different BSLs, and provides examples of communicable diseases that would typically fall in to these classifications, as well as the typical protections that would be necessary to prevent transmission of each of the diseases.

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8 California State University. *CSU Campus Match.* Retrieved 04.30.2021 from: https://www2.calstate.edu/attend/campuses/campus-match/Pages/campus-match.aspx
The Extent of CSU Monterey Bay Communicable Disease Hazards Except COVID-19:

Besides COVID-19, there was no information provided on other communicable disease hazards on campus.

The Extent of CSU Monterey Bay COVID-19 Communicable Disease Hazard:

As a microorganism, the SARS-CoV-2 (COVID-19) virus requires a high level of containment. It is therefore classified at BSL-3. ¹⁰

History of the Hazard

Over an approximately one-year period, from mid-March, 2020 to March 23, 2021, there were a reported 55 cases of COVID-19 at CSU Monterey Bay. Most communicable disease data are maintained by at the state and at the county levels and are not generally available at the municipal or campus levels, unless (a) the CSU campus falls under the jurisdiction of a city-level health department, or (b) a geographically specific outbreak occurs on campus or in the local community. The exception to this is the current COVID-19 pandemic, where both campus and County-level case data have been collected. As a result, it is important to provide COVID-19

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case statistics for both CSU campuses and the counties where CSU campus assets are located.

Tables 15-5 and 15-6 show campus-level and County-level COVID-19 Case data for CSU Monterey Bay. These case data are updated on at least a weekly basis. (Please note that the COVID-19 case numbers here may not reflect the most recent updates.)

Table 15-4: Cumulative Confirmed COVID-19 Cases at CSU Monterey Bay (as of March 2020 to 03/23/2021)11

<table>
<thead>
<tr>
<th>Population Classification</th>
<th>On-Campus</th>
<th>Off-Campus</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Students</td>
<td>5</td>
<td>16</td>
<td>21</td>
</tr>
<tr>
<td>Faculty and Staff</td>
<td>15</td>
<td>19</td>
<td>34</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>20</strong></td>
<td><strong>35</strong></td>
<td><strong>55</strong></td>
</tr>
</tbody>
</table>

Note: “CSUMB tracks all reported cases of positive COVID-19 tests, both on and off-campus. Continuing in a predominantly virtual delivery approach, many of our students, faculty, and staff may be outside of Monterey County or the State of California.”

Table 15-5: Monterey County COVID-19 Statistics (March 2020 to 03/15/2021):12

<table>
<thead>
<tr>
<th>Classification</th>
<th>Statistic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cases</td>
<td>42,734</td>
</tr>
<tr>
<td>Deaths</td>
<td>337</td>
</tr>
</tbody>
</table>

Potential Impacts of the Hazard

Communicable disease outbreaks and pandemics have (and will continue to have) direct impact on life, health, and safety across the CSU system (including the CSU Monterey Bay campus). The extent of this impact is contingent on the type of infection or contagion, the severity of the outbreak, and the speed at which it is transmitted. Property and infrastructure integrity may be affected if large portions of the campus population contract communicable diseases at the same time and are therefore unable to perform maintenance, operations, and educational tasks. This would be particularly disruptive if those impacted are first responders or other essential personnel. Long-term outbreaks affecting large numbers of CSU Monterey Bay students could result in cancelled classes, delayed matriculation, or other disruptions to the CSU System’s mission. This has already occurred with the current COVID-19


pandemic and could occur again with more virulent strains of communicable
diseases, including COVID-19.

Communicable disease hazards found across the CSU system (including CSU
Monterey Bay) vary both by level of containment (BSL) (described previously) and by
level of individual/public health risk, or Risk Group (RG) level. While BSLs describe the
procedures and required levels of containment in a laboratory setting, Risk Groups
(RGs) reflect the potential effects of disease exposure on humans or animals. Like
BSLs, RGs range from Level 1 (RG1) to Level 4 (RG4), with Level 1 (RG1) posing
minimal risk to healthy individuals and public health and Level 4 (RG4) posing a very
serious or extreme risks to individuals and public. BSLs generally correlate with Risk
Group (RG) Levels (e.g., a RG2 agent is worked with at BSL-2), but there are
exceptions (e.g., production volumes, high-risk procedures, etc.). 13

The World Health Organization’s (WHO) Laboratory Biosafety Manual, 3rd ed., NIH
Guidelines, categorizes Risk Groups (RGs) in the following way:

Table 5-6: WHO Risk Group Categorization14

<table>
<thead>
<tr>
<th>Risk Group (RG)</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>RG1</td>
<td>Rarely associated with disease in healthy adult humans or animals and pose no-to-little public health risk (e.g., Saccharomyces cerevisiae, E. coli K-12 strain derivatives often used for recombinant/molecular biology, many environmental organisms)</td>
</tr>
<tr>
<td>RG2</td>
<td>Associated with mild to moderate disease for which preventative measures or post exposure treatments are often available; public health impact is limited (e.g., Streptococcus pyogenes, Salmonella, hepatitis B virus)</td>
</tr>
<tr>
<td>RG3</td>
<td>Associated with serious to lethal human disease for which preventative vaccines or post-exposure therapies may be scarce. Public health impact is limited-to-moderate (e.g., Mycobacterium tuberculosis, hantaviruses, West Nile virus, SARS)</td>
</tr>
<tr>
<td>RG4</td>
<td>Associated with serious to lethal human disease for which preventative vaccines or post exposure therapies are not</td>
</tr>
</tbody>
</table>


usually available. Public health impact is high (e.g., Ebola virus, Marburg virus, smallpox virus, etc.)

Table 15-8 describes the four (4) Risk Group Levels (RGs), and provides examples of communicable diseases that would typically fall into these classifications, and the typical protections that would be necessary to prevent transmission of the disease. It is important to note that all but two (2) communicable disease hazards identified by CSU campuses fall under either the lower-risk RG1 or RG2 categories. COVID-19 and tuberculosis are the two (2) communicable diseases fall under the higher-risk RG3 category. However, with the advent of the recently-developed COVID-19 vaccine, and with the expectation of an increasingly robust vaccine supply, it is possible that the RG level for COVID-19 could be lowered in the future, thereby reducing both the extent and the potential impact of COVID-19.

Table 5-7: Risk Group Levels (RGs) with Example Diseases and Recommended Precautions

<table>
<thead>
<tr>
<th>Level</th>
<th>Examples</th>
<th>Typical Protection to Prevent Transmission</th>
</tr>
</thead>
<tbody>
<tr>
<td>RG I</td>
<td>E. Coli</td>
<td>Precautions are minimal, most likely involving gloves and some sort of facial protection. Usually, contaminated materials are left in open (but separately indicated) waste receptacles. Decontamination procedures for this level are similar in most respects to modern precautions against everyday viruses (i.e.: washing one’s hands with anti-bacterial soap, washing all exposed surfaces of the lab with disinfectants, etc.).</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>RG 2</th>
<th>Chicken Pox</th>
<th>Hepatitis A, B, C</th>
<th>Lyme disease</th>
<th>Salmonella</th>
<th>Mumps</th>
<th>Measles</th>
<th>Malaria</th>
<th>Scrapie</th>
<th>Dengue Fever</th>
<th>HIV</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>These bacteria and viruses cause mild disease in humans or are difficult to contract via aerosol. Routine diagnostic work with clinical specimens can be done safely at BSL-2, using BSL-2 practices and procedures.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>RG 3</th>
<th>Anthrax</th>
<th>West Nile Virus</th>
<th>SARS Virus (Including COVID-19)</th>
<th>Tuberculosis</th>
<th>Typhus</th>
<th>Yellow Fever</th>
<th>Hantaviruses</th>
<th>Avian Flu</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>These bacteria and viruses cause severe to fatal disease in human, but vaccines or other treatments do exist to combat them. Laboratory personnel have specific training in handling pathogenic and potentially lethal agents and are supervised by competent scientists who are experienced in working with these agents. This is considered a neutral or warm zone.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>RG 4</th>
<th>H5N1 (Bird Flu)</th>
<th>Dengue Hemorrhagic Fever</th>
<th>Marburg Virus</th>
<th>Ebola Virus</th>
<th>Smallpox</th>
<th>Lassa Fever</th>
<th>Crimean-Congo Hemorrhagic Fever</th>
<th>Other Hemorrhagic Diseases</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>These viruses and bacteria cause severe to fatal disease in humans, for which vaccines or other treatments are not available. When dealing with biological hazards at this level the use of a Hazmat suit and a self-contained oxygen supply is mandatory. The entrance and exit of a BSL-4 lab will contain multiple showers, a vacuum room, an ultraviolet light room, autonomous detection system, and other safety precautions designed to destroy all traces of the biohazard. Multiple airlocks are employed and are electronically secured to prevent both doors opening at the same time. All air and water service going to and coming from a BSL-4 lab will undergo similar</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
decontamination procedures to eliminate the possibility of an accidental release.

Probability of Future Occurrence of the Hazard

There have been cases of a variety of communicable disease throughout the CSU system, including COVID-19 (SARS-CoV-2), Meningitis, Measles, Influenza (Including H1N1/Swine Flu), Tuberculosis, Norovirus, Mumps, E. Coli, and Sexually Transmitted Diseases (STDs). However, there are significant data limitations regarding non-COVID-19 communicable disease cases, as the information thereof is outdated, anecdotal, and/or inadequate. As a result, it is not feasible to provide quantitative probabilities of future occurrence for non-COVID-19 communicable disease hazards. However, based on the limited data, it is feasible to present qualitative probabilities of future occurrence based on ranges of communicable disease frequency.

Table 15-9 shows a probability scale of future occurrence for the nine (9) communicable disease hazards profiled in this assessment. This scale is divided into four (4) levels of probability:

Table 15-8: Likelihood of Future Hazard Occurrence

<table>
<thead>
<tr>
<th>Likelihood</th>
<th>Parameters for Determining Likelihood</th>
</tr>
</thead>
<tbody>
<tr>
<td>Highly Likely</td>
<td>76 – 100% probability that hazard will occur annually (high to very high frequency)</td>
</tr>
<tr>
<td>Likely</td>
<td>50 – 75% probability that hazard will occur annually (moderate to high frequency)</td>
</tr>
<tr>
<td>Possible</td>
<td>11 – 49% probability that hazard will occur annually (low to moderate frequency)</td>
</tr>
<tr>
<td>Unlikely</td>
<td>0 – 10% probability that hazard will occur annually (very low to low frequency)</td>
</tr>
</tbody>
</table>

Due to significant data limitations surrounding non-COVID communicable diseases, the probability of future occurrence of CSU-system-wide communicable disease is measured by the proportion of campuses that have identified a particular communicable disease as having an impact on the campus community. In this measure, the more frequent a communicable disease is seen as impactful CSU-wide, the greater the probability of future occurrence. Note: Each communicable disease’s
probability of future occurrence ranking CSU-system-wide reflects the ranking at the individual CSU campus level unless noted otherwise.

Table 15-9: Probability of Future Occurrence of Communicable Disease Hazard for CSU System.

<table>
<thead>
<tr>
<th>Collective List of Communicable Diseases Identified by All CSU Campuses</th>
<th>Number of CSU Campuses (Including Chancellor’s Office) Identifying Communicable Disease Having Significant Impact</th>
<th>Proportion of CSU Campuses Identifying Communicable Disease as Having Significant Impact System-Wide</th>
<th>CSU System-Wide Probability Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>COVID-19 (SARS-CoV-2)</td>
<td>24</td>
<td>1.00</td>
<td>Highly Likely</td>
</tr>
<tr>
<td>Meningitis</td>
<td>7</td>
<td>0.29</td>
<td>Possible</td>
</tr>
<tr>
<td>Measles</td>
<td>6</td>
<td>0.25</td>
<td>Possible</td>
</tr>
<tr>
<td>Influenza (Including H1N1/Swine Flu)</td>
<td>6</td>
<td>0.25</td>
<td>Possible</td>
</tr>
<tr>
<td>Tuberculosis</td>
<td>5</td>
<td>0.21</td>
<td>Possible</td>
</tr>
<tr>
<td>Norovirus</td>
<td>4</td>
<td>0.17</td>
<td>Possible</td>
</tr>
<tr>
<td>Mumps</td>
<td>2</td>
<td>0.08</td>
<td>Unlikely</td>
</tr>
<tr>
<td>E. Coli</td>
<td>2</td>
<td>0.08</td>
<td>Unlikely</td>
</tr>
<tr>
<td>Sexually Transmitted Diseases (STDs)</td>
<td>2</td>
<td>0.08</td>
<td>Unlikely</td>
</tr>
</tbody>
</table>

(Source: Interviews with staff at CSU campuses and at the CSU Chancellor’s Office.)

Vulnerability to the Hazard

Vulnerability to a communicable diseases hazard resides in the population of a given area – both human and animal – not in the infrastructure or physical assets. While CSU assets and infrastructure could be impacted indirectly by the communicable disease hazard, these impacts would be secondary to the impact that the communicable disease hazard would have on students, faculty, staff, and visitors at the CSU Monterey Bay campus.

CSU campus settings are geographically diverse, with locations ranging from small towns to medium-sized cities to densely populated urban areas. Hundreds of thousands of people work, study, and/or pass through CSU campuses on any given
day. (As of Fall 2019, the CSU System had 480,541 students and 53,763 faculty and staff.)\textsuperscript{16,17} Each of these persons is vulnerable to communicable disease, particularly if it is a pathogen that individual has not been immunized against, or for which no immunization exists. Prolonged outbreaks could result in a loss of services, failure of infrastructure (from lack of operators or maintenance), and closure of facilities. This exact scenario has played out in the current COVID-19 pandemic on the CSU Monterey Bay campus.

Estimate of Potential Losses

**COVID-19 Pandemic Health Impact on CSU Campuses and Surrounding Communities**

The most prescient metric for estimating losses from COVID-19 is loss of life.\textsuperscript{16} The nationwide campus-related COVID-19 death rate of 0.02\% remains well below the average COVID-19 death rate in the U.S. However, due to data limitations, there is no information on CSU-campus-specific deaths by COVID-19 or by any other communicable diseases. In fact, COVID-19 is the only communicable disease for which case reports have been readily available for CSU campuses.

At some point in the future, CSU campuses will return to full capacity. Without adequate surveillance regarding campus access and student and employee interaction, CSU campuses (including CSU Monterey Bay) are at risk of developing an extreme incidence of COVID-19, and may become “super-spreaders” for adjacent communities.\textsuperscript{18} The emergence of more virulent COVID-19 variants would only add to the potential for high negative impacts on life safety, operations, and service delivery across the CSU system. (Other communicable diseases would also re-emerge, but with low to moderate negative impacts on life safety, operations, and service delivery.)

**Economic Impact of COVID-19 Pandemic on CSU Financial Health**

During the first few months of the COVID-19 pandemic in 2020, the CSU system suffered tremendous negative fiscal impacts. From March through July of 2020 alone, over $146 million worth of revenue losses were sustained across the CSU system due to refunds to students for parking, housing and dining service fees during Spring

\textsuperscript{16} The California State University. *Enrollment*. Retrieved 05.03.2021 from: https://www2.calstate.edu/csu-system/about-the-csu/facts-about-the-csu/enrollment/Pages/default.aspx

\textsuperscript{17} The California State University. *Employee Head Count by Campus*. Retrieved 05.03.2021 from: https://www2.calstate.edu/csu-system/faculty-staff/employee-profile/csu-workforce/Pages/employee-headcount-by-campus.aspx

Semester, 2020. Several CSU campuses saw refund losses surpass $10 million. (See Table CD.8.)
Mitigative Relief from Federal Assistance

The $1.5 billion in total federal assistance sent to the CSU system will help relieve the losses of revenues from services like dorms, parking and dining services during a year of mainly empty campuses. (See Table 15-11.) However, because of staggering COVID-related revenue losses, the CSU system is planning for three (3) years of fiscal duress.
<table>
<thead>
<tr>
<th>Institution</th>
<th>December 2020 Stimulus</th>
<th>CARES Act</th>
<th>APLU Projection of HEERF Total ARP Act Funding Allocation</th>
<th>Total Estimated Federal COVID Relief Funding</th>
</tr>
</thead>
<tbody>
<tr>
<td>California Polytechnic State University</td>
<td>$20,752,799</td>
<td>$14,725,000</td>
<td>$37,000,928</td>
<td>$72,478,727</td>
</tr>
<tr>
<td>California State Polytechnic University, Pomona</td>
<td>$48,614,353</td>
<td>$31,102,000</td>
<td>$86,044,649</td>
<td>$165,761,002</td>
</tr>
<tr>
<td>California State University Channel Islands</td>
<td>$14,288,099</td>
<td>$8,512,000</td>
<td>$24,915,170</td>
<td>$47,715,269</td>
</tr>
<tr>
<td>California State University Maritime Academy</td>
<td>$1,381,700</td>
<td>$1,204,000</td>
<td>$2,472,622</td>
<td>$5,058,322</td>
</tr>
<tr>
<td>California State University - Sacramento</td>
<td>$59,891,260</td>
<td>$35,643,000</td>
<td>$104,900,133</td>
<td>$200,434,393</td>
</tr>
<tr>
<td>California State University, Bakersfield</td>
<td>$22,855,632</td>
<td>$12,483,000</td>
<td>$40,285,565</td>
<td>$75,624,197</td>
</tr>
<tr>
<td>California State University, Chico</td>
<td>$31,603,856</td>
<td>$20,019,000</td>
<td>$55,754,538</td>
<td>$107,377,394</td>
</tr>
</tbody>
</table>


<table>
<thead>
<tr>
<th>University</th>
<th>Budget 2020</th>
<th>Enrollment 2020</th>
<th>Graduates 2020</th>
<th>Total 2020</th>
</tr>
</thead>
<tbody>
<tr>
<td>California State University, Dominguez Hills</td>
<td>$31,843,563</td>
<td>$18,312,000</td>
<td>$55,915,410</td>
<td>$106,070,973</td>
</tr>
<tr>
<td>California State University, East Bay</td>
<td>$24,243,652</td>
<td>$14,394,000</td>
<td>$42,929,208</td>
<td>$81,566,860</td>
</tr>
<tr>
<td>California State University, Fresno</td>
<td>$52,725,317</td>
<td>$32,557,000</td>
<td>$92,926,594</td>
<td>$178,208,911</td>
</tr>
<tr>
<td>California State University, Fullerton</td>
<td>$67,736,949</td>
<td>$41,088,000</td>
<td>$120,859,884</td>
<td>$229,684,833</td>
</tr>
<tr>
<td>California State University, Long Beach</td>
<td>$67,421,424</td>
<td>$41,202,000</td>
<td>$119,508,329</td>
<td>$228,131,753</td>
</tr>
<tr>
<td>California State University, Los Angeles</td>
<td>$61,905,561</td>
<td>$40,067,000</td>
<td>$108,543,672</td>
<td>$210,516,233</td>
</tr>
<tr>
<td>California State University, Monterey Bay</td>
<td>$13,455,716</td>
<td>$8,705,000</td>
<td>$23,922,768</td>
<td>$46,083,484</td>
</tr>
<tr>
<td>California State University, Northridge</td>
<td>$74,004,088</td>
<td>$47,458,000</td>
<td>$131,021,450</td>
<td>$252,483,538</td>
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<tr>
<td>California State University, San Bernardino</td>
<td>$42,438,131</td>
<td>$27,924,000</td>
<td>$74,982,459</td>
<td>$145,344,590</td>
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<tr>
<td>California State University, San Marcos</td>
<td>$26,602,684</td>
<td>$15,542,000</td>
<td>$46,496,808</td>
<td>$88,641,492</td>
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<td>California State University, Stanislaus</td>
<td>$22,007,207</td>
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<td>Humboldt State University</td>
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<tr>
<td>San Diego State University</td>
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<td>$30,394,000</td>
<td>$80,592,385</td>
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<tr>
<td>San Francisco State University</td>
<td>$47,404,409</td>
<td>$30,000,000</td>
<td>$83,075,470</td>
<td>$160,479,879</td>
</tr>
</tbody>
</table>
Vulnerability Assessment Conclusions

Before the COVID-19 pandemic, populations at all CSU campuses and CSU-affiliated facilities were substantial. Collectively, as of Fall 2019, CSU campuses had 480,541 students and 53,763 faculty and staff. All were at risk from the communicable disease events, with 534,304 people being directly vulnerable. The COVID-19 pandemic has caused campus population numbers to plummet to a small fraction of full capacity.

At some point in the future, campus population numbers will return to their pre-pandemic levels, and students, faculty, and staff will again be vulnerable to the communicable disease hazard. If just 10% of the total CSU population were to become ill with a highly infective communicable disease like influenza or another strain of SARS, this would mean that approximately 53,430 people would be sick at the same time. This scenario would likely overwhelm available on-campus medical services could even overwhelm portions of the larger community’s medical resources – especially if there were large numbers of infected people with immune system compromises or other underlying health problems. Table 15-12 shows the “10% outbreak scenario” projections both for each CSU campus and for the entire CSU system.

Table 15-11: Scenario of Communicable Disease Hazard Affecting 10% of the CSU Population

<table>
<thead>
<tr>
<th>CSU Campus</th>
<th>Approximate Enrollment Population (Fall 2019)²³</th>
<th>Approximate Total FT/PT Faculty/Staff Population (Fall 2019)²⁴</th>
<th>Total Combined Approximate Student and Faculty/Staff Population</th>
<th>10% Outbreak Scenario (Students and Faculty/Staff Combined)</th>
</tr>
</thead>
<tbody>
<tr>
<td>CSU Bakersfield</td>
<td>11,199</td>
<td>1,277</td>
<td>12,476</td>
<td>1,248</td>
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</table>


<table>
<thead>
<tr>
<th>CSU Channel Islands</th>
<th>7,093</th>
<th>994</th>
<th>8,087</th>
<th>809</th>
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</thead>
<tbody>
<tr>
<td>Chico State</td>
<td>17,019</td>
<td>1,969</td>
<td>18,988</td>
<td>1,899</td>
</tr>
<tr>
<td>CSU Dominguez Hills</td>
<td>17,027</td>
<td>1,761</td>
<td>18,788</td>
<td>1,879</td>
</tr>
<tr>
<td>Cal State East Bay</td>
<td>14,705</td>
<td>1,764</td>
<td>16,469</td>
<td>1,647</td>
</tr>
<tr>
<td>Fresno State</td>
<td>24,139</td>
<td>2,534</td>
<td>26,673</td>
<td>2,667</td>
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<tr>
<td>Cal State Fullerton</td>
<td>39,868</td>
<td>3,736</td>
<td>43,604</td>
<td>4,360</td>
</tr>
<tr>
<td>Humboldt State</td>
<td>6,983</td>
<td>1,171</td>
<td>8,154</td>
<td>815</td>
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<tr>
<td>Cal State Long Beach</td>
<td>38,074</td>
<td>4,004</td>
<td>42,078</td>
<td>4,208</td>
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<tr>
<td>Cal State LA</td>
<td>26,361</td>
<td>2,821</td>
<td>29,182</td>
<td>2,918</td>
</tr>
<tr>
<td>Cal Maritime</td>
<td>911</td>
<td>329</td>
<td>1,240</td>
<td>124</td>
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<tr>
<td><strong>CSU Monterey Bay</strong></td>
<td><strong>7,123</strong></td>
<td><strong>1,059</strong></td>
<td><strong>8,182</strong></td>
<td><strong>818</strong></td>
</tr>
<tr>
<td>CSUN (Northridge)</td>
<td>38,391</td>
<td>3,832</td>
<td>42,223</td>
<td>4,222</td>
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<tr>
<td>Cal Poly Pomona</td>
<td>27,914</td>
<td>2,650</td>
<td>30,564</td>
<td>3,056</td>
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<tr>
<td>Sacramento State</td>
<td>31,156</td>
<td>3,228</td>
<td>34,384</td>
<td>3,438</td>
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<tr>
<td>Cal State San Bernardo</td>
<td>20,311</td>
<td>2,118</td>
<td>22,429</td>
<td>2,243</td>
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<td>San Diego State</td>
<td>35,081</td>
<td>3,702</td>
<td>38,783</td>
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<tr>
<td>San Francisco State</td>
<td>28,880</td>
<td>3,401</td>
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<td>3,228</td>
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<td>San José State</td>
<td>33,282</td>
<td>3,568</td>
<td>36,850</td>
<td>3,685</td>
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<tr>
<td>Cal Poly San Luis Obispo</td>
<td>21,242</td>
<td>2,871</td>
<td>24,113</td>
<td>2,411</td>
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<tr>
<td>CSU San Marcos</td>
<td>14,519</td>
<td>1,687</td>
<td>16,206</td>
<td>1,621</td>
</tr>
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<td>Sonoma State</td>
<td>8,649</td>
<td>1,338</td>
<td>9,987</td>
<td>999</td>
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<tr>
<td>Stanislaus State</td>
<td>10,614</td>
<td>1,276</td>
<td>11,890</td>
<td>1,189</td>
</tr>
<tr>
<td>Office of the Chancellor</td>
<td>0</td>
<td>673</td>
<td>673</td>
<td>67</td>
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<tr>
<td><strong>CSU System-Wide</strong></td>
<td><strong>480,541</strong></td>
<td><strong>53,763</strong></td>
<td><strong>534,304</strong></td>
<td><strong>53,430</strong></td>
</tr>
</tbody>
</table>

*Note: Enrollment figures do not include non-specific CSU campus International Programs (455 students) or CALStateTEACH Program (933 students).*

While the case numbers of COVID-19 have been significantly lower (about 1% of the total CSU population) than those in the 10% scenario, the degree of virulence and resultant morbidity and mortality caused by COVID-19 have led to widespread campus...
shutdowns, educational disruption, and economic harm to the CSU system, including CSU Monterey Bay. In short, the real-time COVID-19 communicable disease outbreak scenario has proven far more devastating than the 10% simulated scenario.
Identified Data Limitations

There is a wealth of technical information available for communicable disease. However, there is also limited non-COVID-19 communicable disease data available regarding risk or vulnerability of specific populations throughout the CSU. Much of the data that does exist is protected by privacy policies, and therefore cannot be obtained for more specific populations. As a result, performing a detailed quantitative assessment for this hazard is difficult.

- Data that could be collected prior to the next update in order to improve this methodology includes:
  - Data regarding infection rates at the campus level and for specific populations;
  - Data regarding communicable disease case numbers and outcomes, by CSU campus;
  - Data regarding projected population changes;
  - Data regarding absenteeism; and
  - Data regarding increased operating costs as a result of absenteeism (i.e., temporary shifting of duties resulting in business interruption).

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**Dam and Levee Failure**

Description of the Hazard

A dam failure represents the structural collapse of a dam that stores water in a reservoir behind the dam. These failures are typically the result of structural age, damage to the structure caused by earthquake or flooding, inadequate discharge or spillway capacity, inadequate maintenance, improper construction materials, or extreme inflow of water into the reservoir. Prolonged precipitation may result in overtopping of the dam resulting in structural compromise. The tremendous energy generated by a sudden breach of the dam will have significant downstream effects. Flood damage resulting from dam failures potentially will result in economic losses, environmental damage, destruction of agriculture, and human casualties. This type of incident is extremely dangerous as it can occur rapidly, with no warning resulting in an inability to effectively evacuate threatened communities.

A levee failure is similar to dam failures as the result will be a breach causing flooding on the dry side of the levee. Levees are embankments whose primary purpose is to furnish flood protection from seasonal high water or divert the flow of water.25 Most levees in California are intended to withstand peak water levels generated by heavy

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precipitation or rapid snowmelt in a watershed. Other levees are designed to withstand fluctuating water levels on a continuous basis such as those in the California Delta exposed to tidal influences. Levees routinely extend for lengthy distances immediately protecting communities. Levees can be found throughout the state but are most prominent in the Sacramento and San Joaquin Valleys.

Levee failures can vary from over toppings to small uncontrolled discharge to catastrophic failure. Areas downstream of the failure will be subject to inundation dependent on the volume of water released. These levee failures are also typically the result of structural age, damage to the structure caused by earthquake or flooding, slumping, seepage underneath the levee, high velocity flows eroding the levee, inadequate capacity, inadequate maintenance, improper construction materials, or extreme inflow of water into the system. Flood damage resulting from levee failures potentially will result in economic losses, environmental damage, destruction of agriculture, and human casualties.

Dam or levee failure flooding will vary depending on a number of factors including the extent of the collapse or breach, the volume of water behind the structure, and the nature of the exposed downstream features. This unpredictable flooding presents a threat to life and property in addition to critical infrastructure. Lifelines and supply routes will likely be damaged or made impassible by flood erosion or standing water. Water quality and health concerns would likely be cascading effects of dam or levee failures.

Location of the Hazard

Monterey County is home to a variety of flood control facilities and levee systems throughout the county. Seaside and the CSU Monterey Bay campus sit between the Salinas River and the Pacific coastline. The primary dam within Monterey County posing a threat is the San Antonio Dam on the border with San Luis Obispo County. There are levee facilities in Monterey County to the north, east, and south of the campus including levees that separate the Salinas River influences from the community.
Levees have been constructed to protect portions of Monterey County along the Salinas River. A series of levees have been constructed to protect lands alongside the Elkhorn Slough providing protection from tidal and coastal influences. Additionally, levees line parts of the Pajaro River on the Santa Cruz County line. **The CSU Monterey Bay campus is not located in a levee protected area.**

The county is additionally downstream of facilities located in other counties. The primary dam facility that could present a threat to the CSU Monterey Bay campus community is in neighboring San Luis Obispo County containing significant amounts of water. The Nacimiento Dam regulates the Nacimiento River 110 miles upstream that feeds into the Salinas River and eventually into the Pacific Ocean. The Salinas River is almost 4 miles east of the campus. **The campus sits on a bluff that is elevated from the river valley.** A failure of this facility is expected to produce inundations that cover sizable areas through the Salinas River Valley including the area separating the campus from the City of Salinas. Transportation routes accessing locations to the north and east lie within the inundation zones for both the San Antonio and Nacimiento Dams.
Figure 15-4: San Antonio Dam Breach Inundation Map

26 California Department of Water Resources, Dam Breach Inundation Map Publisher, https://fmds.water.ca.gov/webgis/?appid=dam_prototype_v2
Extent of the Hazard

Dams are classified according to the hazard that they pose to life and property in the event of failure, rather than the likelihood of that failure.

- **High hazard potential dams** may result in loss of human life, and will likely result in economic, environmental, or lifeline losses.

- **Significant hazard potential dams** are not expected to result in loss of life, but are expected to cause economic, environmental, and lifeline losses.

- **Low hazard potential dams** are not expected to result in loss of life, and there is a low expectation of economic, environmental, or lifeline losses. What losses do occur are generally limited to the dam owner.

Dams classified as high hazard are required to have Emergency Action Plans (EAP). EAPS are formal documents that identify potential emergency conditions at the dam and specify preplanned actions to be followed in case of failure. An EAP is required for all high hazard dams and is recommended for all significant hazard dams.

Table 15-12: Monterey County Dams Upstream from CSU Monterey Bay

<table>
<thead>
<tr>
<th>River</th>
<th>Dam</th>
<th>Storage</th>
<th>Hazard Severity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nacimiento</td>
<td>Nacimiento (San Luis Obispo County)</td>
<td>470,000af</td>
<td>High Hazard</td>
</tr>
<tr>
<td>San Antonio</td>
<td>San Antonio</td>
<td>350,000af</td>
<td>High Hazard</td>
</tr>
</tbody>
</table>

The CSU Monterey Bay campus lies outside of the inundation zone of the dams listed above. In the event of a catastrophic failure of the identified dams, the CSU Monterey Bay campus is expected to remain out of the inundation area. The inundation area is expected to spread water to the north downstream along the Salinas River. However, there are multiple transportation corridors that lie within the dam inundation zones that could compromise transportation routes and areas the campus community reside or work. Based on these factors, the planning committee ranks the extent of the hazard as **Low**.

Extent: Levee Failure

Levees are used along numerous flood control channels and other waterways including the Salinas River, Pajaro River, and the Elkhorn Slough. The CSU Monterey Bay campus remains outside of any levee flood protected area. In the event any of

these channels were flowing at elevated levels and a failure of a levee were to occur, the community surrounding the campus would likely experience flood related damages. This specific hazard could alter the ability of the campus to maintain operations as damages would be extensive. State Route 1 and US Highway 101 cross through the levee protected zones in addition to the dam inundation zone creating a potential for community-wide isolation from access, evacuation, resources, and other services from outside of the Monterey Bay area. Based on these factors, the planning committee ranks the extent of the hazard as Low.

History of the Hazard

There are no records of dam or levee failures in areas that present a threat to the CSU Monterey Bay campus. Monterey County has not identified a history of dam or levee failures elsewhere in the County. The County has identified that the San Antonio Dam has spilled over in 1958, 1969, 1983 and the Nacimiento Dam has spilled over in 1982 and 1983. None of these dam spill over events caused any damages, injuries, or fatalities.

Potential Impacts of the Hazard

Dam Failure Impacts - While the campus is not within a dam inundation zone, transportation routes, critical infrastructure, and campus community members may reside within inundation zones. Water that is released due to a dam that has failed generates tremendous energy and force causing a flood that will be catastrophic to life and property. Water levels from the failed dam could be significantly higher than those experienced in worst case scenario flood events. Areas closer to the failed dam will be more likely to experience complete devastation while other areas within the inundation zone will see varying levels of flood waters. The extent of the impacts of a failed dam would vary based on a number of factors such as the volume of water released, the base flow of the river, the time of the failure, the amount of warning provided, and the distance from the dam. Impacts resulting from a dam failure include:

- Loss of life
- Property destruction or damage
- Loss of property contents
- Infrastructure damage
- Flooded or destroyed lifelines/supply routes
- Damaged or destroyed utilities
- Loss of community economic base
- Employment losses
- Agricultural (crops and livestock) damages or destruction
Levee Failure Impacts

A levee failure may result in substantial amounts of water to enter into developed areas protected by the levee. The force and volume of water that is generated by a levee failure may cause extensive structural damage in close proximity to the breach and effects of flooding spreading well beyond the point of the failure. The extent of the impacts would vary based on a number of factors such as the volume of water released, the time of the failure, the amount of warning provided, the location of the breach, elevation, and distance from the breach. Potential impacts resulting from a levee failure include:

- Loss of life
- Property destruction or damage
- Loss of property contents
- Infrastructure damage
- Public health hazards resulting from mold, mildew, and disease due to flood water
- Flooded or destroyed lifelines/supply routes
- Damaged or destroyed utilities
- Loss of community economic base
- Employment losses
- Agricultural (crops and livestock) damages or destruction
- Environmental damage
- Prolonged periods of necessary dewatering
- Disruptions to education delivery to community
- Damage or destruction of academic materials, fine arts, and research
- Damage or destruction of university computer systems and networks
- Damaged university infrastructure
- Reduced or eliminated student engagement with academic programs
- Reductions in campus revenues
Probability of Future Occurrence of the Hazard

Monterey County is determined to be at risk from 4 dams around the county. The San Antonio Dam and the Nacimiento Dam are 85 and 95 miles respectively upriver on the Salinas River. However, the dam inundation zone for both dams follows the Salinas River not in proximity to the campus. The campus is 3 miles from the boundary of the dam inundation zone. There are no identified levees in proximity to the campus and thus the campus is outside of any levee protected zone. There are no official recurrence intervals that have been calculated for dam or levee failures. Based on no historical occurrences, the likelihood of this hazard is low.

The probability of future occurrence for and the regulated monitoring, maintenance and inspections in place, both dam and levee failure probability is Unlikely.

Vulnerability to the Hazard

Given high priority monitoring and maintenance practices in place, a catastrophic dam or levee failure is highly unlikely. In addition, the campus does not lie within an inundation zone. As such, the campus is not considered to be truly vulnerable on a daily basis. However, in the unlikely event of a catastrophic failure, the effects of flooding from compromised dams and levees on campus would most likely be limited to indirect or secondary effects in terms of disruption to regional transportation networks and services, and the amount of time to respond to the needs of the campus community prior to inundation will be limited. Any breach along a levee is impossible to predict where a failure may occur. It is likely that response action will not be fully implemented until the incident situational intelligence provides adequate information as to compromised locations. These variables place all those working and living within the dam inundation and flood protection zones in vulnerable locations in the event of a low probability, catastrophic event.

The distributed placement of levees, many near development may expose significant vulnerabilities to other areas of the region even if the campus is unaffected. There is potential the campus community will be affected as a breach may cause flooding and damages to the homes of students, faculty, and staff or to access/supply routes, utilities, or other critical services. The potential for flood damaged structures being left uninhabitable including campus residence halls will result in the vulnerability of numerous displaced individuals and households. The lack of flood insurance will cause extreme additional financial burdens on those affected.

Vulnerability to a dam or levee failure near the CSU Monterey Bay campus will vary depending on the degree of breach or structural failure and when the failure were to occur. The risk to the campus population will be lessened during periods when classes are not in session or during periods of breaks. Conversely, during the days and hours that classes are in session and staff are at their workplaces, the human vulnerability increases. However, in the case of extremely rare region-wide events, this
vulnerability may be shared with the homes and workplaces of members of the campus community and their families.

Some areas of particular vulnerability to dam failure from the Matthews Dam on the campus includes:

- Limited vulnerabilities of the main campus.
- US Highway 101 vulnerable to the effects of dam inundation flows through the length of the Salinas Valley.
- State Route 1 vulnerable to the effects of dam inundation limits the access to and from the campus servicing northern routes into Santa Cruz County.
- Substantial agricultural production lies within the dam inundation directly impacting those campus community members relying on agricultural as an income source.
- The campus is vulnerable to the economic effects resulting from the destruction of agriculture and industry within the inundation zone.
- Campus community members residing in areas east and north of the Salinas River such may become isolated from campus.

Certain campus populations will experience greater challenges to a post-flood / failure environment. Vulnerable populations will likely need to navigate through flood generated debris, face extreme health safety issues from flood waters, experience extreme stresses of a disaster, an inability to communicate to or gain access to support networks, and find difficulty in accessing equipment or supplies to aid in a specific need.

Estimate of Potential Losses

Estimates of potential losses will be influenced by a variety of factors. The volume and force of the water will determine the scale of damages affecting campus infrastructure, equipment, and other impacted features. The proximity to the failure and elevation above flood waters will affect the level of damage and individuals exposed. The time of the academic year, the day of week, and hour in which the failure was to occur will influence the number of people on campus and potential casualties. Losses will be generated by the physical damages, the loss of revenue, loss of academic research, loss of building contents, and community wide economic reductions.

Based on estimate replacement costs of facilities and structures on campus, the total replacement costs due to earthquake are $401,286,223. However, it is unlikely for a dam or levee failure event to cause catastrophic destruction at CSU Monterey Bay.

Vulnerability Assessment Conclusions
While the occurrence of dam and levee failures have not been historically relevant near the CSU Monterey Bay campus, the potential for hazards related to the region’s levees and dams still exists. However, the presence of earthquake faults in proximity to the existing dam and levee structures presents a valid danger to downstream locations in the event of an earthquake. In the unlikely event of a high priority dam’s total failure, the consequences would generate catastrophic results to downstream communities. The potential for dam or levee failure further generates the added potential for a number of cascading effects such as disruptions to the local economy, utility failures, disruptions to providing for the needs of the community, and development of public health hazards. These effects would be exacerbated by effects of seasonal flooding, ongoing heavy precipitation, or excessive run-off from the watershed contributing to the river system. The potential for widespread flooding and damage of structures due to the force of water has exponentially powerful impacts on particular segments of the campus community including those with access or functional needs, international students, the homeless, and students residing in the residence halls.
Identified Data Limitations

Data limitations include missing campus structural replacement costs, and an incomplete inventory of both building construction features and mitigation efforts to lessen the impact due to flood inundation.

**Drought**

Description of the Hazard

Drought is defined as a condition where moisture levels fall significantly below normal for an extended period of time over a large area that adversely affects plants, animal life, and humans. Drought is a gradual phenomenon. Although droughts are sometimes characterized as emergencies, they differ from typical emergency events. Most natural disasters, such as floods or forest fires, occur relatively rapidly and afford little time for preparing for disaster response. Droughts occur slowly, over a multi-year period, and it is often not obvious or easy to quantify when a drought begins and ends.

Throughout California, one dry year does not normally constitute a drought. California’s extensive system of water supply infrastructure (reservoirs, groundwater basins, and conveyance assets) mitigates the effect of short-term dry periods for most water users. Defining when a drought begins is a function of drought impacts to water users. Drought in one location may not constitute a drought for all water users, as some users in relative proximity may have a different water supply. For example, individual water suppliers may use a combination of sources such as rainfall/runoff, water in storage, or expected supply from a water wholesaler to define their water supply conditions.

Drought can be characterized as one or more of the following types:

- **Meteorological drought** is defined on the basis of the degree of dryness (in comparison to some “normal” or average amount) and the duration of the dry period. A meteorological drought must be considered as region-specific since the atmospheric conditions that result in deficiencies of precipitation are highly variable from region to region.

- **Hydrological drought** is associated with the effects of periods of precipitation (including snowfall) shortfalls on surface or subsurface water supply (e.g., streamflow, reservoir and lake levels, ground water). The frequency and severity of hydrological drought is often defined on a watershed or river basin scale. Although all droughts originate with a deficiency of precipitation, hydrologists are more concerned with how this deficiency plays out through the hydrologic system. Hydrological droughts are usually out of phase with or lag the occurrence of meteorological and agricultural droughts. It takes longer for precipitation deficiencies to show up in components of the hydrological system such as soil moisture, streamflow, and ground water and reservoir
levels. As a result, these impacts are out of phase with impacts in other economic sectors.

- **Agricultural drought** focus is on soil moisture deficiencies, differences between actual and potential evaporation, reduced ground water or reservoir levels, and so forth. Plant water demand depends on prevailing weather conditions, biological characteristics of the specific plant, its stage of growth, and the physical and biological properties of the soil.

- **Socioeconomic drought** refers to when physical water shortage begins to affect health, well-being, and quality of life of people, or when the drought starts to affect the supply and demand of an economic product that relies on water.

The drought issue in California is further compounded by water rights. The central challenge is how to prioritize water usage among a broad variety of contexts. It is for this reason that water is a commodity possessed and utilized under a variety of legal doctrines. As such, many competing sets of interests create a dynamic prioritization process between, for example, farming and federally protected fish habitats and water supply for municipal/public use (including usage for CSU - Monterey Bay) versus water usage for wildfire abatement or natural resource protection.

**Location of the Hazard**

Drought conditions have been identified by the campus planning committee for Monterey, CA where CSU – Monterey Bay is located. Drought is not a location-specific hazard and affects the entire planning area equally. Drought location is not isolated to each campus footprint but occurs as a geographic sub-set of drought conditions occurring at larger scales. From 2000-2020, drought conditions existed continuously somewhere in the state, with 80-100% of the state impacted for 12 of the last 20 years.28

**Extent of the Hazard**

Given the historical occurrence of severe drought impacts throughout the region surrounding the planning area and across the state, and the potential future impact exacerbated by climate change, the CSU Planning Committee recognizes that drought will continue to pose a high degree of risk statewide, potentially impacting crops, livestock, water resources, the natural environment at large, buildings and infrastructure (from land subsidence), and local economies.

In addition, although drought affects the entire CSU system wide planning area, the extent of the hazard is variable and specific to each campus/jurisdiction, depending on contextual factors such as the degree of assets and activities historically impacted by drought within each jurisdiction. Based on input from the campus planning

committee, water rights and local seaside groundwater aquifer levels are considered to be serious issues even though no campus level impacts have been recorded.

In addition, land subsidence has occurred and will continue in areas where the groundwater basin has been subject to overdraft and long-term recharge is inadequate to maintain the water table elevation, leaving underground voids. Subsidence levels in California have been measured up to 30-feet with subsidence bowls covering hundreds of square miles. As such, drought-related subsidence may result in serious structural damage to buildings, roads, irrigation ditches, underground utilities, and pipelines, and these risks are applicable concerns for the campus over the long term.

For CSU – Monterey Bay, based on qualitative input from the planning committee, the extent of the hazard is Moderate (corresponding to D1-D2 on the extent scale below). However, the campus planning committee recognizes that the potential for more severe conditions exists and is tied to regional water resource vulnerabilities.

The U.S. Drought Monitor developed tables of impacts reported during past droughts in California in order to depict the extent of drought risk for each level of drought on the U.S. These possible extent conditions for California complement the general impacts column of the U.S. Drought Monitor Classification Scheme.

Table 15-13: Impacts of Drought Levels as Determined by US Drought Monitor

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<thead>
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<th>Category</th>
<th>Impact</th>
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<td>D0</td>
<td>Soil is dry; irrigation delivery begins early</td>
</tr>
<tr>
<td></td>
<td>Dryland crop germination is stunted</td>
</tr>
<tr>
<td></td>
<td>Active fire season begins</td>
</tr>
<tr>
<td></td>
<td>Winter resort visitation is low; snowpack is minimal</td>
</tr>
<tr>
<td>D1</td>
<td>Dryland pasture growth is stunted; producers give supplemental feed to cattle</td>
</tr>
<tr>
<td></td>
<td>Landscaping and gardens need irrigation earlier; wildlife patterns begin to change</td>
</tr>
<tr>
<td></td>
<td>Stock ponds and creeks are lower than usual</td>
</tr>
<tr>
<td>D2</td>
<td>Grazing land is inadequate</td>
</tr>
<tr>
<td></td>
<td>Producers increase water efficiency methods and drought-resistant crops</td>
</tr>
<tr>
<td></td>
<td>Fire season is longer, with high burn intensity, dry fuels, and large fire spatial extent; more fire crews are on staff</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Stage</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>D3</td>
<td>Wine country tourism increases; lake- and river-based tourism declines; boat ramps close</td>
</tr>
<tr>
<td></td>
<td>Trees are stressed; plants increase reproductive mechanisms; wildlife diseases increase</td>
</tr>
<tr>
<td></td>
<td>Water temperature increases; programs to divert water to protect fish begin</td>
</tr>
<tr>
<td></td>
<td>River flows decrease; reservoir levels are low and banks are exposed</td>
</tr>
<tr>
<td></td>
<td>Livestock need expensive supplemental feed, cattle and horses are sold; little pasture remains, producers find it difficult to maintain organic meat requirements</td>
</tr>
<tr>
<td></td>
<td>Fruit trees bud early; producers begin irrigating in the winter</td>
</tr>
<tr>
<td></td>
<td>Federal water is not adequate to meet irrigation contracts; extracting supplemental groundwater is expensive</td>
</tr>
<tr>
<td></td>
<td>Dairy operations close</td>
</tr>
<tr>
<td></td>
<td>Marijuana growers illegally tap water out of rivers</td>
</tr>
<tr>
<td></td>
<td>Fire season lasts year-round; fires occur in typically wet parts of state; burn bans are implemented</td>
</tr>
<tr>
<td></td>
<td>Ski and rafting business is low, mountain communities suffer</td>
</tr>
<tr>
<td></td>
<td>Orchard removal and well drilling company business increase; panning for gold increases</td>
</tr>
<tr>
<td></td>
<td>Low river levels impede fish migration and cause lower survival rates</td>
</tr>
<tr>
<td></td>
<td>Wildlife encroach on developed areas; little native food and water is available for bears, which hibernate less</td>
</tr>
<tr>
<td></td>
<td>Water sanitation is a concern, reservoir levels drop significantly, surface water is nearly dry, flows are very low; water theft occurs</td>
</tr>
<tr>
<td></td>
<td>Wells and aquifer levels decrease; homeowners drill new wells</td>
</tr>
<tr>
<td></td>
<td>Water conservation rebate programs increase; water use restrictions are implemented; water transfers increase</td>
</tr>
<tr>
<td></td>
<td>Water is inadequate for agriculture, wildlife, and urban needs; reservoirs are extremely low; hydropower is restricted</td>
</tr>
<tr>
<td>D4</td>
<td>Fields are left fallow; orchards are removed; vegetable yields are low; honey harvest is small</td>
</tr>
<tr>
<td></td>
<td>Fire season is very costly; number of fires and area burned are extensive</td>
</tr>
<tr>
<td></td>
<td>Many recreational activities are affected</td>
</tr>
<tr>
<td></td>
<td>Fish rescue and relocation begins; pine beetle infestation occurs; forest mortality is high; wetlands dry up; survival of native plants and animals is</td>
</tr>
</tbody>
</table>
low; fewer wildflowers bloom; wildlife death is widespread; algae blooms appear

| Policy change; agriculture unemployment is high, food aid is needed |
| Poor air quality affects health; greenhouse gas emissions increase as hydropower production decreases; West Nile Virus outbreaks rise |
| Water shortages are widespread; surface water is depleted; federal irrigation water deliveries are extremely low; junior water rights are curtailed; water prices are extremely high; wells are dry, more and deeper wells are drilled; water quality is poor; |

**History of the Hazard**

Historically, drought has been so prevalent in California that its presence is almost continuous, including the region, county and city surrounding the CSU - Monterey Bay footprint. Although no drought events have been recorded specific to the campus, the planning committee indicates that occurrences are frequent in the surrounding area. According to the US Drought Monitor, Time Series data, Monterey County has experienced 6 or more periods of drought from 2000-2021, including the severe statewide drought from 2012-2019.

Figure 15-5: Periods of Drought in Monterey County, California, 2000 – 2021

According to the National Drought Mitigation Center, over 3,500 reports and publications covering 370 drought-related events took place across the state (many of which were statewide events) between 2000-2020. In addition, the National Center for Environmental Information (NCEI) reports more than 500 events statewide during this same time period. These events produced a comprehensive range of impacts to water supply, regulations and allocations to businesses and municipalities, budgets and

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resources for firefighting, water law and policy, and physical impacts to built and natural environments. As such, data records of previous occurrences can be viewed as separate time and event demarcations for a hazard almost continuously in effect across the state with cascading impact potential.\textsuperscript{31}

According to the Department of Water Resources, droughts exceeding three years are relatively common in Southern California, but relatively rare in Northern California - the region is the geographic source of much of the state’s developed water supply. The 1929-34 drought established the criteria commonly used in designing storage capacity and yield of large Northern California reservoirs. \textsuperscript{32}

According to the US Drought Monitor’s time series data, from 2000-2021 (with the exception of a 2- to 3-month period in 2000 and 2011), some degree of drought conditions has been continuously in effect somewhere in California. In fact, 80% - 100% of the state has been subjected to drought conditions for 12 of the last 20 years, with the most severe drought being the 100% state-wide event from 2012-2017.

Figure 15-6: Periods of Drought in State of California, 2001 – 2021\textsuperscript{33}

Given the extent of the drought risk in California, the following drought event was selected as an exemplar due to its broad and significant impacts on the state and on the CSU - Monterey Bay campus planning area:

\textbf{2012 – 2017} – Drought produced severe impacts to water wells throughout the state of California, with a high number of wells running dry. Land subsidence due to increased groundwater pumping also occurred in numerous areas of the state such as the San Joaquin and Central Valleys. Crop damage was widespread as well. Water allotments

\begin{itemize}
  \item \textsuperscript{31} NCEI. Storm Events. Retrieved on 5.4.2021 from: https://www.ncdc.noaa.gov/stormevents
\end{itemize}
were drastically reduced in many towns and water agencies, with extremely high costs for procuring water. In addition, job loss occurred with many families requiring food supply assistance, and water supply assistance provided to home-owners with dry wells. According to a report released by UC Davis Center for Watershed Sciences, the 2012-2017 period of the California drought cost the state’s agriculture industry about $1 billion in lost revenue, with a total statewide economic cost of the drought calculated to be $2.2 billion. The report says, ‘it is responsible for the greatest water loss ever seen in California agriculture - about one third less than normal”’. The report calls the groundwater situation in California "a slow-moving train wreck." Spring snowpack at Donner Summit reached record low levels in 2014, exceeded in 2015 by a remarkable April 1 snow-water-equivalent value of only 5% of average. Decreased precipitation since contributed to near-record low levels in the Shasta Reservoir. The ongoing drought has contributed to declines in crop values across the state. For example, crops including cotton, corn silage and barley (the field crop category) fell by 42 percent. 34

Potential Impacts of the Hazard

Drought impacts are wide-reaching and may be economic, environmental, and/or societal. This assessment of its impact recognizes that historic occurrences of drought throughout the planning area are a sub-set of larger and inter-connected local and regional droughts, and that the (related) historic impacts provide a sound basis for understanding potential (future) impacts.

The most significant potential impact associated with drought across the CSU - Monterey Bay campus planning area is a reduction in water availability for the municipal area tied to the campus. Other impacts include crop loss and damage to trees and other natural resources (See Tree Mortality below). The footprint of CSU - Monterey Bay to some extent includes these vulnerable resources based on the campus landscape (trees and other flora).

As a secondary impact of drought, wildfire is directly attributable to dry atmospheric conditions. Wildfires almost always coincide with drought in California, though not limited to such. 35 However, the wildfire hazard is analyzed separately in this plan. (See wildfire hazard).

In reviewing the occurrences of drought for Monterey County (which surrounds CSU - Monterey Bay), the US Drought Monitor and the National Drought Mitigation Center report that tens of millions of trees died during the (2012 - 2017) state-wide drought


disaster. Though data sources do not provide data for tree mortality specific to CSU - Monterey Bay, the broad geographic extent of the impact makes it likely that tree mortality occurred to some degree on the campuses. Due to the lasting and ongoing effects of drought on the landscape, trees will continue to be impacted within the municipalities, counties and regions wherein lies the CSU campus system as long as drought conditions continue to occur in the future.

Given the absence of data, in order for the CSU Committee to assess the impact of tree mortality, it is useful to view it as a risk sub-set to the probability, location, extent, severity and duration of the drought hazard within each campus-located municipality, county and region. Regarding potential impacts, standing dead trees could fall, posing a risk to people, buildings, power lines, roads and other infrastructure. In addition, drought-impacted trees become susceptible to diseases and insect infestations (bark beetle) further adding to the risk of tree mortality and related potential impacts. No data is currently available for tree mortality on campus; however, the CSU Planning Team will pursue data on this issue in the future.

As a potential tertiary impact, prolonged and repeated drought conditions over time can produce land subsidence and the risk of damage to building foundations and infrastructure on campus resulting from ground instability and collapse. Land subsidence is defined as the vertical sinking of the land over manmade or natural underground voids. Subsidence is often the direct result of groundwater over-extraction in response to drought conditions, as well as oil and gas extraction. Weight can accelerate the process of subsidence resulting from surface development and infrastructure such as roads and buildings, vibrations from construction blasting and heavy truck or train traffic. For example, the State Water Project’s 444-mile-long California Aqueduct has required repairs such as the raising of canal linings, bridges, and water control structures on the Aqueduct – in the Central Valley a five-mile reach of the Eastside Bypass was impacted by subsidence, and the Department of Water Resources estimated that it may cost in the range of $250 million to acquire flowage easements and levee improvements to restore the design capacity of the subsided area. 36

At present, drought related damage to campus buildings and infrastructure at CSU - Monterey Bay has not been reported, but the potential for such impacts is possible. With regard to overall potential impact, water supply/availability for CSU - Monterey Bay is ultimately tied to broader inter-dependent, and more intensive modes of water use at local and regional scales such as agriculture and ranching, wildfire protection, larger metropolitan/municipal usage, manufacturing and commerce, tourism, recreation, and wildlife preservation. During drought periods, the State of California’s

Regulated water allocations are modified and often reduced, which can result in reduced water availability for all usage contexts, including CSU - Monterey Bay. A reduction of electric power generation and water quality deterioration are also potential impact factors.

Table 15-14: Summary of Drought Impacts on Water Resources

<table>
<thead>
<tr>
<th>Resource</th>
<th>Type of Impact</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sea Level</td>
<td>Direct</td>
<td>Sea level is rising and will likely impact coastal areas</td>
</tr>
<tr>
<td>Soil Moisture</td>
<td>Direct</td>
<td>Prolonged dry seasons can lead to decreases in soil moisture; drier vegetation</td>
</tr>
<tr>
<td>Vegetation</td>
<td>Indirect</td>
<td>Longer and more intense fire season with increased extent of area burned</td>
</tr>
<tr>
<td>Stream Conditions</td>
<td>Direct</td>
<td>Increases in water temperature; potential effects on fish</td>
</tr>
<tr>
<td>Snowpack</td>
<td>Indirect</td>
<td>Increases in temperature will lead to decreases in snowpack</td>
</tr>
<tr>
<td>Runoff</td>
<td>Direct</td>
<td>Warmer temperatures are likely to lead to a shift in peak runoff from spring to winter and a likely decrease in summer base flow</td>
</tr>
<tr>
<td>Hydropower</td>
<td>Indirect</td>
<td>Decreased summer flows resulting from earlier snowmelt and a shift in peak runoff could affect hydropower generation during summer months</td>
</tr>
<tr>
<td>Precipitation</td>
<td>Direct</td>
<td>Warmer winter temperatures will result in a greater percentage of precipitation falling as rain rather than as snow</td>
</tr>
<tr>
<td>Groundwater</td>
<td>Indirect</td>
<td>Reduction in snowpack and extended periods of drought are likely to increase dependency on groundwater</td>
</tr>
</tbody>
</table>

Probability of Future Occurrence of the Hazard

**Highly Likely** — The US Drought Monitor’s time series data (2000-2020) indicates that some degree of drought has nearly a 100% probability of occurrence somewhere in the state in any given year. Given that CSU - Monterey Bay lies within a drought impacted region, it is prudent to extend this likelihood of occurrence to the planning area.

Vulnerability to the Hazard

In California, rising temperatures are projected to increase the average lowest elevation at which snow falls, reducing water storage in the snowpack, particularly at those lower mountain elevations which are now on the margins of reliable snowpack accumulation. Higher spring temperatures will also result in earlier melting of the snowpack. The shift in snow melt to earlier in the season is critical for California’s water supply because flood control rules require that water be allowed to flow downstream and that water cannot be stored in reservoirs for use in the dry season. As such, state-level drought risk factors that have led to drought’s state-wide severity and extent, and potential impacts also create drought vulnerabilities at the level of the CSU - Monterey Bay campus.

Moreover, climate change will likely adversely impact the vulnerability of watersheds and ecosystems in their ability to deliver important ecosystem services. These changes may limit the natural capacity of healthy forests to capture water and regulate stream flows. Sierra Nevada mountain winters and springs are warming, and on average, precipitation as snowfall relative to rain is decreasing. A warming climate with reduced snowpack will result in earlier snowmelt and will subsequently reduce downstream water availability during summer and early fall.

As such, the state and the CSU - Monterey Bay planning area stakeholders potentially have less capacity to address future drought risks due to projected temperature increases and shortages in water; ground-water withdrawals have been occurring at a deficit rate of 1 – 2-million-acre feet per year, where the impacts of drought include decreased availability of water for agriculture and environmental uses. In forested and other vegetated areas, prolonged drought decreases the moisture content of forest fuels and increases the risk of high severity wildfires.

It should be pointed out that California is the single most productive agricultural state and its agricultural industry relies heavily on reservoir water supplied by snowmelt and rainfall runoff. Yearly variations in snowpack depths have implications for water availability as snowmelt from the winter snowpack feeds a network of reservoirs.

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Spring snowpack at Donner Summit reached record low levels in 2014, exceeded in 2015 by a remarkable April 1 snow-water-equivalent value of only 5% of average. Decreased precipitation since 2011 has contributed to near-record low levels in the Shasta Reservoir.  

Vulnerability of Populations

Drought vulnerabilities include agricultural sector job loss, secondary economic losses to local businesses and public recreational resources, increased cost to local and state government for large-scale water acquisition and delivery, and water rationing and water wells running dry for individuals and families. As drought is often accompanied by prolonged periods of extreme heat, negative health impacts such as dehydration can also occur, where children and elderly are most susceptible. Air quality often declines in times of drought which can affect those with respiratory ailments. These same vulnerabilities apply to the students, faculty and staff of the CSU – Monterey Bay campus.

Property Vulnerability

Drought vulnerabilities include crop loss, injury and death of livestock and pets, and damage to infrastructure, homes and other buildings resulting from the secondary drought impact of land subsidence. The related drought impacts of tree mortality and land subsidence pose risks to vulnerable critical infrastructure and property. These same vulnerabilities apply to the properties of the CSU - Monterey Bay campus.

Natural Environment Vulnerability

Natural environment vulnerabilities are widespread throughout public and private lands within the state, including tree mortality, impacts to all flora and fauna, and destabilization (subsidence) of land along streams and rivers, and within watersheds. The core issue shaping the impact of drought throughout California is water supply and demand. Several factors play into the issue including groundwater basins, surface water run-off, public and agricultural demand, and surface water storage water sheds. A USGS led analysis was first conducted in 2010 through the Forest and Rangeland Assessment and ongoing through the USGS Forest and Rangeland Ecosystem Science Center to identify threats and assets where water supply would benefit from environmental management designed to protect or enhance water resources, the key effort which, in part, both defines and mitigates the severity of drought risk and vulnerabilities.

With regard to the overall threat and asset findings shaping the potential severity of drought for the CSU – Monterey Bay campus, primary concern is focused on seaside groundwater levels, which are currently unknown. As such, efforts have been made to partner with the Monterey Pipeline Project in order to reduce the vulnerability of the campus population and other water dependent assets. At the state level, the watersheds in the Sierra region contribute most greatly to the state’s water supply, but are under threat from climate change, wildfire and development. In addition,
groundwater basins in the San Joaquin Valley and Sacramento Valley bioregions are an abundant resource that is heavily threatened by over pumping.40

Critical Facilities Vulnerabilities

Drought vulnerabilities for CSU - Monterey Bay’s critical facilities include water shortfalls for facility operations and critical functions, and potential structural destabilization and damage resulting from land subsidence.

Estimate of Potential Losses

An estimate of potential losses from drought has not been calculated for the campus or the CSU system as a whole. However, drought related losses to the City of Monterey and the surrounding region such as crop loss and cost increases for water resources have re-occurred over time. Please consult city and county level government, and/or state agricultural agencies for data on the financial impacts from drought.

Vulnerability Assessment Conclusions

The CSU Planning Committee understands that the high degree of vulnerability posed by drought will be exacerbated by greater climate variation in the future and therefore greater variation and uncertainty regarding the availability of water supplies which are already under tremendous stress. In response to such vulnerability, state legislation passed in 2014 requires local governments to regulate pumping and recharge to better manage groundwater supplies, and groundwater-dependent regions are required to halt overdraft and bring basins into sustainable levels of pumping and recharge by the early 2040s. That said, the Committee will continue to work with local, regional and state partners and stakeholders to explore solutions for mitigating the drought hazard on its campuses by accessing the best available data and resources on climate change and its relationship to drought.

Identified Data Limitations

Data is limited concerning campus-related agricultural assets as well as data on campus tree mortality.

40 USGS. Forest and Rangeland Ecosystem Science Center. Retrieved. 5.4.2021 from: https://www.usgs.gov/centers/fresc
**Earthquake**

**Description of the Hazard**

An earthquake is a sudden motion or shaking caused by the release of pressure accumulated along the edge of tectonic plates covering the earth. These huge plates are constantly moving and move ever so slowly under, over, or by passing one another. This movement is gradual however the plates may lock together accumulating enormous amounts of energy. When this energy builds, stress develops, and the adjoining plates will eventually break free and result in ground shaking – an earthquake.

Large earthquakes may result in fissuring, ground settlement, and/or vertical or horizontal displacement. Earthquakes occur without warning and can result in extensive damages and human casualties. Damages associated to earthquake generated ground shaking is normally confined to a narrow area along fault trend from the earthquake epicenter. However, seismic waves may generate ground shaking resulting in damages in areas outside of the fault trend.

**Fault Rupture** – The rupture of faults is the differential movement of the two sides of the earth’s plates at the point of the fault. Horizontal or vertical displacement may be significant and occur over great distances. The movement and energy that occurs along a fault is released in waves resulting in ground shaking. The intensity of ground shaking varies based on the magnitude of the earthquake, the proximity to the earthquake epicenter, the composition of the ground sediment or rock the waves travel through, and the depth of the earthquake.

**Liquefaction** – In addition to the primary fault rupture that occurs right along a fault during an earthquake, the ground many miles away can also fail during intense shaking. As seismic waves travel through saturated granular soil; the soil begins to liquefy and act as a fluid. Soil strength and stability is lost causing the effects of ground shaking to intensify and for ground deformation to occur. These water saturated soils when shaken quickly lose the ability to support buildings, bridges, utilities, and other structures. Areas susceptible to liquefaction include places where sandy sediments have been deposited by rivers along their course or by wave action along beaches. The greater the magnitude of an earthquake and longer duration of strong ground shaking will result in an enhanced potential for liquefaction to occur. Settlement can cause damage when the amount settlement varies significantly across the length of a structure. Lateral spreading occurs when liquefaction occurs on gently sloping ground and the liquefied material at depth allows the area to slide, often toward a vertical discontinuity or “free face” such as a creek or stream channel. Liquefaction can occur in susceptible soils below bodies of water, and settlement and lateral spreading can damage structures built on or adjacent to these areas. Transportation bridges across water bodies, wharves, piers and other structures at ports and harbors, and underwater utility lines can be severely damaged by this hidden hazard.
**Subsidence** - Changes in the local environment that cause subsidence or sinkholes are called triggering mechanisms. Water is the primary factor that affects the local environment and causes subsidence. Water level decline, changes in groundwater flow, increased loading, and deterioration (such as abandoned mines) are all triggering mechanisms. Water level decline may occur naturally, or it may be the result of human action. Factors that lead to water decline are pumping (from wells), localized drainage (for construction activities), dewatering, or drought. Changes in groundwater flow can result from an increase in the velocity of groundwater movement, and increase in the frequency of water table fluctuations, and changes in discharge (either increase or decrease). Increased loading can cause pressure in the soil, leading to the failure of underground cavities and space, such as caves. Vibrations from earthquakes, heavy machinery, and blasting may result in structural collapse, followed by surface resettlement.

**Location of the Hazard**

The State of California is particularly vulnerable to earthquake activity due to California’s location residing between two large tectonic plates. CSU Monterey Bay is located in the Monterey Bay area south of the San Francisco Bay region. In general, numerous fault systems surround and traverse throughout the Monterey Bay Area and Monterey County including the area of CSU Monterey Bay. In many places, the populated areas of the Monterey Bay region and surrounding cities, the ground is saturated with sediment eroded from the hills by means of multiple stream channels. Liquefaction zones rated at moderate susceptibility exist in areas along the Salinas River and the contributing creeks.

The Pacific Plate and the North American Plate come together at the San Andreas Fault 20 miles northeast of the CSU Monterey Bay campus. In addition to the San Andreas Fault, Monterey County is home to or near additional fault systems with the potential to generate strong ground shaking. Two miles north of the campus traversing the City of Marina, the Reliz Fault extends from the southeast to the northwest. The 55-mile-long Monterey Bay-Tularitos Fault extends southeast to northwest from Carmel Valley through Monterey and into the Pacific Ocean is 5 miles southwest of the CSU Monterey Bay campus. The San Gregorio Fault parallels the coastline off of Big Sur 14 miles southeast of the campus. The entire Monterey Bay Area is saturated with numerous additional faults mostly paralleling the San Andreas Fault to the northwest. These fault systems are located on each side of the campus.
The entire CSU Monterey Bay campus resides in areas designated to be areas of low liquefaction susceptibility. The liquefaction zones additionally appear in areas where critical transportation routes extend to other areas including State Route 1 to the San Francisco Bay Area and US Highway 101 to points north and south. Liquefaction zones additionally appear scattered throughout the county and neighboring communities.

The CSU Monterey Bay at Ryan Ranch in Monterey, CA is also located in an area designated as facing a low liquefaction susceptibility. However, an area of high liquefaction susceptibility follows the path of State Route 68 and State Route 218 providing the primary methods of accessing the Monterey facility and transportation between Monterey and Salinas.
Extent of the Hazard

The extent or severity of earthquake damage is expressed in terms of magnitude, intensity, and duration. The amount of energy released during an earthquake is normally conveyed as a magnitude measured from a seismogram. Magnitude is expressed in numbers and decimals representing the physical size of the earthquake. The strength and effect of the shaking on the surface of the earth is classified as the intensity. Intensity is further defined from the effects the earthquake has on people, structures, and the natural environment. The intensity of an earthquake in terms of measuring magnitude and evaluating its effects is generally expressed using the Modified Mercalli (MM) Intensity Scale. Duration is the length of time the earthquake’s energy is released.

The Richter magnitude scale was developed in 1935 by Charles F. Richter of the California Institute of Technology as a mathematical device to compare the size of earthquakes. The Richter Scale is the best-known scale for measuring the magnitude

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41 County of Monterey, Monterey County GIS/Maps, Geologic Hazards Map, https://www.co.monterey.ca.us/government/departments-i-z/resource-management-agency/gis
of earthquakes. The magnitude value is proportional to the logarithm of the amplitude of the strongest wave during an earthquake. A recording of 7, for example, indicates a disturbance with ground motion 10 times as large as a recording of 6. The energy released by an earthquake increases by a factor of 31 for every unit increase in the Richter scale.

Table 15-15: Earthquake Intensity and Frequency Comparisons

<table>
<thead>
<tr>
<th>Magnitude</th>
<th>Mercalli Intensity</th>
<th>Potential Damage</th>
<th>Global Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 2.0</td>
<td>I</td>
<td>None</td>
<td>Continually</td>
</tr>
<tr>
<td>2.0 - 2.9</td>
<td>I to II</td>
<td>None</td>
<td>&gt; 1M per year</td>
</tr>
<tr>
<td>3.0 - 3.9</td>
<td>II to IV</td>
<td>None</td>
<td>&gt; 100,000 per year</td>
</tr>
<tr>
<td>4.0 - 4.9</td>
<td>IV to VII</td>
<td>Light</td>
<td>10K to 15 K per year</td>
</tr>
<tr>
<td>5.0 - 5.9</td>
<td>VI to VII</td>
<td>Moderate</td>
<td>1K to 1,500 per year</td>
</tr>
<tr>
<td>6.0 - 6.9</td>
<td>VII to X</td>
<td>Heavy</td>
<td>100 to 150 per year</td>
</tr>
<tr>
<td>7.0 - 7.9</td>
<td>VII &lt;</td>
<td>Very Heavy</td>
<td>10 - 20 per year</td>
</tr>
<tr>
<td>8.0 - 8.9</td>
<td>VII &lt;</td>
<td>Very Heavy</td>
<td>1 per year</td>
</tr>
<tr>
<td>&gt; 9.0</td>
<td>VII &lt;</td>
<td>Very Heavy</td>
<td>1 per 10-50 years</td>
</tr>
</tbody>
</table>

The Modified Mercalli Intensity Scale provides descriptive values of earthquake intensity that may provide greater meaning to the broader population as the description of intensity refers to the effects actually experienced. This scale uses an arbitrary ranking based on observed earthquake effects. The scale is composed of increasing levels of intensity ranging from shaking that is not recognizable to intense shaking resulting in catastrophic damages and casualties. The Modified Mercalli Intensity Scale is demonstrated below:

Table 15-16: Modified Mercalli Intensity Scale

<table>
<thead>
<tr>
<th>Intensity</th>
<th>Shaking</th>
<th>Description / Damage</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Not felt</td>
<td>Not felt except by a very few under especially favorable conditions.</td>
</tr>
<tr>
<td>II</td>
<td>Weak</td>
<td>Felt only by a few persons at rest, especially on upper floors of buildings.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Level</th>
<th>Intensity</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>III</td>
<td>Weak</td>
<td>Felt quite noticeably by persons indoors, especially on upper floors of buildings. Many people do not recognize it as an earthquake. Standing motor cars may rock slightly. Vibrations similar to the passing of a truck. Duration estimated.</td>
</tr>
<tr>
<td>IV</td>
<td>Light</td>
<td>Felt indoors by many, outdoors by few during the day. At night, some awakened. Dishes, windows, doors disturbed; walls make cracking sound. Sensation like heavy truck striking building. Standing motor cars rocked noticeably.</td>
</tr>
<tr>
<td>V</td>
<td>Moderate</td>
<td>Felt by nearly everyone; many awakened. Some dishes, windows broken. Unstable objects overturned. Pendulum clocks may stop.</td>
</tr>
<tr>
<td>VI</td>
<td>Strong</td>
<td>Felt by all, many frightened. Some heavy furniture moved; a few instances of fallen plaster. Damage slight.</td>
</tr>
<tr>
<td>VII</td>
<td>Very strong</td>
<td>Damage negligible in buildings of good design and construction; slight to moderate in well-built ordinary structures; considerable damage in poorly built or badly designed structures; some chimneys broken.</td>
</tr>
<tr>
<td>VIII</td>
<td>Severe</td>
<td>Damage slight in specially designed structures; considerable damage in ordinary substantial buildings with partial collapse. Damage great in poorly built structures. Fall of chimneys, factory stacks, columns, monuments, walls. Heavy furniture overturned.</td>
</tr>
<tr>
<td>IX</td>
<td>Violent</td>
<td>Damage considerable in specially designed structures; well-designed frame structures thrown out of plumb. Damage great in substantial buildings, with partial collapse. Buildings shifted off foundations.</td>
</tr>
<tr>
<td>X</td>
<td>Extreme</td>
<td>Some well-built wooden structures destroyed; most masonry and frame structures destroyed with foundations. Rails bent.</td>
</tr>
</tbody>
</table>

The graph below illustrates the increasing intensity of energy that is released and as the measured magnitude increases. While each whole number increases in magnitude
represents a tenfold increase in the measured amplitude, it represents an increasing rate of 32 times more energy released in the same increase in magnitude. As the magnitude of an earthquake is measured higher, the intensity of the earthquake worsens progressively from one category to the next.

Figure 15-9: Earthquake Magnitude and Equivalent Energy Release

Numerous fault systems surround and traverse throughout the Monterey Bay Area and Monterey County including the area of CSU Monterey Bay. The campus is not in a liquefaction zone but such zones are located in the Monterey Bay area. In addition, several severe and even catastrophic events have taken place. Based on these factors, the planning committee ranks the extent of the hazard as Moderate.

History of the Hazard

The State of California has a long history of chronic and destructive earthquakes throughout the state. On average, earthquakes strong enough to result in structural damages occur three to four times a year in California, while earthquakes Magnitude 6.0 to 6.9 occur once every two to three years. Likewise, Monterey County also has a long history of earthquake activity. The entire area of Monterey Bay area is at risk to seismic activity and has a history of significant earthquakes resulting in damages.

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Table 15-17: Historic Earthquakes Near Monterey, CA

<table>
<thead>
<tr>
<th>Date</th>
<th>Location</th>
<th>Magnitude</th>
<th>Damages</th>
</tr>
</thead>
<tbody>
<tr>
<td>10/21/1868</td>
<td>Hayward</td>
<td>6.8</td>
<td>Extensive destruction; 20-mile rupture</td>
</tr>
<tr>
<td>4/18/1906</td>
<td>San Francisco</td>
<td>7.9</td>
<td>Extensive destruction; 3000 fatalities</td>
</tr>
<tr>
<td>3/22/1957</td>
<td>Daly City</td>
<td>5.3</td>
<td>$1 million, 1 fatality</td>
</tr>
<tr>
<td>8/6/1979</td>
<td>Gilroy</td>
<td>5.7</td>
<td>Minor</td>
</tr>
<tr>
<td>4/24/1984</td>
<td>Morgan Hill</td>
<td>6.2</td>
<td>$8 million</td>
</tr>
<tr>
<td>10/17/1989</td>
<td>Loma Prieta</td>
<td>6.9</td>
<td>$5.9 billion, 63 fatalities</td>
</tr>
<tr>
<td>8/12/1998</td>
<td>San Juan Batista</td>
<td>5.4</td>
<td>Minor</td>
</tr>
<tr>
<td>9/3/2000</td>
<td>Yountville</td>
<td>5.0</td>
<td>Minor</td>
</tr>
<tr>
<td>12/22/2003</td>
<td>San Simeon</td>
<td>6.5</td>
<td>$200-300 million; 2 fatalities</td>
</tr>
<tr>
<td>10/30/2007</td>
<td>Alum Rock</td>
<td>5.6</td>
<td>Minor</td>
</tr>
<tr>
<td>8/24/2014</td>
<td>American Canyon</td>
<td>6.0</td>
<td>$400 million</td>
</tr>
</tbody>
</table>

The above earthquakes had federal disaster declarations declared:

- Loma Prieta (DR-845-CA)
- San Simeon (DR-1505-CA)
- American Canyon (Dr-4193-CA)

The April 18, 1906 San Francisco Earthquake became one of the most well-known earthquakes in California history. The earthquake caused extensive damage to buildings, bridges, water systems, and critical facilities. Damage was experienced well beyond San Francisco including areas such as Monterey and Santa Cruz. 3,000 people were killed and thousands more injured. The San Francisco Earthquake was found to shift the course of northern California rivers. The shaking was felt from Oregon to Los Angeles.

The October 17, 1989 Loma Prieta Earthquake shook a large part of northern California, especially the San Francisco Bay Area. The earthquake caused $5.9 billion in damages, most extensively in San Francisco, the East Bay, and South Bay areas. The earthquake resulted in extensive infrastructure damages, 12,000 displaced, 3,757

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44 Monterey County Multi-Jurisdictional Hazard Mitigation Plan, June 2015
injuries, and 63 fatalities. The earthquake was provided a federal disaster declaration (DR-845).

Potential Impacts of the Hazard

The shaking of the ground from earthquakes can result in building collapse, bridge failure, utility disruptions and other structural collapse. Large earthquakes can additionally cause natural gas lines to break resulting in structure fires. The proximity to the unstable soils surrounding the campus presents a potential for liquefaction creating greater ground instability during seismic events. A major earthquake in the Los Angeles area would likely result in region-wide social disruptions in addition to structural damages. The region-wide structural damages may disrupt lifelines and supply chain routes limiting the campus from effective evacuation routes and receiving necessary supplies or equipment.

Most injuries resulting from earthquakes are from collapsing walls, flying glass, or other objects moved by ground shaking. The lack of warning allows individuals minimal time to react and find areas of safety. A moderate earthquake occurring near Monterey could cause injuries or fatalities to members of the campus community or support networks the campus relies on. These earthquake effects might be aggravated by collateral incidents such as fire, flooding, hazardous material spills, dam/levee compromises, and other cascading events. A catastrophic earthquake near Monterey could result in extensive casualties, expansive structural damages, panic, widespread utility outages, communication failures, and secondary emergencies such as fire. A catastrophic earthquake would certainly affect the broader Monterey County region limiting immediate assistance that the campus may normally expect.

Local impacts to CSU Monterey Bay campus caused by an earthquake could include:

- Potential hazardous material releases on and off campus
- Infrastructure damage to freeway and roadway system
- Structural damage to bridges over waterways and flood control channels such as the Salinas River
- Potential isolation of campus from community
- Potential isolation among on-campus residents
- Structural damage to levees along Salinas River, Elkhorn Slough, and Pajaro River
- Structural damage to campus academic and support buildings
- Structural damage to residence halls resulting in displaced student populations
- Structural damage to nearby residences
- Community members arriving on campus for refuge from damaged homes
- Damaged university communications, computer systems, and networks
- Considerable stress and fear among community
- Closure or reduction of service to campus operations
- Reduction of campus revenue

Probability of Future Occurrence of the Hazard

The Working Group on California Earthquake Probabilities (WGCEP), a collaboration between the United States Geological Survey (USGS), the Southern California Earthquake Center (SCEC), and the California Geological Survey (CGS) develops Uniform California Earthquake Forecasts (UCERFs) using the best currently available science and technology. The UCERF version 3 provides a three-dimensional view of the likelihood a region in California will experience a Magnitude 6.7 or greater earthquake in the next 30 years. The likelihood for the Monterey County fault systems surrounding the Monterey Bay is included in the following table.

Table 15-18: Major Potentially Active Faults in Proximity to CSU Monterey Bay

<table>
<thead>
<tr>
<th>Fault Zone</th>
<th>Recurrence</th>
<th>Maximum Magnitude</th>
<th>UCERF3 Likelihood</th>
</tr>
</thead>
<tbody>
<tr>
<td>Calaveras</td>
<td>Varies: 125-850 years</td>
<td>6.2 to 7.2</td>
<td>14-17%</td>
</tr>
<tr>
<td>Monterey Bay-</td>
<td>Historic: 2800 years</td>
<td>6.5</td>
<td>1-2%</td>
</tr>
<tr>
<td>Tularcitos</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reliz</td>
<td>Unknown</td>
<td>6.2 to 7.0</td>
<td>&lt;1%</td>
</tr>
<tr>
<td>San Andreas</td>
<td>Varies: 20-300 years</td>
<td>6.8 to 8.0</td>
<td>15-22%</td>
</tr>
<tr>
<td>San Gregorio</td>
<td>Historic: 400-1000 years</td>
<td>6.5 to 7.2</td>
<td>2-4%</td>
</tr>
<tr>
<td>Sargent</td>
<td>Historic: 350-1500 years</td>
<td>6.2 to 7.2</td>
<td>1%</td>
</tr>
<tr>
<td>Zayante-Vergeles</td>
<td>Historic: 3000 years</td>
<td>7.5</td>
<td>&lt;1%</td>
</tr>
</tbody>
</table>

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45 Monterey County Multi-Jurisdictional Hazard Mitigation Plan, June 2015
The Monterey County Multi-Jurisdictional Hazard Mitigation Plan identifies that the region experiences small earthquakes every year. The Plan further estimates the probability for the San Andreas Fault to produce a Magnitude 6.7 or greater earthquake in the next 30 years is 21%.

Based on the earthquake shaking potential in the Monterey Bay area, the proximity to the above listed fault systems, and low liquefaction potential existing throughout the campus, the probability of seismic ground shaking generating damage is considered Possible.

Vulnerability to the Hazard

A considerable challenge regarding earthquakes is they generally occur without warning. The fault systems surrounding the region all cross major transportation routes potentially reducing the availability of access and the supply chain. The geographic location of CSU Monterey Bay places the campus in a suburban community near residential, commercial, and industrial areas that is moderately populated. Earthquake effects experienced in the neighboring local community will likely spill over onto the campus.

The known fault systems generating the threat to the Monterey Bay region generally surround the area and some cross near the CSU Monterey Bay campus. The campus resides in a region that is exposed to fault systems on all sides. The proximity and potential for large earthquake development from these surrounding systems expose significant vulnerabilities. The potential for earthquake damaged structures being left uninhabitable including campus residence halls will result in numerous displaced individuals and households. The lack of earthquake insurance will cause extreme financial burdens on those affected. Campus buildings and equipment would be vulnerable to damages from building, seismic shaking, secondary fires, and secondary building floods from broken pipes.

Elements of the vulnerability to a major earthquake on the CSU Monterey Bay campus will vary depending on when the earthquake were to strike. The primary basis of vulnerability is based on the population affected and the built environment exposed. In general, newer construction will be more earthquake resistant than older buildings as building codes and construction technology have improved. A locally centered earthquake, even from moderate events, would have the potential for more damaging results when associated with the moderate liquefaction zones of the area. This would particularly be seen with greater damages to unreinforced masonry buildings.

The risk to the campus population will be lessened during periods when classes are not in session or during periods of breaks. Conversely, during the days and hours that classes are in session and staff are at their workplaces, the human vulnerability increases. Generally, people are safer when at home in wood frame structures as earthquakes tend to generate less structural damage to wood construction than in
The greater number of people on campus at the time of an earthquake will result in more people being exposed to effects from damaged campus facilities or equipment and require greater evacuation assistance. However, in region-wide events this vulnerability may simply shift to the homes and workplaces of members of the campus community and their families.

The aftermath of a major earthquake will likely result in widespread search and rescue operations for trapped and injured individuals. The demand on emergency services will be great, potentially requiring the campus community to be prepared for these scenarios and initiate response actions as needed. There will be needs for emergency medical care, shelter, water, and food for individuals who have been displaced by the earthquake. In earthquakes causing significant damages, there may be a necessity to provide assistance with sheltering and care of those unable or unwilling to return to their homes. Damages to the homes of the members of the campus community may place greater demands on campus resources and capabilities in the short-term period following a seismic event.

There may be a need to evacuate members of the campus community from the campus and to other locations that are deemed to be safer locations. This may be heightened in the southwestern portions of the campus as this area has been identified as being within a liquefaction zone. As the CSU Monterey Bay campus is downstream from dam facilities, the decision to evacuate will need to take into account whether flood control facilities are filled with water and the actual threat to the dam or levees.

The Monterey Bay region is served by only two primary surface transportation routes to get in and out of the region. The primary route being US Highway 101 providing roadway access to the San Francisco Bay Area 60 miles to the north and to the Los Angeles area 300 miles to the south. California State Highway 1 provides access to the Santa Cruz area and also extends to the south however this is a winding route along seaside cliffs subject to landslides. A major earthquake has the potential for rendering these critical lifelines and supply routes inoperable and forcing the campus community to be self-reliant for a period of time.

Certain campus populations will experience greater challenges to a post-earthquake environment. Vulnerable populations including those that rely on specific services, require electrical power, homeless students, experience disabilities, non-English speakers, those whose age make evacuating difficult, and others will be most affected. These individuals will likely need to navigate through earthquake generated debris, extreme stresses of a disaster, an inability to communicate to or gain access to support networks, and find difficulty in accessing equipment or supplies to aid in a specific need.

Estimate of Potential Losses
Estimates of potential losses will be influenced by a variety of factors. The intensity of the earthquake will determine what scale of damages affecting campus infrastructure, equipment, and other impacted features. Losses will be generated by the physical damages, the loss of revenue, loss of academic research, loss of building contents, and community wide economic reductions.

Based on estimate replacement costs of facilities and structures on campus, the maximum total replacement costs due to earthquake are $401,286,223.

Table 15-19: HAZUS Peak Ground Acceleration Zone (PGA) Estimated Losses

<table>
<thead>
<tr>
<th>PGA Zone Designation</th>
<th>Intensity</th>
<th>No. of Buildings</th>
<th>Maximum Replacement Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Extreme</td>
<td>X+</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Violent</td>
<td>IX</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Severe</td>
<td>VIII</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Very Strong</td>
<td>VII</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Strong</td>
<td>VI</td>
<td>90</td>
<td>$401,286,223</td>
</tr>
<tr>
<td>Moderate</td>
<td>V</td>
<td>1</td>
<td>Unknown</td>
</tr>
<tr>
<td>Light</td>
<td>IV</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Weak</td>
<td>II-III</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Not Felt</td>
<td>I</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>NA</td>
<td>NA</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>No Building Value Data Provided*</td>
<td>NA</td>
<td>32</td>
<td>Unknown</td>
</tr>
</tbody>
</table>

*Buildings with no value defined are also included in the respective Zones they are found in.

The facility identified as being located in a Moderate PGA Zone is the CSU Monterey Bay at Ryan Ranch Monterey, CA.

Vulnerability Assessment Conclusions

It is difficult to predict the severity of casualties, property, and cascading impacts generated by future seismic events affecting the greater Monterey Bay region and the CSU Monterey Bay campus. Each of the earthquake generated effects will vary widely based on the intensity of the earthquake, location of the epicenter, proximity to people and development, time of day and year, the soil composition under the impacted structures, building construction, among others. In any case, the potential for a major earthquake exists affecting the campus and causing extensive challenges to the CSU Monterey Bay campus and community.
In the event that a major earthquake was to strike along the many fault systems surrounding Monterey, the effects could be significant to the campus community and campus operations. The widespread impacts generated by a major earthquake would extend the effects of casualties, damages, and other impacts to the broader Monterey Bay region creating large-scale regionwide needs for critical assistance and a heavy demand on limited emergency resources. The threat and impacts presented to the campus will be shared with the campus community from their homes and places of work. The campus will likely be required to address critical needs independently during early phases of the disaster.

The campus population are additionally vulnerable to the effects of major ground shaking that are far reaching. The psychological and social impacts a major earthquake will give rise to will potentially harm individuals and cause tremendous fear. The willingness to return indoors may be hampered especially as after-shocks continue. These effects are magnified for populations having specific vulnerabilities or access limitations. Populations having various limitations or specific needs may be vulnerable to reduced or eliminated access to essential services that have been rendered incapable to respond.

Identified Data Limitations

Data limitations include missing campus structural replacement costs, and lack of a complete inventory of building construction types to include status of earthquake retrofitting. HAZUS generated analysis is focused on the broader community level versus fine-tuning the analysis to the micro-level for facilities such as a university campus.

Erosion

Description of the Hazard

The US Geological Survey (USGS) defines erosion as “the process whereby materials of the earth’s crust are loosened, dissolved, or worn away and simultaneously moved from one place to another.”\(^{48}\) Erosion may occur in areas of streams and rivers, along bluffs, around immovable objects (such as buildings or bridge abutments), or as a cascading result of other natural hazards, such as earthquakes or wildfires. When erosion occurs along bodies of water, the removal of material causes the shore to move further landward.

Forces such as sea level rise and changes in sediment supply impact erosion gradually and can be difficult to recognize. In contrast, the impacts of short-term events, such as

storms and flooding, can be severe and are immediately recognizable. Along the Pacific coast, rain, wind, and waves can induce significant short-term erosion.

Location of the Hazard

Erosion is a relatively non-spatial hazard that can occur in any location with conducive soil structure and a source of movement such as water or wind. An area’s potential for erosion is determined by several factors, including rainfall, topography, soil characteristics, and vegetative cover. Streambank and bluff erosion can occur near any riverine area. For the purpose of this campus-level analysis, the erosion hazard poses a consistent risk across the terrain of the CSU Monterey Bay campus with erosion-prone characteristics.

Erosion is a severe hazard in coastal communities, where sea level rise and storms contribute to de-sedimentation and the retreat of coastal cliffs, bluffs, and beaches. While coastal erosion can happen in any storm, it is more likely during El Nino events, which occur every 5-7 years. The CSU Monterey Bay campus is located less than a mile from the Pacific Ocean coastline, where the largest concentration of coastal dunes in California is located. This coastline is experiencing continual dune erosion.\(^{49}\)

\(^{49}\) NOAA. Retrieved 2/7/21 from https://montereybay.noaa.gov/resourcepro/resmanissues/coastal.html
Extent of the Hazard

Erosion is occurring on the Pacific coastline west of CSU Monterey Bay. The average dune erosion rate between Moss Landing and Pacific Grove is approximately 2.6 feet per year. At Fort Ord Dunes State Park, adjacent to campus, the coastal retreat rate is believed to be about 7 feet per year, one of the highest rates of shoreline erosion in California. 50 51

Though no history of occurrence has taken place on campus, the severity of erosion closely adjacent to the campus along with the potential for erosion on campus in

51 Monterey County. Retrieved 2/7/21 from https://www.co.monterey.ca.us/home/showdocument?id=13709
areas with relevant characteristics, the planning committee ranks the extent of the hazard on campus as **Moderate**.
History of the Hazard

Following an El Nino event in 1997, a survey revealed that the City of Marina dunes, to which the campus is adjacent, retreated 50 feet. While coastline erosion is ongoing, no incidents of erosion have been reported on the CSU Monterey Bay campus.

Potential Impacts of the Hazard

Coastal erosion can result in severe impacts to infrastructure, including the undermining of foundations, exposure of underground infrastructure, and breaches of natural or constructed protections. The latter can expose communities to the destructive forces of floodwaters, surge, and debris impacts. On campus, areas of erosion can create pedestrian and transportation hazards, and structures may become unsafe if erosion is not controlled. Public health and safety, structures, and infrastructure can all be negatively impacted, damaged, or destroyed by the erosion hazard.

Probability of Future Occurrence of the Hazard

Erosion is an on-going and dynamic process that occurs regularly. As climate change raises sea levels and induces more frequent and intense weather events, coastal and other erosion may generally become more widespread or severe. As a result, and in consideration of the potential extent of erosion both adjacent to, and on the campus, the probability of at least a limited degree of erosion occurring somewhere on the campus in the future is **high** over the long term.

Vulnerability to the Hazard

Topography, soil structure, land use, and precipitation are all factors of erosion. CSU Monterey Bay infrastructure and buildings located on steep slopes, in areas with little vegetation, in areas with conducive soil types, or in coastal erosion hazard zones are more vulnerable to erosion. Most of the campus facilities are located upland and on well-drained soils, making it relatively safe from destructive coastal erosion.

In the wider Monterey Bay community, erosion vulnerabilities include agricultural sector job loss, degradation of riverine ecosystems and coastlines, and loss of water quality.

Estimate of Potential Losses

The historic and potential impacts of erosion on property statewide include reduced agricultural productivity, lower surface water quality, and damaged drainage networks.
Current modeling is not precise enough to allow for an assessment of potential losses to buildings and infrastructure on campus.

Vulnerability Assessment Conclusions

While the ability to predict future erosion on the CSU Monterey Bay campus is limited, the core issues shaping erosion vulnerability on campus are flora and landscaping. If left unchecked, erosion can cause significant damage to campus infrastructure and the surrounding environment.

Identified Data Limitations

The complex interactions between soil erosion factors make predictive modeling, determination of hazard areas, and quantification of loss difficult. Localized data on this hazard is also limited, resulting in more generalized findings.
**Extreme Temperatures (Includes Extreme Cold and Extreme Heat)**

**Heat**

**Description of the Hazard**

What is considered an excessively hot temperature varies according to the normal climate for that region. However, when temperatures are extremely high, people are at higher risk for heat-related illnesses, such as dehydration, heat exhaustion, heat stroke, and in severe cases, death.\(^{52}\)

Hazards from extreme heat are made worse when high temperatures are accompanied by high levels of humidity, which is defined as the amount of moisture in the air.\(^{53}\) As the temperature climbs, the air is able to hold more moisture. High humidity prevents the human body from cooling down naturally, which leads people to perceive that the temperatures “feel” hotter. The combination of temperature and humidity is known as the heat index.\(^{54}\)

Heat stroke, the most serious heat-related illness, occurs when the body is unable to control its temperature. Body temperature rises rapidly, the sweating mechanism fails, and the body cannot cool down.\(^{55}\) In extreme causes, heat stroke can cause confusion and unconsciousness, so the victim is unable to seek treatment without assistance.

There are several groups of people who are uniquely vulnerable to the effects of extreme heat, such as infants and children, older adults aged 65 and up, athletes and outdoor workers, low-income households, and individuals with certain chronic medical conditions.\(^{56}\)

**Location of the Hazard**

Extreme heat events are a non-spatial hazard, and may occur throughout the CSU Monterey Bay campus.

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\(^{54}\) Ibid.


Extent of the Hazard

Extreme heat has a wide range of extent and severity markers and characteristics. In the City of Seaside, where the campus is located, monthly average maximum temperatures in June through October range approximately from the low 60s to the high 60s. According to data from the National Climatic Data Center (NCDC), the highest daily temperature recorded at the Monterey Weather Forecast Office was 104°F on October 8, 1996. Given limited extreme heat events and the unique cooler conditions along the Monterey coast where the campus is located, the planning committee ranks the extent of the hazard as Low.

The National Weather Service issues a Heat Advisory when the heat index value is expected to reach 100° – 104° F within the next 12 to 24 hours. Excessive Heat Warnings are issued when there is an anticipated heat index of 105°F or greater that will last for two (2) or more hours. Excessive Heat Warnings are issued by the county when any location in the county is expected to reach those criteria.57 In anticipation of an Excessive Heat Warning, an Excessive Heat Watch may be issued 1 to 2 days in advance, when the Heat Warning criteria is 50 – 79% likely to occur.

Figure 15-11 (following) depicts the National Weather Service’s methodology for determining the heat index, using the % humidity and the actual temperature.

Figure 15-11: Methodology for Determining Heat Index

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As the heat index rises, so does the potential danger to people and animals. Table xx (following) shows the health hazards associated with extreme heat.

Table 15-20: Health Risks Associated with Heat Index

<table>
<thead>
<tr>
<th>Category</th>
<th>Heat Index</th>
<th>Health Hazards</th>
</tr>
</thead>
<tbody>
<tr>
<td>Extreme Danger</td>
<td>130° F or higher</td>
<td>Heat stroke / sunstroke is likely with continued exposure.</td>
</tr>
<tr>
<td>Danger</td>
<td>105° – 129° F</td>
<td>Sunstroke, heat cramps, and/or heat exhaustion is likely with prolonged exposure and/or physical activity.</td>
</tr>
<tr>
<td>Extreme Caution</td>
<td>90° – 104° F</td>
<td>Sunstroke, heat cramps, and/or heat exhaustion is possible with prolonged exposure and/or physical activity.</td>
</tr>
<tr>
<td>Caution</td>
<td>80° – 89° F</td>
<td>Fatigue is possible with prolonged exposure and/or physical activity.</td>
</tr>
</tbody>
</table>

History of the Hazard

Data gathered from the National Centers for Environmental Information (NCEI) Storm Events Database show three excessive heat events that have impacted Monterey County since 1987, but no excessive heat events that have affected the coastal areas of the county near the CSU Monterey campus specifically.

**July 21-22, 2006:** These heat events were part of a record-breaking heat wave that affected much of the state between July 16 and July 26, 2006. An all-time record for statewide energy consumption was reached on July 24, 2006 with more than 50,000 megawatts of usage.59

**October 2, 2012:** This event was part of a statewide heat wave that caused temperatures approximately 15 to 20 degrees above normal in many areas. One death was attributable to this heat event.

Potential Impacts of the Hazard

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CSU Monterey Bay may experience impacts from extreme heat due to cancelled classes or postponed outdoor events in order to protect students, faculty, and staff from the weather.

In addition to the threat extreme heat poses to humans, high temperatures also pose a threat to utility production, which in turn threaten facilities and operations that rely on utilities. As temperatures rise, more people stay indoors, increasing the demand for air conditioning, fans, and other electronics. This puts a strain on the electrical grid, which can cause temporary outages. These outages can impact operations throughout campus, resulting in interruptions and delays in service. Outages may also negatively impact research efforts on campus, as the inability to maintain a steady, constant temperature may impact research specimens and experimental results.

Probability of Future Occurrence of the Hazard

Only one heat event has impacted Monterey County in the last 10 years. Using the scale provided, it is Unlikely that the hazard will occur annually. It is also important to consider that the Multi-Jurisdictional Hazard Mitigation Plan prepared by Monterey County does not profile excessive heat as a hazard because, “While extreme temperatures are known to occur, prolonged heat waves are rare” in the area.\(^{60}\)

Vulnerability to the Hazard

When dealing with an extreme heat event, the most common impacts are those generally felt by the people living in the targeted area. For people in particular, heat can kill when the body is pushed beyond its limits. Most heat disorders occur because the victim has been overexposed to heat. As discussed, the major human risks associated with extreme heat include dehydration, sunburn, fatigue, heat exhaustion, heat stroke, and in severe cases, death.

Some portions of the population are more at risk to the effects of extreme heat. The very young, the elderly, and certain groups with chronic medical conditions (such as asthma or other pulmonary illnesses, heart disease, poor blood circulation, neurological illnesses, and obesity) are generally more vulnerable to the effects of extreme heat, and are more likely to suffer illness or death as a result.\(^{61}\) This is especially true if exposure is extended for a period of time and preventative measures are not taken immediately.

Extreme heat is not a hazard that CSU Monterey Bay should face on a regular basis. However, the campus is aware of the effects of climate change and how rising temperatures may affect their students, faculty, and staff in the future. Though the

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\(^{60}\) Monterey County Multi-Jurisdictional Hazard Mitigation Plan. Identification and Screening of Hazards. Print. Retrieved 01.28.21 from: https://www.co.monterey.ca.us/home/showdocument?id=13709

campus does not face high risks of extreme heat at this time, they are looking to prepare for future impacts.

**Estimate of Potential Losses**

Based on the previous historical occurrences, annualized losses are considered to be negligible. In an extreme heat event, loss of human life or health impacts are a greater concern than is property damage.
Vulnerability Assessment Conclusions

While the ability to predict future heat events at the CSU Monterey Bay campus is limited, the effects of climate change may provide some information. According to the Environmental Protection Agency (EPA), North-Central California has warmed about 1.5 – 2 degrees on average over the last century, with less rainfall. This may lead to stronger and more frequent heat events, drought, and an increased risk of wildfires.62

Cold

Description of the Hazard

What is considered an excessively cold temperature varies according to the normal climate for that region. However, when temperatures are far below normal, with higher wind speeds, heat leaves the human body more rapidly, which increases the possibility of negative effects from these extreme temperatures.63

The greatest danger from extreme cold is to people, as prolonged exposure can cause frostbite or hypothermia, and can become life threatening. When someone is suffering from hypothermia, body temperatures can become so low that they affect the brain, making it difficult for the victim to think clearly or move well. In the case of frostbite, the frozen tissue becomes numb and the victim may be unaware that anything is wrong until someone else notices.64 This makes hazards from extreme cold particularly dangerous, as people may not understand what is happening to them or what to do about it.

The primary hazards from extreme cold are frostbite and hypothermia. Frostbite is caused by freezing of the skin and underly tissue. It causes a loss of feeling and color in the affected areas of the body, and most often affects the nose, chin, fingers, or toes.65 It can be permanently damaging if not treated promptly and can lead to infection, nerve damage, or amputation in severe cases.66 The risk of frostbite is


66 Ibid.
increased in people with preexisting conditions, the elderly, people with reduced blood circulation, and people who are not dressed warmly enough for the conditions. Hypothermia occurs when the body loses heat faster than it can produce heat, causing a dangerously low body temperature. A normal body temperature is around 98.6°F. Hypothermia occurs when your body temperature falls below 95°F. As this happens, the heart and other essential organs cannot work properly. If hypothermia is not treated, it can lead to heart failure, respiratory failure, and eventually to death.

Excessive or extreme cold can accompany severe winter weather, or it can occur without severe weather. For this reason, extreme cold is a separate hazard from severe winter storms.

Location of the Hazard

Extreme cold events are a non-spatial hazard and may occur at the CSU Monterey Bay campus.

Extent of the Hazard

Extreme cold has a wide range of extent and severity markers and characteristics. Average nighttime winter temperatures in Monterey Bay are typically in the mid-40s. According to data from the National Climatic Data Center (NCDC), the lowest daily temperature recorded in Monterey Bay was 20°F on December 22, 1990. Based on no extreme cold events and just 9 frost/freeze events since 1996, the planning committee ranks the extent of the hazard as Low.

The National Weather Service issues Extreme Cold Warnings when the temperature feels like it is -30°F or colder across a wide area for a period of at least several hours. When possible, these advisories are issued a day or two in advance of the conditions.

The most common extent/severity marker for extreme cold is the Wind Chill scale. Figure 15-10 (following) depicts the National Weather Service’s methodology for determining the wind chill, using wind speed and actual temperature. Although wind chill is not necessarily related to extreme cold as a single cause, the advisory system that the NWS currently uses relies on wind chill to relay warning and advisory information to the public. Extreme cold severity is a function of wind chill and other factors, such as precipitation amount (rain, sleet, ice, and/or snow). Given the historical and potential occurrence of freezing temperatures, but a low probability of

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extreme cold, the planning committee ranks the extent of the hazard as Low to Moderate
In 2011, the National Weather Service introduced an experimental program that issued warnings for extreme cold events, independent of other severe weather warnings. The test areas included North and South Dakota and Minnesota. However, in 2012, after a single season of use, the program was abandoned, based on reports of confusion among test audiences.69

History of the Hazard

Based on data gathered from the National Centers for Environmental Information (NCEI) Storm Events Database, Monterey County has had nine frost/freeze events dating back to 1990, but no extreme cold hazards. [Records for this hazard were first recorded in 1996].

Potential Impacts of the Hazard

Should an extreme cold event occur, CSU Monterey Bay might experience impacts due to cancelled classes.

In addition to the threat posed to humans, extreme cold weather poses a significant threat to utility production, which in turn threatens facilities and operations that rely on utilities, specifically climate stabilization. As temperatures drop and stay low, increased demand for heating places a strain on the electrical grid, which can lead to temporary outages. These outages can impact operations throughout the campus, which can result in interruptions and delays in services. These outages may also negatively impact research efforts throughout the campus, as the inability to maintain a steady, constant temperature may result in unintended effects on research specimens.

Probability of Future Occurrence of the Hazard

The Monterey Bay area has experienced freeze/frost events, but has never experienced an extreme cold event. Due to the campus's location in a temperate climate, it is **Unlikely** that this hazard will occur annually.

Vulnerability to the Hazard

When dealing with an extreme cold event, the most common impacts are those generally felt by the people living in the targeted area. For people in particular, extreme cold can kill when the body is pushed beyond its limits. Most danger due to the cold is because the victim has been overexposed to low temperatures. As discussed, the major human risks associated with extreme cold include frostbite, hypothermia, and in severe cases, death.

Some portions of the population are more at risk to the effects of extreme cold. The elderly, those with certain preexisting conditions (hypothyroidism, diabetes, and high blood pressure, just to name a few), those with poor blood circulation, and people who are not dressed warmly enough for the cold are generally more vulnerable and are more likely to suffer illness or death as a result. This is especially true if exposure is extended for a period of time and preventative measures are not taken immediately.

Estimate of Potential Losses

Based on the previous historical occurrences of extreme cold events, annualized losses are considered to be negligible. In an extreme cold event, loss of human life or health impacts are a greater concern than is property damage.

Vulnerability Assessment Conclusions

While the ability to predict future extreme cold events at the CSU Monterey Bay campus is limited, the effects of climate change may provide some information. According to the Environmental Protection Agency (EPA), areas in North-Central

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California have warmed approximately 1.5 – 2 degrees on average over the last century, with less rainfall. This may lead to fewer frost/freeze events in the future.\textsuperscript{71}

Identified Data Limitations

Numerous public and private actors conduct research, acquire data and disseminate meteorological information and forecasting to the general public, including the CSU university system. Currently, it is assumed that, apart from regular access to climate change models on changes to temperature extremes over time, the CSU community maintains sufficient access to the data needed to plan for, respond to, and mitigate the effects of extreme heat and cold.

\textit{Flood}

Description of the Hazard

The incredible geographic diversity in California presents tremendous challenges for flood planning and response. The state is home to extensive mountain ranges such as the Sierra Nevada, Cascades, Klamath, Coastal Ranges, and the Southern California Transverse Range all creating tremendous watersheds. Large river systems drain the mountains traveling through populated communities including the Sacramento and San Joaquin Rivers draining into the California Delta. The state has a complex system of reservoirs, dams, and levees providing water storage and flood protection. Finally, California’s 840-mile coastline exposes the coastal regions to tidal influences.

Floods are characterized by the rising and overflowing of excess water from a water source such as a stream, river, lake, canal, or coastal body onto an area of normally dry floodplain. A floodplain is a lowland area downstream and adjacent to water bodies that are subject to flood events. Flooding is a naturally occurring event that become hazardous when populations and property are affected.

Flooding can result from excessive precipitation from weather systems generating prolonged rainfall, excessive snowmelt from watersheds upstream from the floodplain, infrastructure failure, exceeding the capacity of dams or levees, tidal influences, or a combination from any of the previous factors.

Floods represent one of the costliest and most frequent natural disasters that influences human suffering and economic impact in the United States. Flooding will likely result in significant damage to structures, infrastructure, utilities, landscapes, and the environment. Erosion of stream banks, roadways, other feature may result from the movement of flood waters. The saturated ground resulting from standing

flood waters may cause ground instability, collapse, erosion, or other damages. Further, floods will often generate substantial debris that will accumulate and be deposited throughout the flooded areas.

Floods can be either slow-rise or rapid onset floods. With slow rise floods, there is often warning preceding water rise by hours or days before dangerous conditions present themselves. Slow rise floods that are expected to enter into populated areas generally allow for some time to initiate evacuation and sand bagging efforts. Flooding that occurs rapidly conversely are water events that present with extremely limited warning times and a limited ability to take response actions until flooding has already begun to occur.

Flooding may take on different forms:

- **Flash Flooding** – Flash flooding is typically characterized by a rapid rise, short duration, and large volume of water in a localized area. Heavy rainfall in areas that have limited drainage capacities often contribute to flash flooding conditions. These flooding events frequently occur with limited notice requiring immediate evacuation or rapid response efforts such as sand bagging. Flash flooding may arrive with fast moving water creating added hazardous conditions.

- **Riverine Flooding** – Riverine flooding is usually caused by prolonged rainfall or rainfall combined with heavy snowmelt. When soils are already saturated, the ability for the ground to absorb water is minimized. In a riverine flood, the water way exceeds channel capacity and extends into areas outside of the channel, often in developed communities. In California, riverine flooding is most likely to occur from November through April. The duration of riverine floods may vary from a period of hours to weeks.

- **Localized Flooding** – Localized flooding is commonly the result of stormwater drainage systems being overwhelmed by unusually heavy rainfall. These flooding events frequently occur in areas that are urbanized or developed with greater amounts of impervious surfaces not allowing ground absorption. This generates added runoff into the drainage systems and onto roadways creating backups.

- **Infrastructure Failure** – Failures of dams or levees presents a serious flooding concern for areas downstream from the compromised structure. This situation may result in a catastrophic flood with limited warning time and widespread areas affected.

- **Coastal Flooding** – Coastal flooding can occur in multiple areas along the California coastline. Flooding may result from intense storms coming from the Pacific Ocean that generate elevated water levels or storm surge. The size, duration, winds generated, and intensity of the storm will influence the effect
the waves will have on the shoreline. Periods of high tide can aggravate the conditions allowing greater wave impingement into coastal areas.

Atmospheric Rivers

California, including the location of this campus, is subject to the effects of a phenomenon referred to as atmospheric rivers. These weather events consist of long, narrow regions in the atmosphere transporting tremendous amounts of water vapor from the tropics. These weather regions behave like rivers in the sky. They can carry heavy volumes of water vapor compared to the amount of water flow at the mouth of the Mississippi River. As these atmospheric rivers arrive into California, they tend to generate significant rain and snow.

Atmospheric rivers can arrive in many different shapes and sizes. The larger events are able to generate extreme rainfall amounts resulting in flooding. They can stall over watersheds vulnerable to flooding, often saturated with heavy snow amounts. The atmospheric rivers known as a “Pineapple Express” coming from the tropics and arriving with warmer air may produce heavy rains that will melt ground snow adding to the water volume that will be added in the flood runoff.

These events can produce heavy amounts of precipitation creating extensive damages. However, these events may present as weaker systems that produce precipitation that is enough to be beneficial for the local water supply. At the higher elevations in the California mountains, these events have the potential to generate a tremendous snowpack providing a source of water during the dry summer months.
Location of the Hazard

Seaside is located in Monterey County on the Pacific coast between Monterey and Santa Cruz. Monterey County can experience flooding from overflowing rivers, streams, and heavy precipitation events in low lying areas. These areas often experience shallow flooding impacting roadways and other areas where drainage is inadequate. The western side of the campus leads to State Route 1, the primary north-south connector and the Pacific Ocean. The Salinas River flows 4-5 miles to the east of the campus after traveling through the length of the Salinas Valley. The communities in and west of the Monterey Bay area are in some cases densely populated while other communities are developed with less density. The Salinas Valley is notable for rich agricultural production.

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72 National Oceanic and Atmospheric Administration, “What are atmospheric rivers?”, https://www.noaa.gov/stories/what-are-atmospheric-rivers

The CSU Monterey Bay campus is located elevated on a bluff that overlooks the Salinas River limiting the flooding potential that exists in the low-lying areas. The campus is situated on a topography of rolling hills 200-300 feet higher than the coast and river channel. Creek beds that have been carved into valleys among the hills surround the campus. The majority of the CSU Monterey Bay campus sits within a Special Flood Hazard Area (SFHA) Zone X: Area of Minimal Flood Risk designation on the Flood Insurance Rate Map. The southwest corner of the campus containing Freeman Stadium and the athletic fields, and the aquatic center resides in a Zone X: 0.2% Annual Chance Flood Hazard.
Extent of the Hazard

The CSU Monterey Bay campus is located in a designated Zone X: Area of Minimal Flood Hazard with the exception of the area containing the athletic fields and stadium south of Divarty Street and west of General Jim Moore Blvd. The portion of the campus containing the athletic facilities are designated Zone X: 0.2% Annual Chance Flood Hazard. The access routes into and out of the campus servicing locations to the
north and east are found in areas primarily designated as Zone X: Area of Minimal Flood Hazard, access routes to and from the south via US Highway 101 are located in Zone X: 0.2% Annual Chance Flood Hazard. Based on no history of flood events on campus, and its location in an area of minimal flooding, the planning committee ranks the extent of the hazard as **Low**.

In support of the NFIP, FEMA identifies those areas that are more vulnerable to flooding by producing Flood Hazard Boundary Maps (FHBM), Flood Insurance Rate Maps (FIRM), and Flood Boundary and Floodway Maps (FBFM). Several areas of flood hazards are commonly identified on these maps, including the 1% annual chance flood zone. Flood zones are further delineated by risk and are assigned a letter signifier. The flood zone designations are defined and described in the following table.

**Table 15-21: Flood Zone Designations and Descriptions**

<table>
<thead>
<tr>
<th>Zone Designation</th>
<th>Percent Annual Chance of Flood</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Zone V</td>
<td>1%</td>
<td>Areas along coasts subject to inundation by the 1% annual chance of flooding with additional hazards associated with storm-induced waves. Because hydraulic analyses have not been performed, no BFEs or flood depths are shown.</td>
</tr>
<tr>
<td>Zones VE and V1-30</td>
<td>1%</td>
<td>Areas along coasts subject to inundation by the 1% annual chance of flooding with additional hazards associated with storm-induced waves. BFEs derived from detailed hydraulic analyses are shown within these zones. (Zone VE is used on new and revised map in place of Zones V1-30.)</td>
</tr>
<tr>
<td>Zone A</td>
<td>1%</td>
<td>Areas with a 1% annual chance of flooding and a 26% chance of flooding over the life of a 30-year mortgage. Because detailed analyses are not performed for such areas, no depths or base flood elevations are shown within these areas.</td>
</tr>
<tr>
<td>Zone AE</td>
<td>1%</td>
<td>Areas with a 1% annual chance of flooding and a 26% chance of flooding over the life of a 30-year mortgage. In most instances, BFEs derived from detailed analyses are shown at selected intervals within these zones.</td>
</tr>
</tbody>
</table>
Areas with a 1% annual chance of flooding where shallow flooding (usually areas of ponding) can occur with average depths between 1 – 3 feet.

Areas with a 1% annual chance of flooding, where shallow flooding average depths are between 1 – 3 feet.

Represents areas between the limits of the 1% annual chance flooding and 0.2% chance flooding.

Areas outside of the 1% annual chance floodplain and 0.2% annual chance floodplain, areas of 1% annual chance sheet flow flooding where average depths are less than one (1) foot, areas of 1% annual chance stream flooding where the contributing drainage area is less than one (1) square mile, or areas protected from the 1% annual chance flood by levees. No BFEs or depths are shown within this zone.

Flooding in the Monterey Bay communities and the broader Monterey and Santa Cruz Counties region have typically occurred during the winter months when Pacific storms are more common. The occurrences of significant flooding typically have been the result of successive intense storms with heavy precipitation. The region has experienced flood events that have caused millions of dollars in damages and casualties. The following provides insight into information of past flooding events that are significant to the CSU Monterey Bay campus. No history of flood on campus is reported, and occasional heavy rainfall events will sometimes produce small, isolated pockets of ponding in low lying areas.

Table 15-22: Historic Flooding Events in Monterey County

<table>
<thead>
<tr>
<th>Date</th>
<th>Event</th>
<th>Declaration</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>February 2017</td>
<td>Flood; Heavy Rains</td>
<td>DR-4308-CA</td>
<td>Countywide</td>
</tr>
<tr>
<td>January 2017</td>
<td>Flood; Heavy Rains</td>
<td>DR-4305-CA</td>
<td>Countywide</td>
</tr>
<tr>
<td>January 2017</td>
<td>Flood; Winter Storms</td>
<td>DR-4301-CA</td>
<td>Countywide</td>
</tr>
</tbody>
</table>

73 Monterey County Multi-Jurisdictional Hazard Mitigation Plan, June 2015
### Potential Impacts of the Hazard

A flood will potentially result in extensive amounts of water entering onto developed areas. The force and volume of water that is generated by a flood may cause extensive structural damage in areas subject to standing or moving water. The effects of flooding may spread over significant distances covering large areas of land. The extent of the impacts would vary based on a number of factors such as the volume of water flooding, the time of the flood event, the amount of warning provided, the location and extent of the flood boundary, facility elevation, and distance from the flood source. Potential impacts resulting from flooding include:

- Injuries or loss of life
- Property destruction or damage
- Loss of property contents
- Infrastructure damage including roadways, bridges, other transportation means
- Potential isolation from other regions and access to support, resources, or evacuation
- Public health hazards resulting from mold, mildew, and disease due to flood water
- Flooded or destroyed lifelines/supply routes
- Damaged or destroyed utilities
- Loss of community economic base
- Employment losses
- Agricultural (crops and livestock) damages or destruction
- Environmental damage
- Prolonged periods of necessary dewatering
- Flooding erosion may alter natural drainage channels
- Societal and community impacts
- Psychological impacts of impacted populations
- Disruptions to education delivery to community

Additionally, individuals who were unable to evacuate in time or refused to leave will likely need assistance or rescue from the flooded area. Remaining in or being trapped by flood waters places individuals in significant risk of injury or death. The impacts extend beyond the danger placed upon the affected individual and places greater resource demands on agencies and organizations making efforts to rescue trapped individuals.

**Probability of Future Occurrence of the Hazard**

Monterey County is determined have considerable portions of the county to be at high risk from flooding. The repeated historic occurrences have shown that the region is subject to flooding in any given year. Floods can occur at any time but are most common in the Monterey Bay area with winter storms that are saturated with subtropical moisture.

The area surrounding the CSU Monterey Bay campus does not generally promote conditions for flood waters to accumulate. The majority of the campus is designated as Zone X (Area of Minimal Flood Hazard). However, the area containing the sports complex is designated as Zone X (0.2% of Annual Chance of Flood Hazard). There are specific buildings and areas of the campus that have a greater risk for isolated flooding. The area is also subject to isolated urban or street flood events providing a demonstration of potential flood activity.

The probability of future occurrence for flooding is **Unlikely**.

**Vulnerability to the Hazard**

The CSU Monterey Bay campus is subject to the effects of limited and isolated flooding and ponding resulting primarily from excessive precipitation and isolated strong storms. The vulnerability to flood among the people and infrastructure is reduced as the campus is located in an area designated as having a minimal flood risk. There is a more remote potential for flooding and damage on campus and surrounding residential and commercial areas in low lying areas of the campus or Seaside due to overflow or damage to drainage or flood control systems. The flood
control channels and drainage systems that surround the campus have limited storage or volume capacities. The campus and the campus community are vulnerable to the effects generated by flooding from these systems.

Vulnerability to flooding on the CSU Monterey Bay campus will vary depending on when the flood was to occur and on the location of people or assets in any low-lying areas on campus. The risk to the campus population will be lessened during periods when classes are not in session or during periods of breaks. Conversely, during the days and hours that classes are in session and staff are at their workplaces, the human vulnerability increases. Members of the campus community in any low lying areas may become trapped on campus depending on the level of flooding occurring on surface streets. However, in rare, region-wide events this vulnerability may be extended to the homes and workplaces of members of the campus community and their families.

CSU Monterey Bay is in a location separated from the larger surrounding communities by areas that have the potential for flooding. When these areas are inundated with flood water, the potential for access barriers, contaminant release into flood waters, and creating physical isolation presenting vulnerabilities to individuals from the campus community regarding challenges to health and safety. The area surrounding the campus is filled with agricultural land uses; flooding of these areas may result in agricultural contaminants to be released into flood waters.

During low probability, severe flood events, some campus buildings and infrastructure in low lying areas might be vulnerable to large-scale flooding that reaches the university. Campus utilities and communication capabilities might be impacted by flood waters rendering them disabled. A rare flood covering a large portion of the city might affect communication capabilities well beyond the boundaries of the campus. Remaining flood waters will leave behind molds and other health concerns in affected campus buildings and facilities likely requiring extensive restoration or demolishing. The residents of the on-campus residence halls in any low lying areas may have transportation limitations requiring evacuation and alternative housing procedures to be implemented if populated. In such areas, flood waters may result in damage to campus equipment, communication systems, protected documents, artwork, academic materials, computer systems, research, and other critical activities on lower levels of buildings.

Certain campus populations will experience greater challenges to a post-flood / failure environment. Vulnerable populations will likely need to navigate through flood generated debris, face extreme health safety issues from flood waters, experience extreme stresses of a disaster, an inability to communicate to or gain access to support networks, and find difficulty in accessing equipment or supplies to aid in a specific need. Students remaining on campus such as those residing in the residence halls would be particularly vulnerable especially those without access to adequate transportation.
Estimate of Potential Losses

Estimates of potential losses will be influenced by a variety of factors. The volume and force of the water will determine the scale of damages affecting campus infrastructure, equipment, and other impacted features. The location and elevation above flood waters will affect the level of damage and individuals exposed. The time of the academic year, the day of week, and hour in which the flooding was to occur will influence the number of people on campus and potential casualties. The severity of the storms producing precipitation, the speed of the storms moving across the area, the level of snowpack in the higher elevations, and amount of resulting snowmelt will produce varying effects on damages produced and costs incurred. Losses will be generated by the physical damages, the loss of revenue, loss of academic research, loss of building contents, and community wide economic reductions.

Based on estimate replacement costs of facilities and structures on campus, the maximum total replacement costs due to flood are $401,286,223. However, it is unlikely for flood to cause destructive losses to the entire campus.

Table 15-23: Special Flood Hazard Area (SFHA) Estimated Losses

<table>
<thead>
<tr>
<th>Zone Designation</th>
<th>No of Buildings</th>
<th>Maximum Replacement Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Zone V</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Zone VE &amp; V 1-30</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Zone A</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Zone AE</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Zone AH</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Zone AO</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Zone X .2%</td>
<td>6</td>
<td>Unknown</td>
</tr>
<tr>
<td>Zone X Minimal Risk</td>
<td>84</td>
<td>$401,286,223</td>
</tr>
<tr>
<td>Not in a SFHA</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>No Building Value Data Provided*</td>
<td>32</td>
<td>Unknown</td>
</tr>
</tbody>
</table>

*Buildings with no value defined are also included in the respective Zones they are found in.

Vulnerability Assessment Conclusions
While the campus is located in an area of minimal flood potential (Zone X), the primary vulnerabilities to flood on campus are people and assets in low lying areas exposed to mostly localized flooding and ponding from overflow of campus creeks or low probability, large-scale storms that produce heavy amounts of precipitation directly over the campus and surrounding neighborhoods.

The potential for flooding generates the potential for a number of cascading effects such as disruptions to the local economy, utility failures, disruptions to providing for the needs of the community, and development of public health hazards. These effects would be exacerbated by effects of seasonal flooding, ongoing heavy precipitation, or excessive run-off from the watershed contributing to the river system. The potential for rare, widespread flooding and damage of structures due to the force of water, while unlikely, has exponentially powerful impacts on particular populations among the campus community including those with access or functional needs, international students, the homeless, and students residing in the residence halls located in low lying areas.

Identified Data Limitations

Data limitations include missing campus structural replacement costs, and an incomplete inventory of both building construction features and mitigation efforts to lessen the impact due to flood inundation. HAZUS generated analysis is focused on the broader community level versus fine-tuning the analysis to the micro-level for facilities such as a university campus.

**Hazardous Materials**

**Description of the Hazard**

A hazardous material is defined in California’s State Hazardous Materials Incident Contingency Plan (1991) as “a substance or combination of substances which, because of quantity, concentration, physical, chemical, or infectious characteristics may: cause, or significantly contribute to an increase in deaths or serious illnesses; and/or pose a substantial present or potential hazard to humans or the environment.”

Hazardous materials are one or more of the following: flammable, corrosive or an irritant, oxidizing, explosive, toxic (poisonous or infectious), thermally unstable or reactive, or radioactive. Hazardous materials are ubiquitous in modern society and may be found at all stages of production, consumption, and disposal.

Federal and state laws permit the intentional release of some hazardous materials into the environment such that the risk to human health and the environment is thought to be acceptable. However, sometimes releases are unintentional, resulting from leaks,

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accidents, or natural hazards. This section focuses on such accidental releases and fall into the following key categories:

**Fixed Hazardous Materials Incident:** A fixed hazardous materials incident is the accidental release of chemical substances or mixtures during production or handling at a fixed facility.

**Transportation Hazardous Materials Incident:** A transportation hazardous materials incident is the accidental release of chemical substances or mixtures during highway, waterway or air transport. Populations, built and natural environments are potentially impacted.

**Pipeline Incident:** A pipeline transportation incident occurs when a break in a pipeline creates the potential for an explosion or leak of a dangerous substance (oil, gas, etc.) possibly requiring evacuation. An underground pipeline incident can be caused by environmental disruption, accidental damage, or sabotage. Incidents can range from a small, slow leak to a large rupture where an explosion is possible. Inspection and maintenance of the pipeline system along with marked gas line locations and an early warning and response procedure can lessen the risk to those near the pipelines.

Hazardous materials can also be classified according to worker safety and health. Information provided by California Division of Safety and Health includes guidelines related to:

- **Safety hazards:** fire and fire byproducts, electricity, flammable gases, unstable structures, demolition, sharp or flying objects, excavations)
- **Health hazards:** carbon monoxide ash, soot and dust; asbestos; hazardous liquids; other hazardous substances; heat illness)

**Natural-Technological Incidents (Natechs):** During the past two decades, increasing attention has been given to hazardous materials releases resulting from Natechs or a natural disaster event that triggers a technological hazard event. Natechs are of particular concern for the following reasons:

- They can produce a simultaneous effect on many industrial facilities
- Can overwhelm response capacity
- Containment systems may fail

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• May produce cascading disasters
• Response may be hindered by a disaster’s impact on the physical environment

Location of the Hazard

Hazardous materials and infrastructure such as fuel tanks, rail lines, chemicals, hazardous waste sites and gas pipelines to varying degrees are located within the CSU system and/or within its surrounding communities. Please refer to Annex 7 for the map identifying the types and locations of hazardous materials and infrastructure on or near the CSU – Monterey Bay campus. The planning committee indicates that diesel generators and propane tanks are located on campus along with possible unexploded military ordinance. A gas pipeline runs through campus and one hazardous waste site is nearby. Also, the campus maintains a “90-day” facility for storing hazardous materials. At larger scales (beyond the campus planning area) a moderate degree of hazardous materials and infrastructure are located throughout the city and county of Monterey.

Extent of the Hazard

There is no comprehensive statewide vulnerability assessment available at this time. As such, the true extent of the hazardous materials risk in California and its communities is not known, meaning no overarching conclusions have been reached which have been able to integrate all qualitative and quantitative risk factors to produce a comprehensive measure of the extent of the hazard.

However, for the CSU – Monterey Bay planning committee, no hazmat events have taken place on campus. In addition, one gas pipeline and 1 hazardous waste site are located very close to the campus. Based on these factors, it is prudent to rank the extent of the hazard for the CSU – Monterey Bay campus as Low, but also to consider worst case scenarios as the main driver of policy in order to fully mitigate all possible hazardous materials event outcomes.

For example, according to the 2018 CA State Hazard Mitigation Plan, 400 hazardous materials problems are tied to 32 past earthquakes, including over 150 problems from the Loma Prieta Earthquake alone. 79 That said, the plan indicates that it is likely that many such hazardous materials releases have received little attention in the past because public authorities, the media, and the public have overlooked them in the


rush to address and recover from immediate disaster threats, and that responsible
parties may have an incentive to understate the extent of releases or not to report
them at all.

History of the Hazard

According to the CA Governor’s Office of Emergency Services’ Hazardous Materials
Spill Report, the state experiences from 10 to 30 spill events daily. As of April 20th,
2021 already 2096 spill events had occurred. Such events have occurred in all the
cities and/or counties where CSU campuses are located.\(^{80}\)

According to the 2018 CA State Hazard Mitigation Plan, with regard to natural-
technological hazard events (Natechs), 400 hazardous materials events are tied to 32
past earthquakes, including over 150 Natech events from the Loma Prieta Earthquake
alone.

For more details on specific hazmat events, please refer to the local, county and/or
multi-jurisdictional hazard mitigation plans where CSU campuses are located at:
https://www.caloes.ca.gov/cal-oes-divisions/hazard-mitigation/hazard-mitigation-
planning/local-hazard-mitigation-program

According to the campus planning committee, no hazmat events have taken place on
the CSU – Monterey Bay campus.

Potential Impact of the Hazard

A large hazardous materials release could affect an entire community or city under
certain conditions related to direction of air flow (air-based chemical release) and
population density or the contamination of a community’s main water supply. Either
type of release could necessitate large scale evacuation. By contrast, in the rural
unincorporated areas where population densities are low, even in the event of a large
release, the number of homes that may need to be evacuated would be significantly
lower than in an urban environment. The occurrence of a hazmat incident can also
result in the shut-down of transportation corridors which can last for hours at a time
while the impacted area is stabilized.

The release of some toxic gases may cause immediate death, disablement, or sickness
if absorbed through the skin, injected, ingested, or inhaled. Contaminated water
resources become unsafe and unusable, depending on the amount of contaminant.
Some chemicals cause painful and damaging burns if they come in direct contact with
skin. Prolonged and concentrated exposure to such chemicals can produce severe
long-term impacts to respiratory, endocrine and nervous systems, heart and brain
health.

\(^{80}\) Cal OES. Spill Report View. Retrieved 04.21.2021 from:
https://w3.calema.ca.gov/operational/malhaz.nsf/$defaultView?OpenView&Start=121&ExpandView
The potential impacts of chemicals and toxic gases discussed here to some degree apply to the students, staff and environment on the CSU – Monterey Bay campus.

With regard to the natural environment overall, contamination of air, ground, or water may result in harm to fish, wildlife, livestock, and crops. The release of hazardous materials into the environment may cause debilitation, disease, or birth defects over a long period of time. Loss of livestock and crops may lead to economic hardships within the community.

Recent California examples include the 2016 Aliso Canyon methane gas leak, which caused evacuation of nearby residents, many of whom experienced temporary health problems such as difficulty breathing and eye irritation; and the 2016 Fruitland metal recycle plant fire in Maywood, which released heavy metals such as lead, magnesium, copper, aluminum, antimony, calcium, iron, sulfur, tin, potassium, and zinc which pose severe risks to public health. Health effects from exposure to these metals included short-term symptoms such as irritation to the eyes, nose, throat, and lungs.

**Potential Impact of the Hazard (Natechs)**

Natural disasters, including earthquake, flood, and fire also pose risks to public health and the environment. For example, following the Northridge Earthquake, California State University (CSU) Northridge laboratories and chemical storage rooms experienced multiple chemical spills. Such incidents, triggered by a natural disaster, pose a significant risk to students, faculty, staff, and first responders. At a minimum, all CSU campuses with a science lab (including CSU – Monterey Bay) is at risk of potential impact from a natural-technological (combined impact) event.

In a severe flood event, floodwaters are often contaminated with hazardous materials posing a threat to public and animal health, groundwater, and other parts of the environment. These hazardous materials may be released from damaged or flooded underground tank sites (e.g., gas stations or chemical storage facilities), propane tanks, manure or human waste handling facilities, fertilizer and pesticide storage, agricultural sites, and household hazardous waste.

In a fire event, (such as the October 2017 Northern California firestorms which destroyed approximately 6,000 residences) entire neighborhoods can be burned to the ground. Hazardous material release creates public health concerns which can delay the initial steps of fire recovery, including reopening burned areas to residents and initiating debris removal activities. The post-fire “toxic sweep” poses a risk of coming

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into contact with toxic substances due to the presence of synthetic and hazardous materials.

Probability of Future Occurrence of the Hazard

The probability of occurrence for a hazmat event on the CSU – Monterey Bay campus can be viewed in two different ways: the history of occurrence serves as a sound predictor of future probability assuming current risk and vulnerability factors remain somewhat constant. For the purposes of the current estimate, no current data clearly indicates otherwise. As such, the probability of occurrence is Low- the campus has not experienced a hazmat event. In addition, nearby hazardous materials and infrastructure may increase probability of a campus-related event. However, hazmat occurrences are largely based on human error, and any changes in risk and vulnerability factors such as a decreased vigilance in materials oversight and handling practices or changes in the amount of chemicals or exposure will likely increase the probability on campus.

Vulnerability to the Hazard

Hazardous materials pose a large risk to the CSU – Monterey Bay campus. As identified by the campus planning committee and on the hazmat map, the following vulnerabilities are present on campus: diesel generators (fuel) and propane tanks pose a risk to the campus. In addition, a gas pipeline and a hazardous waste site are extremely close to the campus footprint. Gases and chemicals or hazardous waste, if spilled or released, could severely impact human health and campus operations. Although it is quite difficult to produce a quantitative measure of vulnerability because (unlike natural hazards) the probability of occurrence is dependent on human error, which itself is variable based upon a fluctuating set of interrelated factors, some of which lack prediction or control, given the complexity of how all natural and built environments and hazmat risks factors interrelate at the local or campus level, it is prudent to assume for planning purposes that the campus’ vulnerability is a sub-set of the larger community’s vulnerability. As such, the CSU – Monterey Bay leadership maintains vigilance to mitigate the campus’ vulnerabilities identified above at a minimum.

Estimate of Potential Losses

As discussed previously, it is difficult if not impossible to produce an accurate quantitative measure of vulnerability because of the variable nature of a hazardous materials spill. For example, the release of a toxic airborne chemical in a populated area has severe impact potential, whereas the impact potential of a small chemical spill in a remote or rural area is most likely limited to remediation of soil. And, in both cases, the probability of occurrence is dependent on human error, which itself is variable based upon a fluctuating set of interrelated factors, some of which lack
prediction or control. In all cases, different types and amounts of hazardous materials interact with fluctuating combinations of human error to produce different event outcomes with variable impact costs.

**Vulnerability Assessment Conclusions**

It is well understood that with regards to hazmat vulnerability, each campus and its surrounding community (including CSU – Monterey Bay) operates through a complex and dynamic interaction between industrial and commercial inputs and outputs and the natural and built environment. Such activity produces hazardous materials that move through the environment along both convergent and divergent routes and across all levels of land-use from site to campus to city and county and beyond. It is also clear from a review of the Monterey County hazard mitigation plan and Cal OES’ records of hazardous material spills, that such events occur with great frequency and varying degrees of severity across jurisdictions statewide. As such, in assessing the vulnerability of the CSU – Monterey Bay campus, campus-level risks and vulnerabilities are not discreet or isolated but can become exacerbated or augmented through connections to broader community-level hazmat risks and vulnerabilities.

Finally, in order to draw conclusions on vulnerability, it should be noted that any identified vulnerabilities at the campus level and/or community level are circumscribed and potentially reduced by targeted policy and program interventions. Numerous policies and programs have been established in recent years in response to California’s widespread and complex and integrated hazardous materials risks - California established the Unified Program which consolidates and integrates the administrative requirements, permits, inspections, and enforcement activities of the following environmental and emergency response programs: the Aboveground Petroleum Storage Act (APSA) Program, Area Plans for Hazardous Materials Emergencies, the California Accidental Release Prevention (CalARP) Program, the Hazardous Materials Release Response Plans and Inventories (Business Plans), Hazardous Material Management Plan (HMMP) and Hazardous Material Inventory Statement (HMIS) requirements (California Fire Code), the Hazardous Waste Generator and Onsite Hazardous Waste Treatment (tiered permitting) Programs, and the Underground Storage Tank Program.

**Identified Data Limitations**

The CSU – Monterey Bay planning committee has provided information on campus-level hazmat materials and risks. Data limitations pertain to a comprehensive understanding of human activity and error related to materials control over the long term.
**Landslide**

Description of the Hazard

A landslide is a down-slope movement of soil, rock, or other debris, and can also be referred to as a mass movement or slope failure. These geological hazards can range in size from a few feet to over a mile in length and width and, when heavy and rapidly moving, can cause serious damage and loss of life.

Landslides are classified based on the type of material and type of movement involved. They can range from slow-moving earth flows to fast-moving debris flows, though many large slope failures involve more than one type of movement. The primary natural triggers of slope failures are water, seismic activity, and volcanic activity. Slope saturation by water can occur from intense rainfall, snowmelt, changes in ground-water levels, and surface-water level changes along coastlines. In winter months, El Nino storms or other high rainfall events may saturate soils and trigger slope failure.

Deep-Seated Landslides

Deep-seated landslides, ranging in depth from ten to several hundred feet, occur as a result of geologic and hydraulic changes, such as earthquakes or increased levels of groundwater. These landslides can move slowly or quickly and can cause extensive property damage, but rarely result in loss of life.

Debris Flows Related to Shallow Landslides

Shallow landslides may mobilize into rapidly moving debris flows and typically occur after sudden saturation of the ground. These types of debris flows are typically more dangerous because they move rapidly, causing both property damage and loss of life.

Debris flows may also occur as a result of post-fire conditions, where wildfires have left barren ground exposed to heavy rainfall. Intense rainfall, generally greater than .5 inch per hour, has the potential to trigger a post-fire debris flow. These landslides may impact lives and properties within its deposition zone, and can result in downstream flooding. These post-fire debris flows often occur during the fall and winter following major summer fires.

Location of the Hazard

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The susceptibility of an area to landslides depends on several variables, including magnitude of slope gradients, water content, ground cover, presence of erosion, and slope material and structure. However, landslides are most prevalent in terrain with weak material and steep slopes, and the highest risk is found in areas with high rainfall or high earthquake potential. Slope failures are also most likely to occur in areas where they have occurred in the past. In California, the most landslide-prone areas are found along the coast and in the northern Franciscan Formation.

General landslide vulnerability can be estimated from the distribution of weak rocks and steep slopes as seen in Figure 15-17. Based on the Figure below, the Monterey Bay campus is located within an area of moderate landslide susceptibility.
Extent of the Hazard

Monterey County is susceptible to slope instability in the Santa Lucia Mountain Range and fault zones. Landslides are more likely to occur in the steep slopes south of Monterey Bay and along the coastline. However, the indirect impacts of landslides in the region may cover a larger geographical extent. Based on the location of the campus inside a moderate the landslide risk area, and an extensive history of occurrences in the vicinity, the planning committee ranks the extent of the hazard as Moderate.

History of the Hazard

NOAA recorded 20 debris flow events in Monterey County from 2012 to 2019. Several of these happened inland from Monterey Bay campus, in Spreckels, Prunedale, and Carmel Valley. FEMA has declared 8 major disasters involving landslides, mudslides, or mud flows since 1978. Recently, landslides have occurred on Highway 1 between Carmel and Big Sur and have resulted in road closures. No history of occurrences are reported on the campus, though nearby transportation routes have been affected.

Potential Impacts of the Hazard

CSU Monterey Bay may be impacted by the disruption of services as a result of landslides in the region. Landslides can result in physical damage to buildings and property and have the potential to significantly effect infrastructure. As a landslide moves, it distresses structural foundations by settlement, cracking, and tilting. Fast-moving flows can remove entire structures in one instance, while other types of flows can cause damage gradually.

Transportation and utility infrastructure are particularly vulnerable to landslides, since the failure of any component can disrupt service over a large area. The loss of power and communication and disruption of transportation can have cascading effects throughout an area, including impaired disposal of sewage, contamination of water supplies, and the release of flammable fuels. Transportation routes are also often expensive to clean up, and prolonged obstruction can disrupt the movement of people and goods for long periods of time.

Probability of Future Occurrence of the Hazard

Slope failures are often triggered by other natural hazards such as heavy rainfall and earthquakes, so landslide frequency is often related to the frequency of these other hazards. As climate change impacts the frequency and intensity of triggers such as rain events, fires, and coastal erosion, landslides may generally occur more often. Historically, landslides have occurred frequently in Monterey County and therefore are highly likely to occur in the future. However, given the topography of the campus, the probability of a landslide directly impacting the campus is reduced. The planning committee ranks the probability of the landslide hazard directly impacting the campus as Unlikely. The probability of experiencing secondary effects of a landslide such as loss of power or transportation disruption is Possible on an annual basis.

Vulnerability to the Hazard

There are no known hazards directly on the CSU Monterey Bay campus or its immediate vicinity, making it relatively safe from direct landslide impacts. While landslides in Monterey County may impact University operations, there is low vulnerability to the hazard.

The vulnerability of the built environment to landslides depends on exposure and is more likely to incur damage as a result of proximity, rather than inferior structural design. The structures most vulnerable to landslides are buildings and
utility/transportation lifelines, which can be impacted by either impact or ground deformation. Utilities and transportation infrastructure are particularly vulnerable, due to their geographic extent and susceptibility to physical distress.

Any population proximal to a landslide when it occurs is vulnerable to its impacts. The vulnerabilities identified (above) exist to some degree on the campus. Campus leadership may decide to conduct a broader assessment in the future.

Estimate of Potential Losses

There are no current models for estimating potential losses from a landslide directly impacting the campus.

Although the economic impact of landslide damage can exceed that of the direct repair costs, there are currently no applicable methods for estimating indirect costs related to CSU Monterey Bay.

Vulnerability Assessment Conclusions

Community exposure to landslides varies depending on their physical locations – whether in flat plains or on steep hillsides – and on their dependence on critical infrastructure located in landslide hazard zones.

Landslides could impact the campus in a variety of ways, primarily related to indirect impacts to transportation and utilities. Utility outages can impact health, particularly for vulnerable populations, and can cause interruptions in operations. Interruptions may impact student and employee’s ability to travel to campus and the delivery of classes and events.

Identified Data Limitations

The ability to predict future landslides at the CSU Monterey Bay campus is limited. However, the USGS estimates that climate change-induced shifts in weather will increase the frequency of post-wildfire landslides, which are expected to occur almost every year in California.

**Power Outage**

Description of the Hazard

Monterey Bay, California is a bay along the Pacific Ocean along the California shores south of San Francisco and San Jose. The Bay spans from Santa Cruz in the north to Monterey Peninsula in the south. Monterey Bay is made up of multiple cities including Santa Cruz, Capitola, Aptos, Rio Del Mar, La Selva Beach, Moss Landing, Marina, Seaside, Sand City, Monterey, New Monterey, Pacific Grove, Carmel, and Carmel Highlands.

Most aspects of modern life, and almost all aspects of urban life, rely on the availability of reliable utilities, such as electricity, water, and natural gas. An
interruption in the supply or distribution of these commodities can leave highly populated areas like Monterey Bay without basic services, such as electricity or sanitation. These interruptions can be cascading effects from other hazard events, such as windstorms, floods, wildfires and earthquakes, or they can be caused by intentional disruptions of transmission lines.

A power outage event can interrupt day-to-day operations of the CSU Monterey Bay campus, like in-person classes, impede or limit digital, telephonic or radio communications, create traffic jams around the busy avenues and boulevards surrounding the campus, close the student health center, and close restaurants around campus and outside the campus. Additionally, thousands of CSU Monterey Bay student residents in on-campus housing would also be affected by a power outage on campus and in the area.

Additionally, a severe outage to the cities making up Monterey Bay would also directly affect the campus and the community.

Electric power disruptions and outages fall into two categories: intentional and unintentional.

The four types of intentional disruptions are:

- **Planned**: Some disruptions are intentional and can be scheduled based maintenance or upgrading needs.
- **Unscheduled**: Some intentional disruptions must be done "on the spot" in response to an emergency.
- **Demand-Side Management**: Some customers (i.e., on the demand side) have entered into an agreement with their utility provider to curtail their demand for electricity during periods of peak system loads.
- **Load Shedding**: When the power system is under extreme stress due to heavy demand and/or failure of critical components, it is sometimes necessary to intentionally interrupt the service to selected customers to prevent the entire system from collapsing. These intentional interruptions result in rolling blackouts.

**Unintentional** or unplanned disruptions are outages that come with essentially no advance notice or warning. This type of disruption is the most problematic. The following are categories of unplanned disruptions:

- Accident by the utility, utility contractor, or others.
- Malfunction or equipment failure.
- Equipment overload (utility company or customer).
- Reduced capability (equipment that cannot operate within its design criteria).
- Tree contact other than from storms.
- Vandalism or intentional damage.
- Weather, including lightning, wind, earthquake, flood, and broken tree limbs taking down power lines.
- Wildfire that damages transmission lines.

Location of the Hazard

Although power outages can take place within a certain area, as a hazard, it has the potential to occur and affect the entire planning area equally.

Extent of the Hazard

In order to anticipate outage conditions and reduce impacts, campus facility managers and others keep track of conditions and data provided by the media, municipal utilities and the California Independent System Operator (CAISO). CAISO is tasked with managing the power distribution grid that supplies most of California, except in areas served by municipal utilities and is thus the entity that coordinates statewide flow of electrical supply. CAISO uses a series of stage alerts to the media based on system conditions. The alerts are:

- Stage 1 - reserve margin falls below 7 percent.
- Stage 2 - reserve margin falls below 5 percent.
- Stage 3 - reserve margin falls below 1.5 percent.

Rotating blackouts become a possibility when Stage 3 is reached. Utility agencies aim to advise affected areas approximately 48 hours in advance of a potential PSPS event and will attempt notification again approximately 24 hours before power is shut off. Campus staff respond accordingly.

Given the prevalence of rolling blackouts and other power outages in California, the campus maintains safety precautions, situational awareness, access to emergency power generators and other protocols for managing campus power outages. Given that recorded outages have taken place on campus, the planning committee ranks the extent of the power outage hazard as Moderate.

History of the Hazard

CSU Monterey Bay has experienced power outages will experience them in the future. In the past, power outages have affected the campus by equipment malfunctions and experienced damage due to the infrastructure from storms and vehicular accidents. Power outages impacting the campus have been blackouts that lasted minutes to those spanning anywhere from several hours to days.

Potential Impacts of the Hazard
Instructors, campus residents, staff and administrators rely on electricity for basic survival and operations. During a widespread power failure, it may take days to restore operations. Electrical power may be the only cooling source for many individuals around the campus and its community, and long-term outages can potentially put people’s health and life at risk. Disruptions in the supply of heating fuel may put people and property at risk during extremely cold weather if it relies on electric generation or heating mechanisms instead of gas. Additionally, many medical devices, communications devices, and security rely on power to maintain their functions.

**Climate Change and Energy Shortage**

Climate change is expected to bring more frequent and intense natural disasters. Over the years, what was once a disaster uncharacteristic to landscape is now occurring outside of historical areas. These changes have created a variability at a rate that makes historical data a poor predictor of future climate. For example, the warmest years on record in California occurred in 2014, 2015, and 2016. The 2016-2017 year broke the record as the wettest ever recorded in the northern Sierra Nevada Mountains.

Changes in temperatures, precipitation patterns, extreme events, and sea-level rise have the potential to decrease the efficiency of thermal power plants and substations, decrease the capacity of transmission lines, render hydropower less reliable, spur an increase in electricity demand, and put energy infrastructure at risk of flooding.

With climate warming, higher costs from increased demand for cooling in the summer are expected to outweigh the decreases in heating costs in the cooler seasons. Hotter temperatures in California will mean more energy (typically measured in “cooling-degree days”) needed to cool homes and businesses both during heat waves and on a daily basis, during the daytime peak of the diurnal temperature cycle. During future heat waves, historically cooler coastal cities (e.g., San Francisco and Los Angeles) are projected to experience greater relative increases in temperature, such that areas that never before relied on air conditioning will experience new cooling demands.

Secondary impacts of energy shortages are most often felt by vulnerable populations. For example, those who rely on electric power for life-saving medical equipment, such as respirators, are extremely vulnerable to power outages. Also, during periods of extreme heat emergencies, the elderly and the very young are more vulnerable to the loss of cooling systems requiring power sources.

**Probability of Future Occurrence of the Hazard**

The probability of California experiencing a power outage can be difficult to quantify but is a hazard that occurs annually during the same seasonal periods of temperature variance throughout the calendar year. Monterey Bay communities experience such outages. As such, the probability ranking for the Monterey Bay area is **Likely**.
the CSU Monterey Bay campus has also recorded power outage events, it is prudent to assign this same ranking for the campus.

Climate models suggest summer global temperatures are likely to increase while changes between temperature extremes would be more pronounced. As such, it is expected that power outages will occur more frequently in the future.

**Vulnerability to the Hazard**

Based on the data available, and in consideration of the increasing effects of climate change, the campus remains vulnerable to power outages in terms of impacts to people, power infrastructure and campus operations. Nonetheless, as discussed campus leadership works to reduce vulnerabilities through consistent use of safety and operational protocols and emergency power sources to ensure it is able to mitigate an interruption to electrical power.

**Estimate of Potential Losses**

The data provided by CSU Monterey Bay State does not report any value for potential losses due to power outage.

**Vulnerability Assessment Conclusions**

CSU Monterey Bay considers power outages a significant and unavoidable hazard. Power outages that are long-lasting. These outages can and will affect academic and business enterprises, residential life, and university operations.

Elevators, entry ways, air filtration systems and lighting provide the campus community with the necessary infrastructure and systems to function and navigate through the campus and to maintain a safe campus environment and visibility during nighttime hours. During a power outage, vulnerable populations, especially students with physical disabilities, may be the most heavily affected by loss of power as they rely on elevators, entry ways with automatic doors and locks and lights may impede on a disabled student’s ability to travel and utilize the campus and its structures safely.

The use of communication devices, billing, records, and electrical tools may also become unusable due to a loss of electricity. Many records and billing items may have to revert to “by-hand” procedures and paper copies may be needed for continuity of operations. Additionally, classrooms may not be usable if lighting equipment is not functioning impacting a semester or quarter’s progress for the academic year.

CSU Monterey Bay should consider continuing to working with power utility providers, response community and systemwide partners, and stakeholders in planning and mitigating the effects of power outages on the campus and to its community.

**Identified Data Limitations**
CSU Monterey Bay did not report any monetary or life losses due to a power outage.

**Volcano (Associated Air Quality)**

Description of the Hazard

The US Geological Service defines volcanoes as “openings or vents where lava, tephra (small rocks), and steam erupt on to the Earth’s surface. Through a series of cracks within and beneath the volcano, the vent connects to one or more linked storage areas of molten or partially molten rock (magma). This connection to fresh magma allows the volcano to erupt over and over again in the same location.”

A volcanic eruption occurs when magma, lighter than surrounding rock, is driven upwards by its buoyancy and by pressure from the dissolved gases contained within it. Gases are released from magma as it reaches the surface and pressure decreases. Magma can be erupted in several ways and violent eruptions typically cause tiny pieces of tephra (ash) to be carried away by the wind. This ash is hard, does not dissolve in water, is extremely abrasive and mildly corrosive, and conducts electricity when wet.

The gases released in an eruption include carbon dioxide, sulfur dioxide, hydrogen sulfide, and hydrogen halides. Depending on their concentration, these are potentially hazardous to people, animals, agriculture, and property.

Location of the Hazard

There are eight volcanic areas located throughout California. Seven of these - Medicine Lake Volcano, Mount Shasta, Lassen Volcanic Center, Clear Lake Volcanic Field, Long Valley Volcanic Region, Coso Volcanic Field, and Salton Buttes – are considered active volcanoes. No portion of CSU Monterey Bay or Monterey County is within a volcano hazard zone.

Extent of the Hazard

Volcanic hazards are most severe within a few miles of the volcano vent and the severity generally decreases with distance. Ash impact zones can range from tens to hundreds of miles from the vent source. The US Geological Survey has estimated zones surrounding active volcanoes wherein 2 inches or more of ashfall following an eruption is possible. While CSU Monterey Bay does not fall within an estimated ashfall zone, lighter dustings of ash outside of those areas may directly or indirectly...

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impact the campus. As such, the planning committee ranks the extent of the hazard for the campus as **Low**.

**History of the Hazard**

No historical eruption events in California have affected the campus. Over the last 1,000 years, there have been at least 12 eruptions in California.\(^{11}\) The most recent volcanic eruption in California occurred at Lassen Peak about 100 years ago, when a major explosion delivered windborne ash over 275 miles away.\(^{12}\)

**Potential Impacts of the Hazard**

The specific impacts vary widely and depend on which type of volcano erupts, the style of explosion, the volume of lava, the eruption duration, and the local water conditions. As CSU Monterey Bay is not proximal to an active volcano, only the potential impacts of ashfall and gases have been detailed. While both these hazards can be widespread, their most severe impacts are generally seen closer to the volcanic source.

Although ashfall is typically a nonlethal volcanic hazard, it is the most widespread and disruptive. Falling ash can damage crops, electronics, and machinery. It can also impact human health by irritating the respiratory tract, eyes, and skin. The particles may enter drinking water and structures and may cause structure failure if it is thick and heavy enough. Even a fine layer of ash can disrupt utilities. A portion of California’s major electric transmission lines, aerial telecommunication lifelines, transportation corridors, and water storage and conveyance lie within the state’s volcano hazard zones. Impacts to any of these can impact operations at CSU Monterey Bay.

The potential impacts of gases released during volcanic eruptions are as follows:

- Carbon dioxide typically becomes diluted very quickly and is not life threatening. However, it can become trapped in higher concentrations in low-lying areas and has the potential to be fatal.
- Sulfur dioxide can cause acid rain and air pollution downwind of a volcano.
- Hydrogen sulfide can cause irritation of the upper respiratory tract. At high concentrations it can cause unconsciousness and death.
- Hydrogen halides can coat ash particles and, once deposited, poison drinking water, agricultural crops, and grazing land.

**Probability of Future Occurrence of the Hazard**

The US Geological Survey, based on the record of volcanic activity in California, estimates that the probability of another small- to moderate-sized eruption in the next thirty years is about 16 percent. As such, the annual probability of future occurrence for the campus is ranked by the committee as **Unlikely**.
Vulnerability to the Hazard

Populations living near volcanoes are the most vulnerable to eruptions and lava flows. However, volcanic ash can travel and affect populations miles away. The location and thickness of ash in any given area is a function of the severity of the eruption and wind speed and direction. For CSU Monterey Bay, there is low vulnerability to the immediate impacts of volcanic eruptions due to the limited area affected and remote potential of an eruption. In the event of a widespread ashfall event, the elderly, infants, and populations with existing respiratory disease will be at higher risk.

Estimate of Potential Losses

Impacts to critical infrastructure, agriculture, and property from ashfall have the potential to cause widespread disruption, damage, and economic loss throughout the state. In the event of a widespread ashfall event, impacts will be immediate.

Current modeling is not precise enough to allow for an assessment of potential losses from ashfall to structures or infrastructure on or surrounding the campus.

Vulnerability Assessment Conclusions

CSU Monterey Bay is unlikely to experience the direct impacts of a volcanic event. While the campus may be indirectly impacted by ashfall elsewhere in the state, direct ashfall impacts are generally unlikely but possible in a widespread event. However, the likelihood of any volcanic eruption in the state impacting the campus is very low.

Identified Data Limitations

Not all active volcanoes in California have been zoned for hazards by the US Geological Survey. This, together with the infrequent occurrence of volcanic explosions and number of factors determining type and extent of impacts, make the quantification of potential loss difficult.
Wildfire

Description of the Hazard

While wildfires are a natural part of California’s ecosystem, wildfires in California represent a hazard that presents one of the greatest probabilities of destruction along with a demonstrated history of catastrophic fire events in recent years. The destructive fire seasons of 2017 to 2020 illustrated the destructive forces fire presents to communities across the state. Wildfires may result in the structural loss, infrastructure loss, dangerous air quality, environmental damages, economic impacts, injuries, and loss of life. In many communities throughout California, wildfire presents greatest risk to human life and property.

Wildfires have been defined as any free burning vegetation fire that initiates from an unplanned ignition, whether natural or human caused demanding fire suppression actions to contain.\textsuperscript{88} These fires are prone to become uncontrolled, spreading through vegetative fuels rapidly exposing people and structures to harm. Wildfires present a significant risk to communities across the state, as evidenced by increasing trends of structural losses from wildland fires. This risk is elevated in areas where development and community growth has intersected, also known as the wildland-urban interface (WUI). In the interface setting, development itself can provide additional fuel for large fires. Recent fires have also demonstrated the ability of fire to consume populated areas in extreme conditions.

California’s Mediterranean climate in combination with its geography and vast population create a combination of factors that promotes an optimal environment for large fire growth and consequences. As there is great diversity of geographic characteristics across the state, the risks and potential consequences of wildfire must be assessed locally. The physical location, weather patterns, local fuel types and volume, extent of the WUI, topography, and additional factors will factor differently from part of the state to another.

The behavior of wildfires in California is significantly influenced by three distinct geographic factors. These factors will help shape the size, direction of spread, rate of combustion, fire intensity, and ability to pre-heat fuels. The physical factors contributing to wildfire behavior include:

- Topography – The rate in which wildfires spread increases with greater slopes in topography. The greater the slope will result in more pre-heating of fuel above the advancing fire. The direction that a slope faces will also influence fire behavior as south facing slopes receive greater solar radiation and thus drier vegetation that is more susceptible to combustion. Ridgetops often denote the end of fire spread as fire has greater difficulty spreading downhill.

\textsuperscript{88} State of California Hazard Mitigation Plan, September 2018
- **Weather** – Weather factors substantially influence the behavior of wildfires. Wind, temperature, humidity, lightning, and lack of precipitation all contribute to a fire’s ability or inability to spread and intensify. California routinely experiences conditions in which these factors are aligned to contribute to extreme fire behavior during the summer and fall seasons. High winds, low humidity, and high temperatures provide an environment promoting extreme fire activity.

- **Fuels** – Certain types of vegetation are increasingly prone to igniting and promoting more intense burning. Areas with greater “fuel loading” (amount of fuel present in terms of weight of fuel per unit of area) increases the amount of fuel to fuel a fire. Greater volumes of dead or dry vegetation compared to live plants is a critical factor. Vegetation during drought conditions will experience a decrease in moisture content increasing the conditions for combustion. Fuels close proximity to one another allows for rapid spread through contact or radiant exposures.

A risk assessment for wildfires should be implemented within a geospatial context focusing on the specific location features and incorporates the three components of the wildfire risk triangle – likelihood, intensity, and susceptibility.

**Location of the Hazard**

Substantial portions of the State of California are exceptionally vulnerable to wildfire activity or reside in a wildland-urban interface (WUI) area due to the vast open spaces, rangelands, forests and other lands with high susceptibility to fire occurring throughout the state. CSU Monterey Bay and the City of Seaside are located in northern Monterey County. This region is coastal with significant open fields and hillsides with moderate vegetation proving direct exposures to wildland fire. CSU Monterey Bay is a former Army installation surrounded by open fields containing brush and trees on the east and north sides of the campus and residential neighborhoods to the south. State Route 1 separates the campus from the ocean on the west side of campus.

The CSU Monterey Bay campus is located in the northern side of Seaside bordering the City of Marina. The campus is immediately adjacent to areas of dense trees along 8th Avenue. Gigling Road, Inter-Garrison Road, and 8th Street with other moderate vegetative fuels. The campus has an additional exposure in an open area south of the library and west of the University Center. The typical weather patterns provide an increased humidity to the area of the campus mitigating fire spread potential however, when winds shift offshore conditions can promote fire growth in this area.

The CSU Monterey Bay campus is further surrounded by mountains and extensive areas of fire hazards. Surrounding the Salinas Valley are large mountain ranges including the Coastal Range Mountains, Santa Lucia Range, Santa Cruz Mountains, and the southern end of the Diablo Range. These mountain ranges host state and
national forests with extensive history of large fire development. The fires that burn in these areas have the potential to develop vast quantities of smoke that can fill the valley in the right wind conditions. The geography of the Salinas Valleys creates a topography that can capture air pollutants including smoke within surrounding mountains and the development of inversion layers. The CSU Monterey Bay campus is located in a region in which wildfire smoke can saturate the air around the campus.

Figure 15-17: Fire Hazard Severity Zones near CSU Monterey Bay

Extant of the Hazard

The area immediately surrounding the CSU Monterey Bay campus is not in proximity to high fire hazard zones. However, CSU Monterey Bay has experienced multiple days of poor air quality due to fires burning in southern California mountains. Given that

the threat to fire directly spreading onto the campus is minimal, the planning committee ranks the extent of the hazard as **Low**.

The National Fire Danger Rating System (NFDRS) is the current system in use for rating and classifying the potential danger of fire. The NFDRS tracks the effects of previous weather events on both dead and live fuel loads and adjusts accordingly based on future or predicted weather conditions. These complex relationships and equations are computed, and the outputs are expressed in terms that users can quickly and easily understand. The current NFDRS is used by all federal and most state agencies to assess fire danger conditions.

The following table depicts the NFDRS, from the US Forest Service’s Wildland Fire Assessment System.

Table 15-24: National Fire Danger Rating System

<table>
<thead>
<tr>
<th>Rating</th>
<th>Basic Description</th>
<th>Detailed Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>CLASS 1: Low Danger (L)</td>
<td>Fires not easily started</td>
<td>Fuels do not ignite readily from small firebrands. Fires in open or cured grassland may burn freely a few hours after rain, but wood fires spread slowly by creeping or smoldering and burn in irregular fingers. There is little danger of spotting.</td>
</tr>
<tr>
<td>COLOR CODE: Green</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CLASS 2: Moderate Danger (M)</td>
<td>Fires start easily and spread at a moderate rate</td>
<td>Fires can start from most accidental causes. Fires in open cured grassland will burn briskly and spread rapidly on windy days. Woods fires spread slowly to moderately fast. The average fire is of moderate intensity, although heavy concentrations of fuel -- especially draped fuel -- may burn hot. Short-distance spotting may occur but is not persistent. Fires are not likely to become serious and control is relatively easy.</td>
</tr>
<tr>
<td>COLOR CODE: Blue</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CLASS 3: High Danger (H)</td>
<td>Fires start easily and spread at a rapid rate</td>
<td>All fine dead fuels ignite readily, and fires start easily from most causes. Unattended brush and campfires are likely to escape. Fires spread rapidly and short-distance spotting is common. High intensity burning may develop on slopes or in concentrations of fine fuel. Fires may become serious and their control difficult, unless they are hit hard and fast while small.</td>
</tr>
<tr>
<td>COLOR CODE: Yellow</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

---

<table>
<thead>
<tr>
<th>CLASS 4: Very High Danger (VH)</th>
<th>Fires start very easily and spread at a very fast rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>COLOR CODE: Orange</td>
<td>Fires start easily from all causes and immediately after ignition, spread rapidly and increase quickly in intensity. Spot fires are a constant danger. Fires burning in light fuels may quickly develop high-intensity characteristics - such as long-distance spotting - and fire whirlwinds when they burn into heavier fuels. Direct attack at the head of such fires is rarely possible after they have been burning more than a few minutes.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>CLASS 5: Extreme (E)</th>
<th>Fire situation is explosive and can result in extensive property damage</th>
</tr>
</thead>
<tbody>
<tr>
<td>COLOR CODE: Red</td>
<td>Fires under extreme conditions start quickly, spread furiously, and burn intensely. All fires are potentially serious. Development into high intensity burning will usually be faster and occur from smaller fires than in the Very High Danger class (4). Direct attack is rarely possible and may be dangerous, except immediately after ignition. Fires that develop headway in heavy slash or in conifer stands may be unmanageable while the extreme burning condition lasts. Under these conditions, the only effective and safe control action is on the flanks, until the weather changes or the fuel supply lessens.</td>
</tr>
</tbody>
</table>

Due to the impacts of wildfires on public health, agencies across the nation have adopted the use of the Air Quality Index (AQI) to communicate and provide a consistent approach to air quality measurements and categorization. The AQI primarily focuses on the health effects caused by pollutants in the air such as smoke. The goal of the AQI is to provide advisories to assist the public in determining when to reduce exposures to inhalation of air pollution as pollution levels rise.
History of the Hazard

The State of California has a long history of chronic and destructive wildfires throughout the state. On average, 8,300 wildfires have caused burnt 928,245 acres across the state over the 20-year period between 2000 and 2020. Monterey County also has a long history of wildfire activity. The majority of the historic large fires have occurred in the mountains and foothills surrounding the Salinas Valley. Wildfires occurring in Monterey County have resulted in hundreds of thousands of acres burned and millions of dollars in damages. The campus has a history of wildfire activity occurring within proximity to the campus including the 2020 River Fire.

In addition to the direct exposure to fire, the County is surrounded by areas that are considered to be of high fire threat that would produce vast quantities of smoke and particulates into the air. The CSU Monterey Bay campus has experienced multiple days of poor air quality due to fires burning in southern California mountains. The 2017, 2018, and 2020 fire seasons in particular illustrated the increase in wildfire generated smoke saturating the air of communities throughout the state including Monterey County. CSU Monterey Bay personnel reported the ongoing development of policies and procedures to address the response to poor air quality days.

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92 California Department of Forestry and Fire Protection, Stats and Events, https://www.fire.ca.gov/stats-events/
Table 15-25: Historic Large-Scale Fires in Monterey County

<table>
<thead>
<tr>
<th>Date</th>
<th>Fire</th>
<th>Location</th>
<th>Declaration</th>
<th>Damages</th>
</tr>
</thead>
<tbody>
<tr>
<td>7/22/2016</td>
<td>Soberanes</td>
<td>Coastal Mountains</td>
<td>FM-5137</td>
<td>132,127 acres</td>
</tr>
<tr>
<td>7/9/2012</td>
<td>Turkey</td>
<td>SE Corner of County</td>
<td>NA</td>
<td>2,529 acres</td>
</tr>
<tr>
<td>8/27/2009</td>
<td>Bryson</td>
<td>Soledad</td>
<td>NA</td>
<td>3,383 acres</td>
</tr>
<tr>
<td>8/26/2009</td>
<td>Gloria</td>
<td>Soledad</td>
<td>NA</td>
<td>6,437 acres</td>
</tr>
<tr>
<td>9/25/2008</td>
<td>Chalk</td>
<td>Nacimiento</td>
<td>NA</td>
<td>16,269 acres</td>
</tr>
<tr>
<td>6/21/2008</td>
<td>Basin Complex</td>
<td>Big Sur</td>
<td>FM-2781; EM-3287</td>
<td>162,818 acres</td>
</tr>
<tr>
<td>6/8/2008</td>
<td>Indians</td>
<td>Ventana Wilderness</td>
<td>NA</td>
<td>81,378 acres</td>
</tr>
<tr>
<td>7/22/2006</td>
<td>Ricco</td>
<td>NA</td>
<td>14,506 acres</td>
<td></td>
</tr>
</tbody>
</table>

Potential Impacts of the Hazard

The location of the CSU Monterey Bay campus along the Pacific Coast is removed from areas with a designated fire hazard, indicating a minimal direct threat of wildfire to the campus. However, as the campus is located adjacent to areas with dense vegetative growth, the potential for wildfires does exist within certain weather conditions. Greater potential impacts from wildfire exist for members of the campus community who reside or work in proximity to fire hazard zones.

Potential impacts to the campus community resulting from wildfires include:

- Injuries or loss of life
- Campus property destruction or damage
- Residential property destruction or damage
- Commercial property destruction or damage
- Loss of property contents
- Infrastructure damage
- Damaged or destroyed lifelines/supply routes
- Damaged or destroyed utilities

93 Monterey County Multi-Jurisdictional Hazard Mitigation Plan, June 2015
• Damaged or destroyed critical facilities supporting campus emergency support needs
• Loss of community economic base
• Employment losses
• Loss to ground supporting vegetation on hillsides resulting in erosion or landslides in future precipitation events
• Agricultural (crops and livestock) damages or destruction
• Environmental damage
• Societal and community impacts
• Damage to organizations and facilities providing support services to vulnerable populations
• Greater evacuation challenges for those most vulnerable
• Psychological impacts of impacted populations
• Disruptions to education delivery to community

Potential impacts resulting from wildfire generated smoke include:
• Dangerous levels of air pollution
• Human Health Effects
  • Similar health impacts to pets

• Air conditioning systems overwhelmed
• Greater demands on air filtration systems
• Greater demands on healthcare systems
• Reduced outdoor work productivity
• Closures of academic sessions

Additionally, there remains a number of secondary impacts from wildfires that could affect the campus community. Residential communities along the Wildland Urban Interface may experience extensive damage or destruction in areas the campus community members call home. Utilities feeding areas of Monterey County including the campus may be damaged resulting in power outages. Fire related damage in the watersheds will likely cause future landslides, degradation to plants supporting hillsides, and impact the hydroelectric power capabilities. Fires may present threats to areas of recreation, scenic value, and wildlife that are a part of the culture of the campus community. In addition, these locations may be the sites of academic study altering research or generating costs.
Probability of Future Occurrence of the Hazard

Based on the wildfire threat potential in the area surrounding the CSU Monterey Bay campus and large areas of heavy vegetative growth along the south and east sides of the campus, including the immediate proximity to Fire Hazard Severity Zones listed as “Moderate”, the density of residential and commercial development, and the historic occurrences of fires, the probability of wildfire related damage is considered Possible.

Based on the wildfire threat potential in the area surrounding Central California including the hills and mountains throughout the region, the volume of areas in elevated Fire Hazard Severity Zones throughout the southern portions of the state, and the historic occurrences of smoke, the probability of wildfire generated smoke impacts to air quality is considered Possible.

Vulnerability to the Hazard

The CSU Monterey Bay campus is subject to the direct impact from wildfire due to the campus location adjacent to areas of dense vegetation. However, the typical weather conditions do not promote significant fire growth. The campus is not identified to reside near a designated local High Fire Hazard Severity Zone. The campus is surrounded on three sides by hillside and open lands containing combustible vegetation combined with residential development. Additionally, vulnerabilities to the effects of wildfire would lie within the campus community who may reside or work in locations that are exposed to the Fire Hazard Severity Zones in other parts of the surrounding region. Wildfires occurring in other areas of the region may result in the displacement of large numbers of people. These effects may spill onto the campus in the form of evacuees or facility support to emergency resources.

Fire directly threatening the campus would likely take the form of vegetation fires along the hillside and extending onto the campus or localized fires involving single structures or small areas. Smaller vegetation fires are possible surrounding the campus or in open areas on the campus. These incidents could have significant impact to the campus.

The primary basis of vulnerability is based on the population affected and the built environment exposed. In general, newer construction will be more fire resistant than older buildings as building and fire codes and construction technology have improved. Density of buildings and proximity of fuels to buildings or equipment at risk of combustion would additionally influence the fire’s ability to spread to structures. Structures with vegetation and other combustibles near the structure increases the ability of fire to spread to buildings. The construction type of buildings on the Monterey Bay campus and the density of the buildings do not promote the ease of fire spread.

Access to the east using Inter-Garrison Road or Reservation Road servicing access to Salinas could become cutoff during fire incidents. Access should remain open using State Route 1 to Monterey or Santa Cruz. However, it is possible for the university to
be limited by these routes for access to and from the campus. Access for supplies, equipment, and emergency services in addition to evacuation away from the campus could be forced to use alternative routes into Seaside.

Some areas of particular vulnerability on the campus includes:

- Fire fuels reduction projects will need to be maintained to adequately protect the campus.
- Many buildings do not have HVAC causing limitations in filtering of air during smoke filled days
- Many buildings use open windows to circulate and cool indoor environments
- Large open areas between campus buildings contain dense vegetation providing opportunities for fire growth in the middle of campus
- The campus childcare center is located removed from the main campus potentially isolated during wildfire events.

The greater concerns regarding vulnerabilities to wildfire are related to the smoke that fires in the area would produce. The past few summers have clearly demonstrated the reality of large wildfires producing enough smoke to fill northern and central California even from substantial distances away. These recent fires have displayed how the effects of this smoke impact the general population and especially vulnerable populations. CSU Monterey Bay students, faculty, and staff both on campus and off campus face these same vulnerabilities related to smoke filled air.

Smoke generated from large wildfires pose a threat in terms of diminished air quality that would be exposed to the population within the area of smoke distribution. Individuals with existing health problems such as respiratory or cardiac illnesses are increasingly vulnerable to wildfire generated smoke. Staff who work in roles requiring outdoor activity will be increasingly exposed during days where the air quality index is considered unhealthy or worse. Student athletes participating in outdoor sports and engaging in aerobic activities are increasingly vulnerable to the effects of wildfire.

The vulnerability to members of the campus community in which wildfire generated smoke on the CSU Monterey Bay campus will vary depending on when the air quality was to reach unhealthy levels. The risk to the campus population will be lessened during periods when classes are not in session or during periods of breaks. Conversely, during the days and hours that classes are in session and staff are at their workplaces, the human vulnerability increases. However, in region-wide events this vulnerability may be shared with the homes and workplaces of members of the campus community and their families.

Certain campus populations will experience greater challenges to a post-flood / failure environment. Vulnerable populations will likely face disproportionate health safety issues from smoke filled air, experience increased stresses, may require the need to
remain away from the campus enclosed at home, and may find difficulty in accessing equipment or supplies to aid in a specific need.

**Estimate of Potential Losses**

Estimates of potential losses will be influenced by a variety of factors. The risk to wildfire directly impacting the campus is minimal. Costs would be likely be limited to mitigation or repairs of HVAC systems, sealing of doors and windows, and other methods of keeping smoke from entering buildings. Secondary costs would include lost academic days during campus closures, lost staff on campus productivity, and health and medical interventions for affected members of the campus community.

Based on estimate replacement costs of facilities and structures on campus, the maximum total replacement costs due to wildfire are $401,286,223. Due to the lack of a complete inventory of building and facility costs, the total replacement estimate is likely much higher. However due to the campus being located in an urban environment, it is unlikely for fire to cause destructive losses.

Table 15-26: Wildfire Hazard Potential (WHP) Zone Estimated Losses

<table>
<thead>
<tr>
<th>WHP Zone</th>
<th>No of Buildings</th>
<th>Maximum Replacement Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Extreme</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Very High</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>High</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Moderate</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Low</td>
<td>1</td>
<td>Unknown</td>
</tr>
<tr>
<td>Non-Burnable</td>
<td>89</td>
<td>$401,286,223</td>
</tr>
<tr>
<td>No Building Value Data Provided*</td>
<td>32</td>
<td>Unknown</td>
</tr>
</tbody>
</table>

*Buildings with no value defined are also included in the respective Zones they are found in.

The CSU Monterey Bay at Ryan Ranch in Monterey, CA is included in the non-Burnable category but did not have cost estimates available.

**Vulnerability Assessment Conclusions**

The occurrence of wildfires has been a frequent event in Monterey County, including wildfire incidents that have threatened or caused damages near the CSU Monterey Bay campus. The location of the CSU Monterey Bay campus in proximity to open hillsides with light to moderate vegetative fuels along the entire eastern edges presents a threat of fire to the campus community and campus assets. Typical weather conditions in Monterey would mitigate this threat however when warm dry
air covers the area there is a potential fire development. The consequences of fires in these areas would present primary and secondary consequences to the CSU Monterey Bay campus and expose vulnerabilities on the campus and to the campus community.

The topography of the valley surrounded by mountains allows for smoke filled air to linger in the valleys of Monterey County area with the potential for unhealthy air quality depending on wind conditions. The standard weather patterns would mitigate this threat however, in offshore wind conditions smoke may be introduced onto the campus from distant locations. Fires in the watersheds of the Monterey County mountains and tributaries may damage vegetation stabilizing hillsides and result in increased sediments to be discharged into the river system and reservoirs reducing their capacity and effectiveness.

Communities located within or near the Wildland Urban Interface may be subject to damaging fires. These same communities may be home to members of the campus community. The potential for large-scale wildfires in the region further generates the added potential for a number of cascading effects such as disruptions to the local economy, utility failures, disruptions to providing for the needs of the community, and development of public health hazards. The potential for large-scale wildfires and resulting damage of homes and businesses has exponentially powerful impacts on particular populations among the campus community including those with access or functional needs, international students, the homeless, and students residing in the residence halls.

Identified Data Limitations

Data limitations include missing campus structural replacement costs, and lack of both a complete inventory of building construction types and mitigation efforts to lessen the impact due to fire activity. HAZUS generated analysis is focused on the broader community level versus fine-tuning the analysis to the micro-level for facilities such as a university campus.

Severe Weather (Wind, Tornado, Hail, Lightning)

Description of the Hazard

Severe weather can be described as a variety of weather or climate events that are beyond or near the ends of the range of observed weather patterns and behavior. These events can include high or extreme winds, storms, lightning, hail, tornadoes, heat waves, unusually cold temperatures, extreme rainfall, and flooding. According to the Intergovernmental Panel on Climate Change (IPCC), to be classified as severe (or

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extreme), the occurrence of each value of a climate or weather variable (e.g., wind, hail, lightning, tornado, etc.) must be “above (or below) a threshold value near the upper (or lower) ends of the range of observed values of the variable.”

Severe weather in California can be generated by local, regional, and/or global weather and climate influences. From the individual thunderstorm to the Santa Ana wind event to the strong El Niño, damaging weather elements that are produced by and accompany severe weather and climate phenomena (e.g., damaging winds, hail, lightning, and tornadoes) occur throughout California and the California State University (CSU) system.

**Global Scale Influences on Severe Weather in California: El Niño, La Niña, and ENSO**

The El Niño-Southern Oscillation (ENSO) is a recurring climate pattern involving changes in the temperature of waters in the central and eastern tropical Pacific Ocean. On periods ranging from about three (3) to seven (7) years, the surface waters across a large swath of the tropical Pacific Ocean warm or cool by anywhere from 1°C to 3°C, compared to normal. This oscillating warming and cooling pattern, referred to as the ENSO cycle, directly affects rainfall distribution in the tropics and can have a strong influence on weather across the United States and other parts of the world.

El Niño and La Niña are extreme phases of the ENSO cycle, with a third phase occurring between them called the Neutral phase. The El Niño phase is characterized by unusually warm ocean temperatures and weaker-than-normal east winds in the Equatorial Pacific, while the La Niña phase is characterized by unusually cold ocean temperatures and stronger-than-normal east winds in the Equatorial Pacific. Both extreme ENSO phases lead to significant differences from the average ocean temperatures, winds, surface pressure, and rainfall across parts of the tropical Pacific. The Neutral phase indicates that conditions are near their long-term average.

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96 Retrieved on 07.18.2021 from https://www.weather.gov/mhx/ensowhat


The extreme ENSO phases affect the frequency and intensity of weather events across the world, including in California. On average, areas across California experience exceptionally stormy winters with increased precipitation under El Niño conditions, but experience less stormy and drier winters under La Niña conditions. This variability in storminess and precipitation brought on by El Niño and La Niña events affects the both the frequency and intensity of severe weather conditions experienced by all CSU campuses, including CSU Monterey Bay.

**Regional Climate Influences on Severe Weather across California**

Most of the weather in California is influenced by the wet-winter/ dry-summer Mediterranean climate pattern. In the summer months, Pacific storm tracks are deflected north due to the position of the Pacific High (i.e., a large-scale atmospheric circulation over the Northeast Pacific Ocean), preventing Pacific storms from reaching California. As a result, most summer storms are generated due to the incursion of moist air from the Gulf of Mexico or the Gulf of California, and occur as scattered, locally heavy showers in the desert and mountain regions of the state. In the winter months, the Pacific High decreases in intensity and moves south, permitting powerful Pacific storms to move into and across the state; these storms can produce extreme winds, heavy rains (including “atmospheric river” events), and widespread coastal and inland flooding. (Please see the Flood Hazard profile in this document for information on Floods.) As a result, storm events accompanied by precipitation in California are far more frequent in the winter months than they are in the summer months.

While the Mediterranean climate pattern influences the seasonal frequency, intensity, geographic spread, and type of some severe weather events CSU campuses experience (including CSU Monterey Bay), other severe weather phenomena may occur in California at any time of the year. For example, near the coast and over the Central Valley, there appears to be no defined seasonality to thunderstorms, and these storms are usually light and infrequent. Thunderstorms are more intense and more frequent in the intermediate and higher elevations of the Sierra Nevada, and occur with greater frequency during the summer months.

**Types of Storms in California**

The 2018 California State Hazard Mitigation Plan (SHMP) defines a storm as a violent atmospheric disturbance occurring over land and/or water that is distinguished by its

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101 Retrieved on 07.17.2021 from https://wrcc.dri.edu/Climate/narrative_ca.php

102 Retrieved on 07.17.2021 from https://wrcc.dri.edu/Climate/narrative_ca.php
strength, characteristics, and the scale of the resulting damage. The SHMP also lists the following types of storms that produce hazardous conditions and potential damage throughout the state of California. These storms affect (in varying degrees) all CSU campuses, including CSU Monterey Bay.

- **Thunderstorm**: A rain-bearing cloud that also produces lightning. Thunderstorms can produce some of nature’s most destructive and deadly weather including tornadoes, hail, strong winds, lightning and flooding. Thunderstorms are caused by an atmospheric imbalance from warm unstable air rising rapidly into the atmosphere. Lightning, which occurs during all thunderstorms, can strike anywhere. Thunderstorms can produce some of nature’s most destructive and deadly weather including tornadoes, hail, strong winds, lightning and flooding. **Severe thunderstorms** are more intense, violent, and dangerous thunderstorms. The National Oceanic and Atmospheric Administration (NOAA) defines a severe thunderstorm as any storm that produces one or more of the following elements: Damaging winds or speeds of 58 mph (50 knots) or greater, hail 1 inch in diameter or larger, and/or a tornado.

- **Hailstorm**: a type of storm that precipitates round chunks of ice. Hailstorms usually occur during regular thunderstorms.

- **Wind storm**: marked by high wind with little or no precipitation.

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- **Winter storm**: A storm that can produce a combination of freezing rain, sleet, heavy snow, and/or strong winds.¹¹²

- **Coastal storm**: Large wind-driven waves and/or storm surge that strike the coastal zone.¹¹³

- **Ice storm**: Ice storms are one of the most dangerous forms of winter storms. When surface temperatures are below freezing, but a thick layer of above-freezing air remains aloft, rain can fall into the freezing layer and freeze upon impact into a glaze of ice. In general, 8 millimeters (0.31 inch) of accumulation is all that is required, especially in combination with breezy conditions, to start downing power lines as well as tree limbs. Ice storms also make unheated road surfaces too slick to drive on. Ice storms can vary in time range from hours to days and can cripple small towns and large urban centers alike.¹¹⁴

- **Snowstorm**: A heavy fall of snow accumulating at a rate of more than 5 centimeters (2 inches) per hour that lasts several hours. Snowstorms, especially ones with a high liquid equivalent and breezy conditions, can down tree limbs, cut off power, and paralyze travel over a large region.¹¹⁵

**Severe Weather Hazard Elements: Wind Hazards, Hail, and Lightning**

This hazard profile concentrates on the following types of severe weather hazards: wind hazards *(including tornadoes)*, hail, and lightning. These hazards are produced by a variety of weather phenomena, including thunderstorms, coastal storms, winter storms, and topographically-enhanced downslope winds. While storm and downslope wind hazards are responsible for severe weather events across the CSU system, only the wind, tornado, hail, and lightning elements generated by these hazards are covered in this profile. (Storm-related hazards such as flooding and extreme temperatures are covered in other sections of this document.)


Wind Hazards

Wind is the horizontal movement of air past any given point. Wind begins with differences in air pressures; pressure that is higher at one point than another sets up a force, pushing the high towards the low pressure.\textsuperscript{116} Wind gusts are defined as “rapid fluctuations in the wind speed with a variation of 10 knots or more between peaks and lulls.” \textsuperscript{117}

Wind hazards in California take several forms: High Wind, Strong Winds, Thunderstorm Winds, Mountain-Valley (Downslope) Winds, and Tornadoes. These hazards are encountered across California, and have the potential to cause harm to or loss of life and/or property throughout California and the CSU system (including CSU Monterey Bay).

High Winds, Strong Winds, and Thunderstorm Winds

The National Weather Service reports three (3) types of wind events that occur areas over land: High Winds, Strong Winds, and Thunderstorm Winds. Collectively, these reports are used to determine the frequency with which wind hazard events have affected areas across the U.S., including California.

High Winds

High winds are defined as sustained non-convective winds of 35 knots (40 mph) or greater lasting for 1 hour or longer, or gusts of 50 knots (58 mph) or greater for any duration (or otherwise locally/regionally defined). In some mountainous areas, the above numerical values are 43 knots (50 mph) and 65 knots (75 mph), respectively.\textsuperscript{118}

Strong Winds

Strong winds are defined as non-convective winds gusting less than 50 knots (58 mph), or sustained winds less than 35 knots (40 mph), resulting in a fatality, injury, or damage.\textsuperscript{119}

Thunderstorm Winds

Thunderstorm winds are winds that arise from thunderstorm convection (occurring within 30 minutes of lightning being observed or detected), with speeds of at least 50

\textsuperscript{117} Retrieved on 07.15.2021 from https://forecast.weather.gov/glossary.php?word=wind%20gust
\textsuperscript{118} Retrieved on 07.17.2021 from https://www.nws.noaa.gov/directives/sym/pd01016005curr.pdf
\textsuperscript{119} Retrieved on 07.17.2021 from https://www.nws.noaa.gov/directives/sym/pd01016005curr.pdf
knots (58 mph). They can also be winds of any speed (non-severe thunderstorm winds below 50 knots (58 mph)) producing a fatality, injury, or damage.\textsuperscript{120}

Please note: \textit{Straight-line wind} is a term used to define any thunderstorm wind that is not associated with rotation. It is used mainly to differentiate from the rotational winds found in tornado-producing storms.\textsuperscript{121} However, it is not a term used in the NCEI Storm Events Database, and therefore cannot be used to determine severe weather history of or potential impacts to CSU campuses.

\textbf{Tornadoes}

A tornado is an extreme severe weather wind hazard. A tornado is a rapidly rotating column of air extending from a thunderstorm to the surface of the Earth.\textsuperscript{122} This column extends between cloud and the Earth’s surface. The damage from tornadoes comes from the strong winds they contain and the flying debris they create. It is generally believed that rotational wind speeds can be as high as 300 mph in the most violent tornadoes.\textsuperscript{123} On a local scale, tornadoes are the most violent and most destructive of all atmospheric phenomena.\textsuperscript{124}

\textbf{Mountain-Valley (Downslope) Wind Systems: Santa Ana, Diablo, and Sundowner Winds.}

\textbf{Santa Ana Winds.} A type of wind hazard that is peculiar to Southern California is called a \textit{Santa Ana Wind}. Santa Ana winds are strong, topographically-enhanced, extremely dry downslope winds that originate inland and affect coastal southern California and northern Baja California (Mexico).\textsuperscript{125} They occur when air from a region of high pressure over the dry, desert region of the southwestern U.S. flows westward towards low pressure located off the California coast. This creates dry winds that flow east to west through the mountain passages in Southern California. These winds have a strong seasonal component; they are most common during the cooler months of the year, occurring from September through May. Santa Ana winds typically feel warm (or even hot) because as the cool desert air moves down the side of the mountain, it is compressed, which causes the temperature of the air to rise. If strong enough, Santa Ana winds can cause major property damage, and may present difficulties for airborne and seagoing transportation.

\begin{footnotesize}
\item[121] Retrieved on 07.15.2021 from https://www.nssl.noaa.gov/education/svrwx101/wind/types/
\item[122] Retrieved on 07.15.2021 from https://www.earthnetworks.com/tornado/
\item[123] Retrieved on 07.15.2021 from https://www.nssl.noaa.gov/education/svrwx101/tornadoes/faq/
\item[124] Retrieved on 07.15.2021 from https://www.weather.gov/bgm/severedefinitions
\end{footnotesize}
They also may increase wildfire risk because of the dryness of the winds and the speed at which they can spread a flame across the landscape.\textsuperscript{126} (Note: The Wildfire hazard is profiled elsewhere in this document.)

Figure below illustrates the mechanisms involved in the generation of Santa Ana winds across Southern California.

Figure 15-19: What Drives a Santa Ana Wind?\textsuperscript{127}

\textbf{Diablo Winds}: The Diablo wind is another type of topographically-enhanced downslope wind phenomenon that occurs in the North-Central areas of California. Diablo winds are offshore wind events that flow northeasterly over Northern California’s Coast Ranges, often creating high wind speeds downwind of major canyons and over ridges, and extreme fire danger for the San Francisco Bay Area. Diablo winds are driven by a surface

\textsuperscript{126} Retrieved on 07.13.2021 from https://www.weather.gov/safety/wind-mountain-valley

\textsuperscript{127} Retrieved on 07.14.2021 from https://twitter.com/nwslosangeles/status/933049473034579968
pressure gradient that forms in response to an inverted pressure trough that develops over California.\textsuperscript{128}

**Sundowner Winds.** Sundowner winds are significant and potentially damaging downslope wind and warming events that periodically occur along a short segment of the southern California coast in the vicinity of Santa Barbara, CA. The unique topography of this coastal region promotes the development of Sundowner wind events: over a length of about 100 km, the coastline is oriented approximately west–east, with the adjoining narrow coastal plain bounded by a steeply rising (to elevations greater than 1200 m) and coast-parallel mountain range. Called Sundowner winds because they often begin in the late afternoon or early evening, their onset is typically associated with a rapid rise in temperature and decrease in relative humidity, and the winds tend to blow from the north from the Santa Ynez Mountains to the coast of Santa Barbara County, California. During the more intense Sundowner wind events, wind speeds can be of gale force 39-54 miles per hour or higher, and can even reach hurricane force (≥ 74 miles per hour) in the most extreme cases. Temperatures over the coastal plain, and even at the coast itself, can rise significantly above 37.8°C (100°F). Seasonally, Sundowner winds peak in March, April, and May, with a minimum during summer and a secondary peak in winter that often corresponds with Santa Ana winds. In addition to causing a dramatic change from the more typical marine-influenced local weather conditions, Sundowner wind episodes have produced significant wind-related property and agricultural damage, as well as conditions of extreme fire danger.\textsuperscript{129 130 131}

**Hail**

Hail is a form of precipitation consisting of solid ice that forms inside thunderstorm updrafts.\textsuperscript{132} It is roughly round in shape and at least 0.2’ in diameter. Hail develops in the upper atmosphere as ice crystals that are bounced about by high velocity updraft winds; the ice crystals accumulate frozen droplets and fall after developing enough weight. The size of hailstones varies and is a direct consequence of the severity and size of the storm that produces them – the higher the temperatures at the Earth’s surface, the greater the

\footnotesize
\textsuperscript{128} Retrieved on 07.13.2021 from https://www.fireweather.org/diablo-winds


strength of the updrafts and the amount of time hailstones are suspended, and therefore the greater the size of the hailstone.\textsuperscript{133}

\textbf{Lightning}

Lightning is an electrical discharge produced by a thunderstorm. Lightning rapidly heats the air in its immediate vicinity to about 50,000°F - about five times the temperature of the surface of the sun. This compresses the surrounding air and creates a supersonic shock wave, which decays to an acoustic wave that is heard as thunder.\textsuperscript{134}

The discharge may occur within or between clouds, between the cloud and air, between a cloud and the ground, or between the ground and a cloud.\textsuperscript{135}

Lightning that is produced from thunderstorms in which precipitation evaporates before reaching the ground is called “dry lightning.”

\textbf{Location of the Hazard}

Severe weather is a non-spatial hazard, and can occur anywhere in the CSU system, including on the CSU Monterey Bay campus. No one area of the campus – or of the surrounding community – is subject to experiencing severe weather more than any other area.

There is geographic variability among the different types of mountain and valley wind events (as a sub-category of the severe weather hazard). Santa Ana winds occur in Southern California, Diablo winds occur in North-Central California, and Sundowner winds occur almost exclusively in Santa Barbara County, California.

\textbf{Extent of the Hazard}

Severe weather hazards are non-spatial hazards that potentially affect all CSU Monterey Bay campus areas equally. However, the smallest geographic unit of measurement for almost all official severe weather event data is at the county level. Because the severe weather data used do not exist at the campus level, it is assumed that the same (or similar) severe weather risks to CSU Monterey Bay reflect those of the surrounding community and County. As a result, all assets and people at CSU Monterey Bay are at risk from the effects of severe weather and can expect to experience at least some (or the complete range of) endemic severe weather hazards. In consideration of the campus’ design, layout, and operations, the severe weather history and degree of severity in the Seaside and Marina areas, and the history and degree of severity of each severe weather sub-type identified by the extent scales (below), the campus planning committee ranks


the overall extent of the Severe Weather hazard as **MODERATE**. See each sub-hazard below for the planning committee’s sub-type extent ranking.

**Wind Hazard: Non-Rotational**

The Beaufort Scale (Table below) is an empirical measure that relates wind speed to observed conditions at sea or on land. Its full name is the Beaufort wind force scale. First developed in 1805, it is still used today to estimate wind strengths.

Table 15-27: **Beaufort Wind Force Scale**

<table>
<thead>
<tr>
<th>Force</th>
<th>Speed (mph)</th>
<th>Speed (knots)</th>
<th>Description</th>
<th>Specifications for use at sea</th>
<th>Specifications for use on land</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0-1</td>
<td>0-1</td>
<td>Calm</td>
<td>Sea like a mirror.</td>
<td>Calm; smoke rises vertically.</td>
</tr>
<tr>
<td>1</td>
<td>1-3</td>
<td>1-3</td>
<td>Light Air</td>
<td>Ripples with the appearance of scales are formed, but without foam crests.</td>
<td>Direction of wind shown by smoke drift, but not by wind vanes.</td>
</tr>
<tr>
<td>2</td>
<td>4-7</td>
<td>4-6</td>
<td>Light Breeze</td>
<td>Small wavelets, still short, but more pronounced. Crests have a glassy appearance and do not break.</td>
<td>Wind felt on face; leaves rustle; ordinary vanes moved by wind.</td>
</tr>
<tr>
<td>3</td>
<td>8-12</td>
<td>7-10</td>
<td>Gentle Breeze</td>
<td>Large wavelets. Crests begin to break. Foam of glassy appearance. Perhaps scattered white horses.</td>
<td>Leaves and small twigs in constant motion; wind extends light flag.</td>
</tr>
<tr>
<td>4</td>
<td>13-18</td>
<td>11-16</td>
<td>Moderate Breeze</td>
<td>Small waves, becoming larger; fairly frequent white horses.</td>
<td>Raises dust and loose paper; small branches are moved.</td>
</tr>
</tbody>
</table>

---

136 Retrieved on 07.15.2021 from https://www.rmets.org/resource/beaufort-scale
137 Retrieved on 07.15.2021 from https://www.weather.gov/mfl/beaufort
<table>
<thead>
<tr>
<th>No.</th>
<th>Wind Force</th>
<th>Wind Speed</th>
<th>Wind Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>Fresh Breeze</td>
<td>19-24</td>
<td>Moderate waves, taking a more pronounced long form; many white horses are formed.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>17-21</td>
<td>Small trees in leaf begin to sway; crested wavelets form on inland waters.</td>
</tr>
<tr>
<td>6</td>
<td>Strong Breeze</td>
<td>25-31</td>
<td>Large waves begin to form; the white foam crests are more extensive everywhere.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>22-27</td>
<td>Large branches in motion; whistling heard in telegraph wires; umbrellas used with difficulty.</td>
</tr>
<tr>
<td>7</td>
<td>Near Gale</td>
<td>32-38</td>
<td>Sea heaps up and white foam from breaking waves begins to be blown in streaks along the direction of the wind.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>28-33</td>
<td>Whole trees in motion; inconvenience felt when walking against the wind.</td>
</tr>
<tr>
<td>8</td>
<td>Gale</td>
<td>39-46</td>
<td>Moderately high waves of greater length; edges of crests begin to break into spindrift. The foam is blown in well-marked streaks along the direction of the wind.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>34-40</td>
<td>Breaks twigs off trees; generally impedes progress.</td>
</tr>
<tr>
<td>9</td>
<td>Severe Gale</td>
<td>47-54</td>
<td>High waves. Dense streaks of foam along the direction of the wind. Crests of waves begin to topple, tumble and roll over. Spray may affect visibility.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>41-47</td>
<td>Slight structural damage occurs (chimney-pots and slates removed)</td>
</tr>
<tr>
<td>10</td>
<td>Storm</td>
<td>55-63</td>
<td>Very high waves with long overhanging crests. The resulting foam, in great patches, is blown in dense white streaks along the direction of the wind. On the whole the surface of the sea takes on a white appearance. The tumbling of the sea becomes heavy and shock-like. Visibility affected.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>48-55</td>
<td>Seldom experienced inland; trees uprooted; considerable structural damage occurs.</td>
</tr>
<tr>
<td>11</td>
<td>Violent Storm</td>
<td>64-72</td>
<td>Exceptionally high waves (small and medium-size ships might be for a time lost to view behind the waves). The sea is completely covered with long white patches of foam lying along the direction of the wind. Everywhere the</td>
</tr>
</tbody>
</table>
edges of the wave crests are blown into froth. Visibility affected.

Very rarely experienced; accompanied by widespread damage.

<table>
<thead>
<tr>
<th>Number</th>
<th>Value</th>
<th>Type of Wave</th>
</tr>
</thead>
<tbody>
<tr>
<td>12</td>
<td>73+</td>
<td>64+</td>
</tr>
</tbody>
</table>

The air is filled with foam and spray. Sea completely white with driving spray; visibility very seriously affected.

Based on those extent ranking factors identified (above), the planning committee ranks the extent of non-rotational wind hazards as **MODERATE**.

**Extent: Tornado**

Tornadoes have their own severity/extent scale. Until 2007, tornadoes were measured and described according to the Fujita Scale.\(^{139}\)

In February 2007, use of the Fujita Scale was discontinued. In its place, the Enhanced Fujita (EF) Scale is used. The Enhanced Fujita scale considers how most structures are designed and is thought to be a much more accurate representation of the surface wind speeds in the most violent tornadoes. Like the original Fujita scale, the Enhanced Fujita scale is a set of wind estimates (not measurements) based on damage.

It is important to note the **date** that a tornado occurred. Tornadoes that occurred prior to February, 2007 are classified using the original Fujita scale and will not be converted to the Enhanced Fujita Scale.

Table below illustrates the Fujita Scale in use prior to February 2007.

**Table 15-28: Fujita Tornado Scale (Pre-February 2007)**\(^{140}\)

<table>
<thead>
<tr>
<th>F-Scale Number</th>
<th>Intensity Phrase</th>
<th>Wind Speed</th>
<th>Type of Damage</th>
</tr>
</thead>
<tbody>
<tr>
<td>F0</td>
<td>Gale tornado</td>
<td>40-72 mph</td>
<td>Some damage to chimneys; breaks branches off trees; pushes over shallow-rooted trees; damages sign boards.</td>
</tr>
<tr>
<td>F1</td>
<td>Moderate tornado</td>
<td>73-112 mph</td>
<td>The lower limit is the beginning of hurricane wind speed; peels surface off roofs; mobile homes pushed off foundations or</td>
</tr>
</tbody>
</table>

\(^{139}\) Retrieved on 07.19.2021 from https://www.weather.gov/tae/ef_scale

<table>
<thead>
<tr>
<th>F2</th>
<th>Significant tornado</th>
<th>113-157 mph</th>
<th>Considerable damage. Roofs torn off frame houses; mobile homes demolished; boxcars pushed over; large trees snapped or uprooted; light object missiles generated.</th>
</tr>
</thead>
<tbody>
<tr>
<td>F3</td>
<td>Severe tornado</td>
<td>158-206 mph</td>
<td>Roof and some walls torn off well-constructed houses; trains overturned; most trees in forest uprooted.</td>
</tr>
<tr>
<td>F4</td>
<td>Devastating tornado</td>
<td>207-260 mph</td>
<td>Well-constructed houses leveled; structures with weak foundations blown off some distance; cars thrown and large missiles generated.</td>
</tr>
<tr>
<td>F5</td>
<td>Incredible tornado</td>
<td>261-318 mph</td>
<td>Strong frame houses lifted off foundations and carried considerable distances to disintegrate; automobile sized missiles fly through the air in excess of 100 meters; trees debarked; steel reinforced concrete structures badly damaged.</td>
</tr>
<tr>
<td>F6</td>
<td>Inconceivable tornado</td>
<td>319-379 mph</td>
<td>These winds are very unlikely. The small area of damage they might produce would probably not be recognizable along with the mess produced by F4 and F5 wind that would surround the F6 winds. Missiles, such as cars and refrigerators would do serious secondary damage that could not be directly identified as F6 damage. If this level is ever achieved, evidence for it might only be found in some manner of ground swirl pattern, for it may never be</td>
</tr>
</tbody>
</table>
Table below illustrates the Enhanced Fujita (EF) Scale, currently in use. Tornadoes that have occurred since February, 2007 are classified using the Enhanced Fujita Scale.

Table 15-29: Enhanced Fujita Scale (February 2007 and Later) ¹⁴¹

<table>
<thead>
<tr>
<th>Enhanced Fujita Category</th>
<th>Wind Speed</th>
<th>Potential Damage</th>
</tr>
</thead>
<tbody>
<tr>
<td>EF0</td>
<td>65-85 mph</td>
<td>Light damage. Peels surface off some roofs; some damage to gutters or siding; branches broken off trees; shallow-rooted trees pushed over.</td>
</tr>
<tr>
<td>EF1</td>
<td>86-110 mph</td>
<td>Moderate damage. Roofs severely stripped; mobile homes overturned or badly damaged; loss of exterior doors; windows and other glass broken.</td>
</tr>
<tr>
<td>EF2</td>
<td>111-135 mph</td>
<td>Considerable damage. Roofs torn off well-constructed houses; foundations of frame homes shifted; mobile homes completely destroyed; large trees snapped or uprooted; light-object missiles generated; cars lifted off ground.</td>
</tr>
<tr>
<td>EF3</td>
<td>136-165 mph</td>
<td>Severe damage. Entire stories of well-constructed houses destroyed; severe damage to large buildings such as shopping malls; trains overturned; trees debarked; heavy cars lifted off the ground and thrown; structures with weak foundations blown away some distance.</td>
</tr>
<tr>
<td>EF4</td>
<td>166-200 mph</td>
<td>Devastating damage. Well-constructed houses and whole frame houses completely leveled; cars thrown and small missiles generated.</td>
</tr>
</tbody>
</table>

Incredible damage. Strong frame houses leveled off foundations and swept away; automobile-sized missiles fly through the air in excess of 100 m (107 yd); high-rise buildings have significant structural deformation; incredible phenomena will occur.

Based on the extent ranking factors identified (above), the planning committee ranks the extent of tornados as **LOW**.

**Extent: Hail**

The National Oceanic and Atmospheric Administration and the Tornado and Storm Research Organization (TORRO) have combined efforts to create the Hailstorm Intensity Scale. Table below provides details of this scale.

Table 15-30: Combined NOAA/TORRO Hailstorm Intensity Scale\(^{142}\)

<table>
<thead>
<tr>
<th>Size Code</th>
<th>Intensity Category</th>
<th>Typical Hail Diameter</th>
<th>Approximate Size</th>
<th>Typical Damage Impacts</th>
</tr>
</thead>
<tbody>
<tr>
<td>H0</td>
<td>Hard Hail</td>
<td>Up to 0.33”</td>
<td>Pea</td>
<td>No damage</td>
</tr>
<tr>
<td>H1</td>
<td>Potentially Damaging</td>
<td>0.33” – 0.60”</td>
<td>Marble or Mothball</td>
<td>Slight damage to plants and crops</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>H2</th>
<th>Potentially Damaging</th>
<th>0.60” – 0.80”</th>
<th>Dime or grape</th>
<th>Significant damage to fruit, crops, and vegetation</th>
</tr>
</thead>
<tbody>
<tr>
<td>H3</td>
<td>Severe</td>
<td>0.80” – 1.20”</td>
<td>Nickel to Quarter</td>
<td>Severe damage to fruit and crops, damage to glass and plastic structures, paint and wood scored</td>
</tr>
<tr>
<td>H4</td>
<td>Severe</td>
<td>1.20” – 1.60”</td>
<td>Half Dollar to Ping Pong Ball</td>
<td>Widespread glass damage, vehicle body damage</td>
</tr>
<tr>
<td>H5</td>
<td>Destructive</td>
<td>1.60” – 2.0”</td>
<td>Silver Dollar to Golf Ball</td>
<td>Wholesale destruction of glass, damage to tiled roofs, significant risk of injuries</td>
</tr>
<tr>
<td>H6</td>
<td>Destructive</td>
<td>2.0” – 2.4”</td>
<td>Lime or Egg</td>
<td>Aircraft body dented; brick walls pitted</td>
</tr>
<tr>
<td>H7</td>
<td>Very Destructive</td>
<td>2.4” – 3.0”</td>
<td>Tennis Ball</td>
<td>Severe roof damage, risk of serious injuries</td>
</tr>
<tr>
<td>Extent</td>
<td>Size</td>
<td>Damage Assignment</td>
<td>Damage Description</td>
<td></td>
</tr>
<tr>
<td>--------</td>
<td>------</td>
<td>-------------------</td>
<td>--------------------</td>
<td></td>
</tr>
<tr>
<td>H8</td>
<td>Very Destructive</td>
<td>3.0” – 3.5”</td>
<td>Baseball to Orange</td>
<td>Severe damage to aircraft body</td>
</tr>
<tr>
<td>H9</td>
<td>Super Hailstorms</td>
<td>3.5” – 4.0”</td>
<td>Grapefruit</td>
<td>Extensive structural damage, risk of severe or fatal injuries to persons caught in the open</td>
</tr>
</tbody>
</table>

Based on those extent ranking factors identified (above), the planning committee ranks the extent of the hail hazard as **LOW**.

**Extent: Lightning**

The National Weather Service (NWS) uses a Lightning Activity Level (LAL) scale to indicate the frequency and character of cloud-to-ground (C/G) lightning. The scale uses a range of 1 – 6, with 6 being the high end of the scale. Table below provides details of the LAL scale.
Table 15-31: Lightning Activity Level (LAL) Scale\textsuperscript{143}

<table>
<thead>
<tr>
<th>Rank</th>
<th>Cloud and Storm Development</th>
<th>Areal Coverage</th>
<th>Counts C/G per 5 Minutes</th>
<th>Counts C/G per 15 Minutes</th>
<th>Average C/G per Minute</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>No Thunderstorms</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>2</td>
<td>Cumulus clouds are common but only a few reaches the towering stage. A single thunderstorm must be confirmed in the rating area. The clouds mostly produce virga, but light rain will occasionally reach ground. Lightning is very infrequent.</td>
<td>&lt;15%</td>
<td>1-5</td>
<td>1-8</td>
<td>&lt;1</td>
</tr>
<tr>
<td>3</td>
<td>Cumulus clouds are common. Swelling and towering cumulus cover less than 2/10 of the sky. Thunderstorms are few, but 2 to 3 occur within the observation area. Light to moderate rain will reach the ground, and lightning is infrequent.</td>
<td>15% to 24%</td>
<td>6-10</td>
<td>9-15</td>
<td>1-2</td>
</tr>
<tr>
<td>4</td>
<td>Swelling cumulus and towering cumulus cover 2-3/10 of the sky. Thunderstorms are scattered but more than three must occur within the observation area. Moderate rain is commonly produced, and lightning is frequent.</td>
<td>25% to 50%</td>
<td>11-15</td>
<td>16-25</td>
<td>2-3</td>
</tr>
</tbody>
</table>

\textsuperscript{143} Retrieved on 07.19.2021 from https://graphical.weather.gov/definitions/defineLAL.html
**Lightning Activity Level Scale**

<table>
<thead>
<tr>
<th>Rank</th>
<th>Cloud and Storm Development</th>
<th>Areal Coverage</th>
<th>Counts C/G per 5 Minutes</th>
<th>Counts C/G per 15 Minutes</th>
<th>Average C/G per Minute</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>Towering cumulus and thunderstorms are numerous. They cover more than 3/10 and occasionally obscure the sky. Rain is moderate to heavy, and lightning is frequent and intense.</td>
<td>&gt;50%</td>
<td>&gt;15</td>
<td>&gt;25</td>
<td>&gt;3</td>
</tr>
<tr>
<td>6</td>
<td>Dry lightning outbreak. (LAL of 3 or greater with majority of storms producing little or no rainfall.)</td>
<td>&gt;15%</td>
<td>None</td>
<td>None</td>
<td>None</td>
</tr>
</tbody>
</table>

Based on those extent ranking factors identified (above), the planning committee ranks the extent of the lightening hazard as **LOW**.

**Extent: Thunderstorms that Generate Wind, Tornado, Hail, and Lightning Hazard Events**

Thunderstorms are not explicitly identified as a severe weather category for this hazard profile. However, they are responsible for most tornado, lightning, and hail hazard events – as well as a significant number of wind hazard events – across California and the CSU system. While individual thunderstorms affect relatively small areas, there are many instances in which thunderstorms can cluster together and/or travel in a line over long distances, producing significant damage over large geographic areas.

A thunderstorm is classified as “severe” when certain meteorological parameters within the thunderstorm are reached (i.e., damaging winds or speeds of 58 mph (50 knots) or greater, hail 1 inch in diameter or larger, and/or a tornado). However, there is currently no established, objective severity scale for thunderstorms.\(^{144}\) \(^{145}\) That said, according to the *Glossary of Meteorology* published by the American Meteorological Society (AMS), a thunderstorm is reported as *light*, *medium*, or *heavy* according to following five (5) characteristics:

\(^{144}\) Retrieved on 07.15.2021 from https://www.noaa.gov/explainers/severe-storms

\(^{145}\) Retrieved on 07.15.2021 from https://www.weather.gov/safety/thunderstorm
the nature of the lightning and thunder;
the type and intensity of the precipitation, if any;
the speed and gustiness of the wind;
the appearance of the clouds; and
the effect upon surface temperature.\textsuperscript{146}

A thunderstorm may also be classified by the nature of the overall weather situation in which the thunderstorm is produced, including:

- \textbf{Airmass Thunderstorm}: A thunderstorm produced by local convection within an unstable air mass;\textsuperscript{147}
- \textbf{Frontal Thunderstorm}: An individual thunderstorm the initiation of which results from rising motion associated with a front, or a thunderstorm within a convective system generated and organized by frontal rising motion;\textsuperscript{148} or
- \textbf{Squall-line Thunderstorm}: An individual thunderstorm included within a squall line (i.e., a continuous or broken line of active deep moist convection frequently associated with thunder). \textsuperscript{149 150}

Based on the extent ranking factors identified (above) in relation to campus layout and operations, and past event low degree of severity, the planning committee ranks the extent of the thunderstorm hazard as \textbf{LOW}.


History of the Hazard

Severe weather hazards have been an annual occurrence in Monterey County and on the CSU Monterey Bay campus. Historical data for these hazards are presented below.

Historical Storm Data Collection: NCEI Storm Events Database

Historical information regarding severe weather hazards can be found using The National Centers for Environmental Information (NCEI) Storm Events Database. The Storm Events Database contains searchable, archived National Weather Service (NWS) storm data from January 1950 to April 2021, as entered by NOAA's National Weather Service (NWS). Due to changes in the data collection and processing procedures over time, there are unique periods of record available depending on the event type. For example, from 1950 through 1954, only tornado events were recorded; from 1955 through 1995, only tornado, thunderstorm wind, and hail events were introduced into the database; from 1996 to present, 45 additional event types are recorded, including high wind, strong wind, and lightning events. To obtain the most accurate portrayal of severe weather event frequency, searches of the Storm Events Database are conducted using data collected since 01/01/1996. As a reminder, all official severe weather event data is at the county level. Severe weather data do not exist at the campus level. That said, it may be the case that the campus to some degree experiences the severe weather events reported for the surrounding community and County.

Wind Hazards (excluding Tornadoes)

Information obtained from the NCEI Storm Event Database website shows the number of events (or occurrences) of wind hazard events in Monterey County since 1996. Here, wind hazard events include all “High Wind,” “Strong Wind,” and “Thunderstorm Wind” storm reports.

- **High Wind**: at least 52 events, or approximately 2.05 events per year

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155 National Climatic Data Center. Storm Events Database. Retrieved 07.30.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType%28Z%29+High+Wind&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=202
- **Strong Wind:** at least 115 events, or 4.54 events per year<sup>156</sup>
- **Thunderstorm Wind:** at least 7 events, or approximately 0.28 events per year<sup>157</sup>
- **All Wind Hazard events** (excluding Tornadoes): at least 168 events, or approximately 6.63 events per year.<sup>158</sup> (Note: This was determined by conducting a simultaneous search of the component wind hazards of high wind, strong wind and thunderstorm wind.)

Overall, in Monterey County, there have been at least 168 wind hazard events since 1996, excluding tornadoes.<sup>159</sup> That translates to an approximate average historical frequency of occurrence of 6.63 wind hazard events per year.

Please note: Differences between the sums of individual component severe weather hazard event Database searches (i.e., 174 events) and simultaneous Database searches of all severe weather hazard events (i.e., 168 events) may be due to the following factors: (1) multiple event types are in the same record (e.g., "Thunderstorm Wind/Hail" or "Hail/Tornado;" and/or (2) severe weather hazard events such as “Thunderstorm Wind”

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<sup>156</sup> National Climatic Data Center. Storm Events Database. Retrieved 07.30.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28Z%29+Strong+Wind&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=MONTEREY%3A53&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA

<sup>157</sup> National Climatic Data Center. Storm Events Database. Retrieved 07.30.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Thunderstorm+Wind&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=MONTEREY%3A53&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA

<sup>158</sup> National Climatic Data Center. Storm Events Database. Retrieved 07.30.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28Z%29+High+Wind&eventType=%28Z%29+Strong+Wind&eventType=%28C%29+Thunderstorm+Wind&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=MONTEREY%3A53&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA

<sup>159</sup> National Climatic Data Center. Storm Events Database. Retrieved 07.30.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28Z%29+High+Wind&eventType=%28Z%29+Strong+Wind&eventType=%28C%29+Thunderstorm+Wind&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=MONTEREY%3A53&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA
or “Hail” that are reported for Monterey County have actually taken place hundreds of miles away, but are erroneously recorded as events that have occurred in the County.\(^{160}\) When such a discrepancy arises, the more conservative aggregate hazard wind event value (i.e., 168 events) is used to determine the historical frequency of occurrence for the severe weather hazard. The origin of this discrepancy is unknown at this time.

**Historical Wind Hazard Losses for Monterey County since 1996**

According to the NCEI Storm Events Database, the wind hazard events that Monterey County has experienced since 1996 have been costly. There have been 1 death and 1 injury, and property damage estimates have totaled approximately $1,600,000; however, there has been no reported crop damage.\(^{161}\)

**Tornado Wind Hazards**

Information from the NCEI Storm Events Database indicates that since 1996, there has been one (1) reported event of a tornado in Monterey County, which translates to approximately 0.04 tornado events per year.\(^{162}\) The reported severity rating of the lone tornado is EF0.\(^{163}\)

**Historical Tornado Hazard Losses for Monterey County since 1996**


\(^{161}\) National Climatic Data Center. Storm Events Database. Retrieved 07.30.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28Z%29+High+Wind&eventType=%28Z%29+Strong+Wind&eventType=%28C%29+Thunderstorm+Wind&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=MONTEREY%3A53&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitButton=Search&statefips=6%2CCALIFORNIA

\(^{162}\) National Climatic Data Center. Storm Events Database. Retrieved 07.30.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Tornado&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=MONTEREY%3A53&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitButton=Search&statefips=6%2CCALIFORNIA

\(^{163}\) National Climatic Data Center. Storm Events Database. Retrieved 07.30.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Tornado&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=MONTEREY%3A53&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitButton=Search&statefips=6%2CCALIFORNIA
According to the NCEI Storm Events Database, the one (1) tornado hazard event that Monterey County has experienced since 1996 has produced no deaths or injuries, and has generated no property or crop damages.164

**Hail**

Information from the NCEI Storm Events Database indicates that since 1996, there have been 20 reported events of hail in Monterey County, which translates to approximately 0.79 hail events per year.165 (Note: The NCEI Storm Event Database search results for hail indicate that there has been a total of 21 reports of hail since 1996. However, one (1) entry is for a hail event in San Diego County, hundreds of miles away from Monterey County. The origin of this error is unknown at this time.)

**Historical Hail Hazard Losses for Monterey County since 1996**

According to the NCEI Storm Events Database, the hail hazard events that Monterey County has experienced since 1996 have been minimal. There have been no deaths or injuries, and property and crop damage estimates have totaled approximately $60 and $50, respectively.166 (Note: The San Diego County hail event that was included erroneously in the search results for hail hazard events in Monterey County accounted for all injuries (i.e., 5) and crop damage estimates (i.e., $300,000) presented in the search results.)

**Lightning**

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164 National Climatic Data Center. Storm Events Database. Retrieved 07.30.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Tornado&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=MONTEREY%3A53&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitButton=Search&statefips=6%2CCALIFORNIA

165 National Climatic Data Center. Storm Events Database. Retrieved 07.30.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Hail&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=MONTEREY%3A53&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitButton=Search&statefips=6%2CCALIFORNIA

166 National Climatic Data Center. Storm Events Database. Retrieved 07.30.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Hail&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=MONTEREY%3A53&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitButton=Search&statefips=6%2CCALIFORNIA
Information from the NCEI Storm Events Database indicates that since 1996, there has been one (1) reported event of lightning in Monterey County, which translates to approximately 0.04 lightning hazard events per year.\textsuperscript{167}

**Historical Lightning Hazard Losses for Monterey County since 1996**

According to the NCEI Storm Events Database, the lightning hazard events that Monterey County has experienced since 1996 have produced no deaths or injuries, and have generated no property or crop damage.\textsuperscript{168}

**All Severe Weather Hazard Events Recorded by the NCEI Storm Events Database**

Information obtained from the NCEI Storm Events Database indicates that there have been 190 occurrences of the severe weather hazard in Monterey County. This translates to 7.50 severe weather hazard occurrences per year.\textsuperscript{169}

Please note: Differences between the sums of individual component severe weather hazard event Database searches (i.e., 197 events) and simultaneous Database searches of all severe weather hazard events (i.e., 190 events) may be due to the following factors: (1) multiple event types are in the same record (e.g., “Thunderstorm Wind/Hail” or “Hail/Tornado;” and/or (2) severe weather hazard events such as “Thunderstorm Wind” or “Hail” that are reported for Monterey County have actually taken place hundreds of miles away, but are erroneously recorded as events that have occurred in the County.\textsuperscript{170}

When such a discrepancy arises, the more conservative aggregate hazard wind event

\begin{itemize}
\item \textsuperscript{167} National Climatic Data Center. Storm Events Database. Retrieved 07.30.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Lightning&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=MONTEREY%3A53&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA
\item \textsuperscript{168} National Climatic Data Center. Storm Events Database. Retrieved 07.30.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Lightning&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=MONTEREY%3A53&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA
\item \textsuperscript{169} National Climatic Data Center. Storm Events Database. Retrieved 07.30.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Hail&eventType=%28Z%29+High+Wind&eventType=%28C%29+Lightning&eventType=%28Z%29+Strong+Wind&eventType=%28C%29+Thunderstorm+Wind&eventType=%28C%29+Tornado&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=MONTEREY%3A53&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA
value (i.e., 190 events) is used to determine the historical frequency of occurrence for the
severe weather hazard. The origin of this discrepancy is unknown at this time.

**Historical, Aggregated Severe Hazard Losses for Monterey County since 1996**

According to the NCEI Storm Events Database, the severe weather events that Monterey
County has experienced since 1996 have been costly. There have been 1 death and 1
injury, and property and damage estimates have totaled approximately $1,600,000 and
$50, respectively. However, it is important to note that for all Monterey County severe
weather hazard events recorded on the Storm Events Database, all deaths, injuries, and
property damage have been caused by wind hazard events alone.

**Wind Hazards Not Included in the NCEI Storm Events Database**

**Santa Ana Winds**

Santa Ana wind events occur at least twice per month from October through April. From 1948 to 2012, total of 2056 events on the 65-year record were recorded in the
Southern California region, yielding an average of 32 occurrences per year. Typical Santa
Ana wind events last 1–2 days and represent 27% of the occurrences, with events lasting
up to 6 days accounting for 90% of all occurrences. The remaining 10% are made up
almost entirely of events lasting between 7 and 12 days.

Figure below shows the mean monthly frequency per season of Santa Ana Wind events
detected from 1948 to 2012. Extreme Santa Ana wind events are shown in dark red, and
are defined as those events that are above the 90th percentile of all events on record.

Figure 15-20: Mean Annual Frequency of Santa Ana Wind events (1948-2012)

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171 National Climatic Data Center. Storm Events Database. Retrieved 07.30.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Hail&eventType=%28Z%29+High+Wind&eventType=%28C%29+Lightning&eventType=%28Z%29+Strong+Wind&eventType=%28C%29+Thunderstorm+Wind&eventType=%28C%29+Tornado&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=MONTEREY%3A53&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA


Diablo Winds

Diablo wind events occur approximately **2.5 events per year**. These events are most frequent during the fall and early winter seasons, with the highest frequency of events occurring in October. As a result, the highest risk of Diablo-wind-related damage is in the fall and early winter.\textsuperscript{177}

Figure below shows the monthly frequency of Diablo winds (along with average live fuel moisture content). The Diablo Wind data are derived from a 17-year climatology of San Francisco Bay Area regional surface weather stations.\textsuperscript{178}

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\textsuperscript{177} Retrieved on 07.14.2021 from https://www.fireweather.org/diablo-winds

\textsuperscript{178} Retrieved on 07.15.2021 from https://www.fireweather.org/diablo-winds
Sundowner Winds

Strong sundowner wind events occur approximately 2-3 times per year. These events can create sharp temperature rises, local gale force winds, and significant weather-related problems. Rare, “explosive” types of sundowner wind events occur about 6 times per century that present dangerous weather situations, generating extremely strong and hot winds that can reach gale force or higher speeds.  

Historical Frequency of All Severe Weather Hazards

Table below shows the average historical frequency of severe weather hazard events for Monterey County since 1996.)

Table 15-32: Severe Weather Hazard Event Frequencies for Monterey County since 1996.

<table>
<thead>
<tr>
<th>Severe Weather Hazard Category</th>
<th>Average Number of Hazard Events Per Year</th>
</tr>
</thead>
</table>


Wind Hazards (Including Tornadoes)

<table>
<thead>
<tr>
<th>Hazard</th>
<th>Priority</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wind (Includes High, Strong and Thunderstorm Winds ONLY)</td>
<td>6.63</td>
</tr>
<tr>
<td>Tornado</td>
<td>0.04</td>
</tr>
<tr>
<td>Hail</td>
<td>0.79</td>
</tr>
<tr>
<td>Lightning</td>
<td>0.04</td>
</tr>
<tr>
<td>Diablo Wind*</td>
<td>2.5</td>
</tr>
<tr>
<td>Santa Ana Wind</td>
<td>32</td>
</tr>
<tr>
<td>Sundowner Wind*</td>
<td>2 to 3</td>
</tr>
</tbody>
</table>

* Note: The Diablo and Sundowner wind hazards are not present in Monterey County. They are included here for information purposes only.

Potential Impacts of the Hazard

The significance (or priority) of a hazard’s potential impacts is based primarily on the frequency and resulting damage caused by the hazard, including deaths/injuries and property, crop, and economic damage. All assets and people within CSU Monterey Bay campus areas are at risk from the effects of severe weather hazards.

**Wind Hazards (Including Tornadoes)**

Wind hazard events have the potential to impact people, property, and operations on campuses across the CSU system. People caught in the open during an extreme wind event are exposed to high winds and debris, and could be injured or killed.

The habitability of buildings can be compromised (by damaging roofs, windows, or other weak points in the building envelope), leading to long-term operational issues for the campus. As with most university campuses, space is always at a premium at the CSU Monterey Bay campus, and the loss of any currently utilized space due to building or structural damage would likely disrupt operations and the University’s mission.

Extreme wind events can result in power failure, which would impact the operation of the campus. Fallen tree limbs and other potential transportation hazards may also cause disruption to the surrounding community and limit ingress/egress to the campus.

The only severe weather hazard that is significant enough to be profiled in the 2016 Monterey County Multi-Jurisdictional Hazard Mitigation Plan (MJHMP) is the “Windstorm” hazard; tornadoes are not considered to be significant hazards for the
County and therefore are not profiled.\textsuperscript{181} (According to the MJHMP, a “windstorm” is a strong wind event either from cyclonic systems and their cold fronts in the winter, or from thermally forced circulations during the spring/summer months (i.e., sea breezes)). Windstorms are considered to be hazards that have a medium significance for the County; areas of wind hazard susceptibility (and therefore potential impact) within the County differ between the winter and spring/summer months, spreading the impact of the hazard across the year.\textsuperscript{182} As a result, wind hazards are considered to have a moderate potential impact on the County and (by extension) the CSU Monterey Bay campus. Because tornadoes are not considered to be significant hazards for the County, they have minimal potential impact on the County and (by extension) the CSU Monterey Bay campus.

\textbf{Hail}

Hail typically impacts property by damaging structures, cars, and utilities as it falls. Dents in cars, broken glass, and holes in roofs are common impacts of hail. Injuries to people from hail are less common, though they can happen, as hail is a hard object falling in an unpredictable manner at a fairly high rate of speed.

The 2016 Monterey County Multi-Jurisdictional Hazard Mitigation Plan does not explicitly profile hail, as it is not considered to be a significant severe weather hazard event in Monterey County. As a result, hail hazards are considered to be of low significance, and therefore to have a minimal potential impact on the city and (by extension) the CSU Monterey Bay campus.\textsuperscript{183}

\textbf{Lightning}

Lightning strikes the United States about 20-25 million times a year.\textsuperscript{184} Although most lightning occurs in the summer months, people can be struck at any time of year. Since 1990, lightning has killed an average of 39 people each year in the United States, and hundreds more have been injured.\textsuperscript{1} Property losses due to lightning have been very costly...

\begin{itemize}
  \item \textsuperscript{184} Retrieved on 07.21.2021 from https://www.elcosh.org/document/4154/d001459/OSHA+NOAA+Fact+Sheet%253A+Lightning+Safety+When+Working+Outdoors.html
\end{itemize}
across the U.S. For example, from 2005 through 2020, U.S. homeowner’s insurance claim payouts for lightning losses totaled approximately $15,334,600,000, or $958,412,500 worth of payouts per year.ii (Commercial claim payouts for lightning losses for the U.S. were not available.)

The 2016 Monterey County Multi-Jurisdictional Hazard Mitigation Plan does not explicitly profile lightning as a significant severe weather hazard event in Monterey County, although it is included as a causal event for wildfire hazards. As a result, lightning hazards are considered to be of low severe weather significance, and therefore to have a minimal severe weather potential impact on the city and (by extension) the CSU Monterey Bay campus.iii

**Probability of Future Occurrence of the Hazard**

Areas throughout California, including all California State University (CSU) campuses, experience severe weather events every year, and future occurrences of such events are projected to increase in both their frequency and intensity. The 2016 Monterey County Multi-Jurisdictional Hazard Mitigation Plan states that there is between 10% and 100% chance that “Windstorm” hazards (i.e., wind hazards, excluding tornadoes) will occur in the future, and that its probability of future occurrence is “likely.”iv However, according to the NCEI Storm Events Database, wind hazards have occurred in Monterey County far more than once annually – an average of 6.63 times per year since 1996. Furthermore, while the severe weather hazard is a non-spatial hazard that affects all areas of the CSU Monterey Bay campus equally, the smallest geographic unit of measurement for almost all official severe weather event data is at the county level. Because the severe weather data used in this assessment do not exist at the campus level, it is assumed that the severe weather probabilities for the CSU Monterey Bay campus reflect those of the surrounding community and County identified in the Table below.

Based on the data available from both 2016 Monterey County Multi-Jurisdictional Hazard Mitigation Plan and the NCEI Storm Events Database, the severe weather hazard is expected to occur on (or otherwise impact) the CSU Monterey Bay campus at least once on an annual basis. Therefore, the probability of future occurrence of the severe weather hazard for CSU Monterey Bay is **HIGHLY LIKELY**. See Table below for probabilities of future occurrence for component severe weather hazards for the City/County and the campus.

Table 15-33: Severe Weather Hazard Probabilities of Future Occurrence for Monterey County and CSU Monterey Bay

<table>
<thead>
<tr>
<th>Severe Weather Hazard Category</th>
<th>Average Number of Hazard Events Per Year</th>
<th>Probability of Future Occurrence</th>
</tr>
</thead>
</table>

15-154
Vulnerability to the Hazard

People, structures, and assets on the CSU Monterey Bay campus are all vulnerable to the impacts associated with severe weather. Infrastructure can be damaged or destroyed by hail, wind, tornadoes, thunderstorms, and lightning, which can result in service interruptions and outages. Structures can be damaged or destroyed by hail, wind, tornadoes, thunderstorms, and lightning. People can be injured or killed by lightning, flying debris, hail, or extreme wind events. The CSU Monterey Bay campus also has vehicles, as well as off-campus conference and recreational facilities, that are all vulnerable to a severe weather event.

Estimate of Potential Losses

Severe weather is a non-spatial hazard that affects the entire CSU Monterey Bay campus. Each of the hazards associated with severe weather can result in losses throughout the planning area.

All structures within the CSU Monterey Bay campus are at risk from severe weather. There are approximately 122 buildings that could be damaged by wind, hail, and/or lightning. If even a fraction of these assets were to be damaged, the resulting estimated losses would still be in the millions of dollars. The total replacement costs due to severe weather hazard are $401,286,223 for 89 of the buildings, and unknown for the remaining 33 buildings. An analysis of projected dollar losses to campus buildings from severe weather as a percentage of building replacement costs is not currently available, though CSU leadership may pursue such data in the future.

<table>
<thead>
<tr>
<th>Severe Weather Hazard</th>
<th>Probability</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Highly Likely</strong></td>
<td></td>
</tr>
<tr>
<td>Wind (Includes High, Strong and Thunderstorm Winds ONLY)</td>
<td>6.63</td>
</tr>
<tr>
<td>Tornado</td>
<td>0.04</td>
</tr>
<tr>
<td>Hail</td>
<td>0.79</td>
</tr>
<tr>
<td>Lightning</td>
<td>0.04</td>
</tr>
<tr>
<td>Diablo Wind**</td>
<td>2.50</td>
</tr>
<tr>
<td>Santa Ana Wind</td>
<td>32.00</td>
</tr>
<tr>
<td>Sundowner Wind**</td>
<td>2 to 3</td>
</tr>
</tbody>
</table>

** Note: The Diablo and Sundowner wind hazards are not present in Monterey County, and therefore are not rated for probability of future occurrence. They are included here for information purposes only.
The population at the CSU Monterey Bay campus varies throughout the day. As of Fall, 2019, CSU Monterey Bay had 7,123 students and 1,059 faculty and staff. All are at risk from severe weather events, with 8,182 being directly vulnerable in this scenario.

Vulnerability Assessment Conclusions

Severe weather presents a variety of hazards to the CSU Monterey Bay campus. People, assets, infrastructure, and vehicles can all be damaged by this hazard, and losses can quickly begin to rise. In the aggregate, severe weather is a frequently occurring hazard (mostly in the form of wind hazard events) that presents a variety of risks to CSU Monterey Bay.

It is evident that the CSU Monterey Bay campus has vulnerabilities to and risks from severe weather hazard incidents, and that pre-event planning, communication, and mitigation efforts should be implemented. Public education and outreach regarding areas of shelter that could be used by campus populations during severe weather events is considered by campus leadership to be one viable mitigation option. The campus planning committee will continue to look for feasible and cost-effective options for the mitigation of severe weather risks going forward.

Identified Data Limitations

Numerous federal agencies maintain a variety of records regarding losses associated with hazards. Unfortunately, no single source is considered to offer a definitive accounting of all losses. The Federal Emergency Management Agency (FEMA) maintains records on federal expenditures associated with declared major disasters. The US Army Corps of Engineers (USACE) and the Natural Resources Conservation Service (NRCS) collect data on losses during the course of some of their ongoing projects and studies. Additionally, the National Oceanic and Atmospheric Administration’s (NOAA) National Centers for Environmental Information (NCEI) collects and maintains data about natural hazards in summary format, as well as occurrences, dates, injuries, deaths, and estimated costs for individual storm events. Many of these databases and other data collection services, including the NCEI, have inherent data limitations when searching for information at a scale as small as a single campus.

The best available data and records have been used throughout this section. Where no data or records exist or could be located, that deficiency is noted.
15.4 Social Resilience Assessment

Overview

While every person is vulnerable to risk, individuals from diverse populations such as those with access and functional needs are disproportionately more vulnerable and may be at a higher risk to harm in a disaster event. In addition to physical vulnerabilities, the intersectionality between physical hazard risks and population social vulnerabilities must be considered to holistically address overall campus risk.

As inclusivity is a high priority for CSU, addressing campus risk and resilience must be done through the lens of inclusion and equity. Addressing social vulnerability is an increasingly critical requirement of state and national doctrines and described in Section 4.4 of the HVRA Base Plan. Every individual of the campus’s richly diverse population group needs to have the capacity, skills, and knowledge in order to understand, access, and participate in risk reduction and disaster response in ways that are meaningful to their own unique situation. In a campus community, having strong social support networks and active involvement in community disaster responses may negatively or positively impact these opportunities and reduce the resilience-building process. This section offers a glimpse into the CSU Monterey Bay campus’s unique social construct, population demographics, strengths and concerns and presents a high-level assessment of the resilience, coping capacities and potential social vulnerabilities of students, staff and faculty. The research variables that were asked are often considered sensitive subjects, and few are traditionally included in emergency management/hazard mitigation planning.

This social resilience assessment of college campuses is the first of its kind in the nation. The research methodology unfolded as the interviews with campuses progressed. The assessment data presented are not definitive or authoritative. The answers, analysis, and suggested trends are strictly indicators for potential social risk. They do not represent an accurate data capture as limitations on the data gathering process influenced an ability to provide accuracy. This assessment provides indications of increased risk, not accuracy of response or a true reflection of the situation of the campus. The information presented is to be considered in the context of the more detailed system-wide CSU social vulnerability assessment that is included in the baseline HVRA.

Campus-Identified Populations of Concern

During the campus interview, the following responses were provided when asked, “In considering the diverse population group(s) amongst student body, faculty and staff, which are of the most concern in your emergency management planning?”
### Table 15-34: High level summary of campus populations of concern

<table>
<thead>
<tr>
<th>Question</th>
<th>Campus Response</th>
</tr>
</thead>
</table>
| Which population groups amongst the student body, faculty, and staff, are of the most concern for physical and social vulnerabilities in emergency management planning? | ▪ Employees in rented employee housing  
▪ Disabled students and employees  
▪ Populations experiencing homelessness |
| Which population groups are most difficult to reach in an event?          | Partners who lease or rent facilities on campus                                   |
| Which population groups have little/limited support networks if impacted by an event? | ▪ Students and employees’ staff with access and functional needs  
▪ Populations with mental health needs  
▪ Students in the area alone |

**Resilience Variables Related to Campus Emergency Management**

The interviewees were asked to reflect on a set of 12 variables for the campus populations of student, faculty and staff: homelessness (*housing insecurity*), food security, health and wellness, disability/access and functional needs (AFN), racial equity, digital equity, communications, international students, immigrants/immigration status issues (*undocumented, DACA, etc.*), LGBTQI (Lesbian Gay Bisexual Transgender Questioning (or queer) Intersex), and transportation dependency. They were also offered an opportunity to add any other factor they wanted to include. The following two questions were asked:
- Is this factor a particular issue of concern for emergency management on your campus? Responses were summarized as **Very High, High, Medium, Low**
- Is this factor reflected in the emergency plans and processes for your campus? Responses were summarized as **Yes, No, In Progress, NA**

In order to provide a high-level qualitative response for the answers, the approach of averaging response was taken. If conflicting answers were expressed by the interviewees, the answer (code) was averaged out. A detailed explanation of the response averaging approach is included in the base HVRA.

Table 15-35: Campus-specific emergency management issues of concern and inclusion in emergency management plans and processes.

<table>
<thead>
<tr>
<th>Issue of Concern</th>
<th>Plans &amp; Processes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Homelessness (Housing Insecurity)</td>
<td>Very High</td>
</tr>
<tr>
<td>Food Security</td>
<td>Very High</td>
</tr>
<tr>
<td>Health &amp; Wellness</td>
<td>High</td>
</tr>
<tr>
<td>AFN</td>
<td>Very High</td>
</tr>
<tr>
<td>Racial Equity</td>
<td>Medium</td>
</tr>
<tr>
<td>Digital Equity</td>
<td>High</td>
</tr>
<tr>
<td>Comms.</td>
<td>Very High</td>
</tr>
<tr>
<td>International Students</td>
<td>Medium</td>
</tr>
<tr>
<td>Immigrants / Immigration Status</td>
<td>High</td>
</tr>
<tr>
<td>LGBTQI</td>
<td>Medium</td>
</tr>
<tr>
<td>Transportation Dependency</td>
<td>High</td>
</tr>
</tbody>
</table>

![Color key](image)
Qualitative Narrative: Campus Overview of Potential Resilience Vulnerabilities

The following are interview notes of interest:

- In some important areas there were disagreement in the answers.
- “Response Averaging” was used in the Table X: Issues of Concern and Inclusion in Emergency Management Plans and Processes to address disagreements.
- Food issues are the largest issues besides homelessness and financial. Need a generator in the cafeteria but permits for backup power is a huge issue.
- Health and wellness are in the plan for mass casualty instances and satellite locations; will make it more robust. Director of the health and wellness services serves as the IMT and is in the EOC.
- Ken Folsom is on the county AFN committee; AFN is incorporated it into the entire plan for communications and response. Have two positions as a tech specialist (with JOS/check lists) as AFN coordinators for any event to make sure it is in everything they do.
- For racial equity, they have a tight incident management team; as part of NIMS, they can pull anyone in to the IMT if having a student impacted to make sure to address issues. Not mentioned in the EOP, more in the plans but don’t want too much in the plans as they respond to everybody and don’t think this is a necessity.
- Social media plays a huge part in the plans and getting the message out. They have a few buildings on campus with no cell phone coverage (cell phone and text messages) – if so, will get an email. Looking at ALERTUS SYSTEM to interrupt the tv, cable. The gap needs to be filled in some areas of campus. access to outside of building PA SYSTEM – not designed to be heard in the building that is on the system. Must tie the computers into the network.
- International programs played a huge part in the onset of notifying the international students and have the director as part of the IMT. They do a great job and be more involved in that. Have worked with the state dept. While not in the EOP, they plan to expand this section.
- Immigrants and those with immigration status issues (undocumented, DACA, etc.) and related diverse populations are afraid. While not addressed in the EOP, the objectives of Residential Life address it in the shelter objectives.
- They don’t address LGBTQI issues directly as the plan is considered a whole community plan.
- Transportation dependency is an issue East campus because there is a large population of families living there and an issue if they must evacuate the east campus. Have an operational plan for evacuation in the EOP; especially noted the wildfire threats.
Campus High Hazards and Potentially Vulnerable Populations

This section provides a brief introduction to the link between socially vulnerable populations and a particular hazard type. While extensive research has been conducted on the impacts of hazards, not all linkages have been documented or published, and detail for finding them are beyond the scope of this assessment. It’s important to note, the intersectional nature of what makes an individual’s personal experience and resilience to an event is played out by unique factors for that individual or population. The nuanced social vulnerabilities often come from the social and physical environment in which a person is embedded.

In order to aid in further assessing campus resilience, below is a general description of the known impacts. From some hazards, the descriptions are robust, while others are only brief introductions.

Table 15-36: CSU Monterey Bay Highly Likely and Likely Hazards

<table>
<thead>
<tr>
<th>Hazard</th>
<th>Future Occurrence Probability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Communicable Disease</td>
<td>Highly Likely</td>
</tr>
<tr>
<td>Drought</td>
<td>Highly Likely</td>
</tr>
<tr>
<td>Earthquake</td>
<td>Possible</td>
</tr>
<tr>
<td>Erosion</td>
<td>Likely</td>
</tr>
<tr>
<td>Power Outage</td>
<td>Likely</td>
</tr>
<tr>
<td>Wildfire</td>
<td>Possible (Fire); Possible (Smoke)</td>
</tr>
</tbody>
</table>

Drought

The 2012-2016 drought had severe effects on two vulnerable sectors of our population: those in low-income brackets, and those, especially Native Americans, who rely on subsistence fishing for their livelihoods.\(^{185}\) Water bills increased throughout the state. Due to rising water prices, for the working poor, many have paid four to five percent of their income for water. Since many CSU students are commuters, and many living with families, future drought impacts may potentially affect a percentage of non-resident students. NASA’s modeling shows that future droughts are likely to last longer and be more intense, even leading to “megadroughts” in the western states.\(^{186}\) Fresh water supplies are predicted to be full of extremes, with both droughts and extreme

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precipitation events being more severe. The interrelationship between drought and other hazard conditions may lead to a set of secondary impacts. Drought conditions lead to water quality issues due to loss of drinking water, increased fire danger that leads to drought-induced fires and elevated AQI levels, as well as extreme heat or prolonged heat events.

**Earthquake**

Impacts on populations from earthquakes are complex, with long-term implications on social stability for all populations. In addition to the physical impact exposure during a no-notice earthquake event and the social and logistical challenges of a recovering community, an earthquake can have lasting impacts long afterwards due to post traumatic stress disorder (PTSD).

Socioeconomic vulnerabilities of populations at risk were analyzed in the hypothetical yet scientifically realistic earthquake sequence that is being used to better understand hazards for the San Francisco Bay region during and after a magnitude-7 earthquake (mainshock) on the Hayward Fault and its aftershocks. In this study, the at-risk populations located in areas of concentrated damage are anticipated to experience longer recovery trajectories, increased long term housing displacement, and transportation impacts due to dependencies on transit dependencies. When neighborhood schools close, families with school age children may move to other areas to keep their children in schools. Persons with access and functions needs are likely to be more dependent on access to functioning medical, social and personal health care services that would be overwhelmed by the event and therefore increasing their vulnerabilities. For the homeless populations, the loss of social community services and damages to shelters could add to protracted relocations. For the young and mobile populations who rent, the major disruption to housing, jobs and transit will also drive relocation. Widespread housing damage and preexisting housing market constraints will make it “extremely challenging” for the socially and economically vulnerable populations to find alternative housing near their home communities. Those who utilize interim and irregular housing for months and years after a disaster are more vulnerable to physical, social, and mental disorders, including suicide, substance abuse, and physical and verbal abuse. Aftershocks and post disaster conditions delay population return and increase outmigration.\(^{187}\)

**Erosion**

Risk from erosion relates to earthen and infrastructural losses. The degree of vulnerability to these events and their impacts depends on human behavior and the traditional social factors such as situational awareness, prior knowledge of hazards, social capital and

decision-making capabilities, as well as increased vulnerability due to social factors, such as racial and economic disparities.

**Power Outage/Public Safety Power Shutdowns (PSPS)**

Loss of power creates economic hardship to a region experiencing regular PSPS events, such as those experienced throughout the state over the recent years. Many businesses close, including gas stations, grocery stores, and local retail establishments. These impacts may deeply impact students dependent on support jobs, as well impacting family members of campus staff and faculty. PSPS increases risks to the public due to inability to use medical devices, spoilage of food and medicines, and disruption to infrastructure, such as supply of clean water and electricity used to run home medical equipment, such as lift chairs and ventilators.

**Wildfire**

Increased wildfire threat occurs especially in the end of fall, when conditions are driest, but before the winter rains have come; an east-to-west wind gusts exacerbate fire risk. Wildfire threats have the concomitant threat of Public Safety Power Shutoffs (PSPS). And, in the case of an actual wildfire, danger exists both from fire and from the smoke. Recent wildfires have demonstrated that some demographics are disproportionately affected. Native Americans are six times more likely to be affected than white people. Blacks and Hispanic people are 50 percent more vulnerable. These values take into account the likelihood of a community being affected and the greater difficulty of that community to recover. These statistics reflect the lack of access to resources to pay for insurance, to rebuild and recover, to implement fire safety measures, and to access other resources. Price gouging after a fire (such as documented in Sonoma County after the 2017 Tubbs Fire) further exacerbates the disparity. Furthermore, the disabled and the elderly are at particular risk from extreme wildfire conditions, as they are often not as able to effectively evacuate. Of the 85 people who died in the Camp Fire in Butte in 2018, 62 of them were at least 65 years old.

Smoke from wildfires creates a significant public health threat. Especially vulnerable are individuals who have heart or lung issues, such heart disease, lung disease or asthma. Those most vulnerable include the medically fragile, elderly and children.

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Indexes track the level of the following: particulate matter, surface levels of ozone, carbon monoxide, sulfur dioxide, and nitrogen dioxide. All of these can cause respiratory distress and harm lungs.

The California Department of Public Health reports the increased public health risks, and risk indicators that include: heat-related ED visits, populations living in wildfire areas, adults with multiple chronic conditions, populations living in poverty, race/ethnicity, outdoor workers, public transit access, air conditioner ownership and tree canopy.

Hazard Mitigation and Emergency Management Planning

The goal of this high-level assessment is to provide a starting point to encourage further exploring campus social risks and vulnerabilities, as well as to inform and to enhance holistic emergency management and hazard mitigation decision making, planning processes and future adaptive risk management strategies. By including the social resilience factors, mitigation investments may move beyond standardized planning and regulations, structure and infrastructure projects, and natural systems protections to embrace a more expanded, customized emergency operations plan and an education and outreach program unique to the campus.

A more robust social resilience inquiry is strongly encouraged to develop an accurate picture, based on methodical and scientific research-based data. Such an effort would be envisioned through both nuanced discussions with a variety of campus stakeholders and the invitation of nontraditional stakeholders to join in a collaborative resilience partnership. Such a forward-leaning effort would be directly in keeping with CSU’s commitment to inclusion and equity in risk reduction.


Section 16
California State University, Northridge

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16.1 University Profile

University History

In the fall of 1956, the San Fernando Valley campus of the Los Angeles State College of Applied Arts and Sciences was established on the present site of California State University, Northridge. California Legislative action in 1958 decreed that the campus would separate from its parent college (on July 1, 1958) to become San Fernando Valley State College. During the 1960s and into the early 1970s, San Fernando Valley State College evolved from a collection of temporary buildings into a true college campus. On June 1, 1972, San Fernando Valley State College was renamed California State University, Northridge (CSUN, for short), by action of the California Legislature and the Board of Trustees of the California State University. CSUN continued to grow both in enrollment and in academic offerings throughout the 1970s, 1980s, and early 1990s.

CSUN faced its greatest challenge as an institution when a devastating 6.7-magnitude earthquake struck the Northridge area on January 17, 1994, heavily damaging CSUN facilities. Numerous buildings on campus, including the University Library, suffered severe damage, and one of the parking structures collapsed entirely. In addition, the South Library was condemned and later demolished. However, the spring semester of that year began after a delay of only two weeks, with temporary buildings set up to conduct regular classes during the reconstruction effort. The library was restored to service by the fall of 1994, though the east and west wings had to be completely rebuilt and did not regain full service until the fall of 2000. Post-earthquake recovery concluded with the construction of the new Administration Building, University Hall, in 2003.

Today, CSUN is one of the largest campuses of the 23-campus California State University system. CSUN’s commitment to student success, inclusivity, and community involvement has gained notoriety for the university, and CSUN has been designated as both a Hispanic-Serving Institution (HSI) and an Asian American and Native American Pacific Islander-Serving Institution (AANAPISI).

University Governance

The campus president is the chief executive officer who oversees the administration of the entire university. The president manages campus operations and fundraising, sets campus priorities, and oversees the hiring and support of staff and faculty. The president also maintains a close working relationship with the CSU’s systemwide office, reporting to the chancellor and participating in the systemwide Executive Council.

The provost is the chief academic officer of the university, overseeing all academic affairs and programs of the university. The provost reports directly to the president.
CSUN’s university governance also includes five (5) campus divisions and twenty-one (21) university-level advisory committees. The advisory committees must fulfill at least one of the following criteria:

1. Serves as a standing advisory committee to the president
2. Addresses a CSU directive, executive order, or other state requirement
3. Serves in a community relations capacity

University Mission

“California State University, Northridge exists to enable students to realize their educational goals. The University’s first priority is to promote the welfare and intellectual progress of students. To fulfill this mission, we design programs and activities to help students develop the academic competencies, professional skills, critical and creative abilities, and ethical values of learned persons who live in a democratic society, an interdependent world, and a technological age; we seek to foster a rigorous and contemporary understanding of the liberal arts, sciences, and professional disciplines, and we believe in the following values.”

CSU Northridge highlights core values fundamental to the University’s success; Commitment to Teaching, Scholarship, and Active Learning, Commitment to Excellence, Respect for All People, Alliances with the Community, and Encouragement of Innovation, Experimentation, and Creativity.

University Location

CSUN is located in Northridge, a neighborhood of Los Angeles. The campus is approximately 25 miles northwest of Downtown Los Angeles, near the geographic center of the San Fernando Valley.

University Population

CSUN has a total enrollment of 38,815 undergraduate and graduate students combined. The full-time enrollment is 33,093 students and the part-time enrollment is 5,722 students.

The enrolled Fall 2020 student population at CSUN, both undergraduate and graduate, is 54.2% Latinx, 22.1% White, 9.4% Asian American, 4.6% African American, 2.9% Two or More Races, 0.1% American Indian or Alaska Native, and 0.1% Native Hawaiian or Other Pacific Islanders.

The most popular Bachelor’s Degree concentrations at CSUN are General Psychology, Sociology, and General Business Administration & Management. CSUN is primarily a commuter campus.
16.2 Interim Final Rule for Hazard Vulnerability and Risk Assessment

Requirement §201.6(c)(2): The plan shall include a risk assessment that provides the factual basis for activities proposed in the strategy to reduce losses from identified hazards. Local risk assessments must provide sufficient information to enable the jurisdiction to identify and prioritize appropriate mitigation actions to reduce losses from identified hazards.

Requirement §201.6(c)(2)(i): [The risk assessment shall include a] description of the type...location and extent of all natural hazards that can affect the jurisdiction. The plan shall include information on previous occurrences of hazard events and on the probability of future hazard events.

Requirement §201.6(c)(2)(ii): [The risk assessment shall include a] description of the jurisdiction’s vulnerability to the hazards described in paragraph (c)(2)(i) of this section. This description shall include an overall summary of each hazard and its impact on the community.

Requirement §201.6(c)(2)(ii): [The risk assessment] must also address National Flood Insurance Program (NFIP) insured structures that have been repetitively damaged floods.

Requirement §201.6(c)(2)(ii)(A): The plan should describe vulnerability in terms of the types and numbers of existing and future buildings, infrastructure, and critical facilities located in the identified hazard area.

Requirement §201.6(c)(2)(ii)(B): [The plan should describe vulnerability in terms of an] estimate of the potential dollar losses to vulnerable structures identified in paragraph (c)(2)(ii)(A) of this section and a description of the methodology used to prepare the estimate ..

Requirement §201.6(c)(2)(ii)(C): [The plan should describe vulnerability in terms of] providing a general description of land uses and development trends within the community so that mitigation options can be considered in future land use decisions.

Requirement §201.6(c)(2)(iii): For multi-jurisdictional plans, the risk assessment must assess each jurisdiction’s risks where they vary from the risks facing the entire planning area.

16.3 Hazard Identification and Risk Assessment

Overview of California State University, Northridge History of Hazards

Numerous federal agencies maintain a variety of records regarding losses associated with hazards. Unfortunately, no single source is considered to offer a definitive accounting of all losses. The Federal Emergency Management Agency (FEMA)
maintains records on federal expenditures associated with declared major disasters. The US Army Corps of Engineers (USACE) and the Natural Resources Conservation Service (NRCS) collect data on losses during the course of some of their ongoing projects and studies. Additionally, the National Oceanic and Atmospheric Administration’s (NOAA) National Centers for Environmental Information (NCEI) database collects and maintains data about natural hazards in summary format. The data includes occurrences, dates, injuries, deaths, and estimated costs. Many of these databases and other data collection services, including the NCEI, have inherent data limitations when searching for information at a university scale.

The best available data and records were used throughout this assessment.

Hazard Identification

As part of the initial hazard identification process, the Campus Assessment Team considered potential hazards with the most chance to significantly affect the planning area. The hazards include those that have occurred in the past and may occur in the future. A variety of sources were used to develop the list of hazards considered including national, regional, and local sources such as emergency operations plans, FEMA’s How-To Series, websites, published documents, databases, and maps, as well as discussion among the Campus Assessment Team members.

In the initial phase of the planning process, the Campus Assessment Team considered 14 hazards and the risks they create for the University and its material assets, population, and operations. The hazards initially considered, and the determinations as to the treatment of those hazards, are shown in Table 16-1 (following).
Table 16-1: Hazard Identification Determinations

<table>
<thead>
<tr>
<th>Hazard</th>
<th>Determination (Yes/No)</th>
<th>Reason for Determination</th>
<th>Future Occurrence Probability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Communicable Disease</td>
<td>Yes</td>
<td>Hazard of concern for campus</td>
<td>Highly Likely</td>
</tr>
<tr>
<td>Dam and Levee Failure</td>
<td>Yes</td>
<td>Hazard of concern for campus</td>
<td>Unlikely</td>
</tr>
<tr>
<td>Drought</td>
<td>Yes</td>
<td>Hazard of concern for campus</td>
<td>Highly Likely</td>
</tr>
<tr>
<td>Earthquake</td>
<td>Yes</td>
<td>Hazard of concern for campus</td>
<td>Possible</td>
</tr>
<tr>
<td>Erosion</td>
<td>Yes</td>
<td>Hazard of concern for campus</td>
<td>Likely</td>
</tr>
<tr>
<td>Extreme Temperature</td>
<td>Yes - Heat; No - Cold</td>
<td>Hazard of concern for campus</td>
<td>Possible (Heat only)</td>
</tr>
<tr>
<td>Flood</td>
<td>Yes</td>
<td>Hazard of concern for campus</td>
<td>Unlikely</td>
</tr>
<tr>
<td>Hazardous Materials</td>
<td>Yes</td>
<td>Hazard of concern for campus</td>
<td>Possible</td>
</tr>
<tr>
<td>Landslide</td>
<td>Yes</td>
<td>Hazard of concern for campus</td>
<td>Possible</td>
</tr>
<tr>
<td>Power Outage</td>
<td>Yes</td>
<td>Hazard of concern for campus</td>
<td>Likely</td>
</tr>
<tr>
<td>Sea Level Rise</td>
<td>No</td>
<td>Not a hazard of concern for campus</td>
<td>N/A</td>
</tr>
<tr>
<td>Tsunami</td>
<td>No</td>
<td>Not a hazard of concern for campus</td>
<td>N/A</td>
</tr>
<tr>
<td>Volcano</td>
<td>Yes</td>
<td>Hazard of concern for campus</td>
<td>Unlikely</td>
</tr>
<tr>
<td>Wildfire</td>
<td>Yes</td>
<td>Hazard of concern for campus</td>
<td>Unlikely (Fire); Possible (Smoke)</td>
</tr>
</tbody>
</table>

**Future Occurrence Probability**

In order to determine the probability of future occurrences of each hazard profiled, the following scale was developed:

- Highly Likely- 76%-100% that the hazard would occur annually.
- Likely- 50%-75% that the hazard would occur annually.
- Possible- 11%-49% that the hazard would occur each annually.
- Unlikely- 0%-10% that the hazard would occur each annually.
**Communicable Disease**

**Description of the Hazard**

Communicable diseases are illnesses that occur due to infectious agents or their toxic products and are infectious due to their potential of transmission from one person or species to another by a replicating agent. They may be transmitted from a reservoir to a susceptible host either directly as from an infected person or animal or indirectly through the agency of an intermediate plant or animal host, vector, or the inanimate environment. Communicable diseases are clinically evident illness resulting from the presence of pathogenic microbial agents, including pathogenic viruses, pathogenic bacteria, fungi, protozoa, multi-cellular parasites, and aberrant proteins known as prions. The degree of spread of a communicable disease depends on both the ability of an organism to enter, survive and multiply in the host and the comparative ease with which the disease is transmitted to other hosts.

Some ways in which communicable diseases spread are by:

- Travel through the air, such as tuberculosis, measles, or COVID-19;
- Physical contact with an infected person, such as through touch (staphylococcus), sexual intercourse (gonorrhea, HIV), fecal/oral transmission (hepatitis A), or droplets (influenza, TB, COVID-19);
- Contact with a contaminated surface or object (Norwalk virus), food (salmonella, E. coli), blood (HIV, hepatitis B), or water (cholera); and
- Bites from insects or animals capable of transmitting the disease (mosquito: malaria and yellow fever; flea: plague)

Collectively, the twenty-three (23) campuses and Chancellor’s Office of the California State University (CSU) system have identified nine (9) communicable disease hazards that have had significant impacts on their respective student, faculty, and staff populations. Of these communicable diseases, COVID-19 is considered to be the most prominent and widespread agent across all CSU campuses. (See Table 16-2 below.)

---


Table 16-2: Communicable Diseases at Identified CSU Campuses

<table>
<thead>
<tr>
<th>Collective List of Communicable Diseases Identified by All CSU Campuses</th>
<th>Number of CSU Campuses (Including Chancellor’s Office) Identifying Communicable Disease Having Significant Impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>COVID-19 (SARS-CoV-2)</td>
<td>24</td>
</tr>
<tr>
<td>Meningitis</td>
<td>7</td>
</tr>
<tr>
<td>Measles</td>
<td>6</td>
</tr>
<tr>
<td>Influenza (Including H1N1/Swine Flu)</td>
<td>6</td>
</tr>
<tr>
<td>Tuberculosis</td>
<td>5</td>
</tr>
<tr>
<td>Norovirus</td>
<td>4</td>
</tr>
<tr>
<td>Mumps</td>
<td>2</td>
</tr>
<tr>
<td>E. Coli</td>
<td>2</td>
</tr>
<tr>
<td>Sexually Transmitted Diseases (STDs)</td>
<td>2</td>
</tr>
</tbody>
</table>

(Source: Interviews with CSU campus staff at CSU campuses and at CSU Chancellor’s Office.)

With the exception of COVID-19, there is variability among CSU campuses regarding which communicable diseases have had the greatest impact on individual campus communities. Table 16-3 shows the communicable disease hazards that have had the greatest impact on each CSU campus.

Table 16-3: Communicable Disease Hazards at CSU Campuses with Greatest Impact

<table>
<thead>
<tr>
<th>CSU Campus</th>
<th>Identified Communicable Disease Hazards with the Greatest Impact on CSU Campus</th>
</tr>
</thead>
<tbody>
<tr>
<td>CSU Bakersfield</td>
<td>COVID-19, Meningitis</td>
</tr>
<tr>
<td>CSU Channel Islands</td>
<td>COVID-19, Measles</td>
</tr>
<tr>
<td>Chico State</td>
<td>COVID-19, Tuberculosis</td>
</tr>
<tr>
<td>CSU Dominguez Hills</td>
<td>COVID-19</td>
</tr>
<tr>
<td>Cal State East Bay</td>
<td>COVID-19, Meningitis</td>
</tr>
<tr>
<td>Fresno State</td>
<td>COVID-19, Meningitis, Tuberculosis</td>
</tr>
<tr>
<td>Cal State Fullerton</td>
<td>COVID-19, Influenza</td>
</tr>
<tr>
<td>Humboldt State</td>
<td>COVID-19, Measles, Norovirus, Influenza, STDs</td>
</tr>
<tr>
<td>Cal State Long Beach</td>
<td>COVID-19</td>
</tr>
</tbody>
</table>
Descriptions of Identified Communicable Disease Hazards at CSUN (Northridge) CSU Northridge (CSUN) has identified two (2) communicable disease hazards that have had the greatest impact on campus – COVID-19 and Measles. The following are brief descriptions of the communicable disease hazards at CSUN.

**COVID-19 (SARS-CoV-2)**

Coronaviruses are a family of viruses that can cause illnesses such as the common cold, severe acute respiratory syndrome (SARS) and Middle East respiratory syndrome (MERS). In 2019, a new coronavirus was identified as the cause of a disease outbreak that originated in China. This virus is now known as the **severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2)**. The disease it causes is called Coronavirus Disease 2019 (COVID-19). In March 2020, the World Health Organization (WHO) declared the COVID-19 outbreak a pandemic.

Signs and symptoms of coronavirus disease 2019 (i.e., COVID-19) may appear two to 14 days after exposure. Common signs and symptoms can include fever, cough, and tiredness. Early symptoms of COVID-19 may also include a loss of taste or smell.
The virus that causes COVID-19 spreads easily among people, and more continues to be discovered over time about how it spreads. Data has shown that the COVID-19 virus spreads mainly from person to person among those in close contact (within about 6 feet, or 2 meters). The virus is transmitted by respiratory droplets being released when someone with the virus coughs, sneezes, breathes, sings or talks. These droplets can be inhaled or land in the mouth, nose or eyes of a person nearby. In some situations, the COVID-19 virus can spread by a person being exposed to small droplets or aerosols that stay in the air for several minutes or hours (i.e., airborne transmission). It's not yet known how common it is for the virus to spread this way. The COVID-19 virus can also spread if a person touches a surface or object with the virus on it and then touches his or her mouth, nose or eyes; however, this is not considered to be a main way it spreads.

The severity of COVID-19 symptoms can range from very mild to severe. Some people may have only a few symptoms, and some people may have no symptoms at all. However, some people may experience worsened symptoms, such as worsened shortness of breath and pneumonia. People who are older have a higher risk of serious illness from COVID-19, and the risk increases with age. People who have existing medical conditions also may have a higher risk of serious illness from COVID-19. In some cases, the disease can cause severe medical complications and may even lead to death.⁵

**Measles**

Measles (also known as rubeola) is a highly contagious childhood infection caused by a virus. The measles virus replicates in the nose and throat of an infected child or adult. Then, when someone with measles coughs, sneezes or talks, infected droplets spray into the air, where other people can inhale them. The infected droplets may also land on a surface, where they remain active and contagious for several hours. The virus is contracted by putting touching one’s nose, mouth, or eyes after touching the infected surface.

Measles can be serious and even fatal for small children. The disease still kills more than 100,000 people a year worldwide, most under the age of 5. However, as a result of high vaccination rates in general, measles hasn’t been widespread in the United States for more than a decade.⁶

**Location of the Hazard**

Communicable diseases have the potential to affect the entire CSUN (Northridge) planning area equally. As a result, the communicable disease hazard can be found at the CSU Northridge (CSUN) campus, located in the Northridge neighborhood of the

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City of Los Angeles (Los Angeles County). Because of the ubiquitous nature of many communicable diseases, students, faculty, staff at (and visitors to) students, faculty, and staff at CSUN are at risk of exposure to the communicable disease hazard.

**CSU Student Housing Locations and Populations**

Although CSU-campus-owned student housing opportunities have been severely limited due to the COVID-19 pandemic, this situation is temporary. Eventually, students will be allowed back on campus at full capacity, and many of these students will be living in campus-owned housing. When this occurs, over 53,000 students (i.e., just over 11% of the CSU total enrollment) will be at increased risk of exposure to communicable disease hazards, owing to the “close-quarters” living arrangements in student housing. For CSUN, approximately 8% of its 38,391 enrolled students (or 3,071 students) reside in student housing.

**Extent of the Hazard**

Various communicable diseases are categorized by the Center for Disease Control and Prevention (CDC) by levels of containment called Biosafety Levels (or BSLs). The higher the BSL, the greater the level of containment and level of effort necessary to prevent transmission of the disease, and therefore the greater the hazard. Biosafety Levels prescribe procedures and levels of containment for a particular microorganism or material (including research involving recombinant or synthetic nucleic acid molecules) and procedures associated with that containment. BSLs also consider primary barriers (e.g., biosafety cabinets), secondary barriers, facility design, air handling, laboratory security, etc. BSLs are graded from 1 to 4; as the BSL increases so does the relative risk of the agent/procedures as well the stringency of procedures and facility design.

Figure 16-1 describes the different BSLs, and provides examples of communicable diseases that would typically fall in to these classifications, as well as the typical protections that would be necessary to prevent transmission of each of the diseases.
The Extent of CSUN (Northridge) Communicable Disease Hazards Except COVID-19:

Before the COVID-19 pandemic, there were cases of Measles at CSUN (Northridge). Measles would be classified at the BSL-2 containment level. (Source: Stanford University Environmental Health and Safety. 8

The Extent of CSUN (Northridge) COVID-19 Communicable Disease Hazard:

As a microorganism, the SARS-CoV-2 (COVID-19) virus requires a high level of containment. It is therefore classified at BSL-3. 9

History of the Hazard

Over an approximately one-year period, from mid-March, 2020 to June 7, 2021, there were a reported 272 cases of COVID-19 at CSUN. Most communicable disease data are maintained by at the state and at the county levels and are not generally available at the municipal or campus levels, unless (a) the CSU campus falls under the jurisdiction of a city-level health department, or (b) a geographically specific outbreak occurs on campus or in the local community. The exception to this is the current COVID-19 pandemic, where both campus and County-level case data have been collected. As a

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result, it is important to provide COVID-19 case statistics for both CSU campuses and the counties where CSU campus assets are located.

Tables 16-5 and 16-6 show campus-level and County-level COVID-19 Case data for CSUN (Northridge). These case data are updated on at least a weekly basis. (Please note that the COVID-19 case numbers here may not reflect the most recent updates.)

Table 16-4: Cumulative Confirmed Cases at CSUN (from March, 2020 through 06/07/2021)\textsuperscript{10}

<table>
<thead>
<tr>
<th>COVID-19 Classification</th>
<th>Reported Cases (updated weekly, data current through 6/7/21)</th>
<th>Number of cases reported due to on-campus exposure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Students</td>
<td>148</td>
<td>6</td>
</tr>
<tr>
<td>Employees</td>
<td>111</td>
<td>0</td>
</tr>
<tr>
<td>Contract/Affiliate</td>
<td>13</td>
<td>0</td>
</tr>
<tr>
<td>(non-employees)</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Totals</strong></td>
<td><strong>272</strong></td>
<td><strong>6</strong></td>
</tr>
</tbody>
</table>

Table 16-5: Los Angeles County COVID-19 Statistics (as of 03/17/2021):\textsuperscript{11}

<table>
<thead>
<tr>
<th>COVID-19 Classification</th>
<th>Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cases</td>
<td>1,149,878</td>
</tr>
<tr>
<td>Deaths</td>
<td>21,449</td>
</tr>
</tbody>
</table>


Potential Impacts of the Hazard

Communicable disease outbreaks and pandemics potentially have (and will continue to have) direct impact on life, health, and safety across the CSU system (including the CSUN campus). The extent of this impact is contingent on the type of infection or contagion, the severity of the outbreak, and the speed at which it is transmitted. Property and infrastructure integrity may be affected if large portions of the campus population contract communicable diseases at the same time and are therefore unable to perform maintenance, operations, and educational tasks. This would be particularly disruptive if those impacted are first responders or other essential personnel. Long-term outbreaks affecting large numbers of CSUN students could result in cancelled classes, delayed matriculation, or other disruptions to the CSU System’s mission. This has already occurred with the current COVID-19 pandemic, and could occur again with more virulent strains of communicable diseases, including COVID-19.

Communicable disease hazards found across the CSU system (including CSUN) vary both by level of containment (BSL) (described previously) and by level of individual/public health risk, or Risk Group (RG) level. While BSLs describe the procedures and required levels of containment in a laboratory setting, Risk Groups (RGs) reflect the potential effects of disease exposure on humans or animals. Like BSLs, RGs range from Level 1 (RG1) to Level 4 (RG4), with Level 1 (RG1) posing minimal risk to healthy individuals and public health and Level 4 (RG4) posing a very serious or extreme risks to individuals and public. BSLs generally correlate with Risk Group (RG) Levels (e.g., a RG2 agent is worked with at BSL-2), but there are exceptions (e.g., production volumes, high-risk procedures, etc.).

The World Health Organization’s (WHO) Laboratory Biosafety Manual, 3rd ed., NIH Guidelines, categorizes Risk Groups (RGs) in the following way:

### Table 16-6: WHO Risk Group Categorization

<table>
<thead>
<tr>
<th>Risk Group (RG)</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>RG1</td>
<td>Rarely associated with disease in healthy adult humans or animals and pose no-to-little public health risk (e.g., Saccharomyces cerevisiae, E. coli K-12 strain derivatives often used for recombinant/molecular biology, many environmental organisms)</td>
</tr>
<tr>
<td>RG2</td>
<td>Associated with mild to moderate disease for which preventative measures or post exposure treatments are often available; public health impact is limited (e.g., Streptococcus pyogenes, Salmonella, hepatitis B virus)</td>
</tr>
<tr>
<td>RG3</td>
<td>Associated with serious to lethal human disease for which preventative vaccines or post-exposure therapies may be scarce. Public health impact is limited-to-moderate (e.g., Mycobacterium tuberculosis, hantaviruses, West Nile virus, SARS)</td>
</tr>
<tr>
<td>RG4</td>
<td>Associated with serious to lethal human disease for which preventative vaccines or post exposure therapies are not usually available. Public health impact is high (e.g., Ebola virus, Marburg virus, smallpox virus, etc.)</td>
</tr>
</tbody>
</table>

Table 16-8 describes the four (4) Risk Group Levels (RGs), and provides examples of communicable diseases that would typically fall in to these classifications, and the typical protections that would be necessary to prevent transmission of the disease. It is important to note that all but two (2) communicable disease hazards identified by CSU campuses fall under either the lower-risk RG1 or RG2 categories. COVID-19 and tuberculosis are the two (2) communicable diseases that fall under the higher-risk RG3 category. However, with the advent of the recently-developed COVID-19 vaccine, and with the expectation of an increasingly robust vaccine supply, it is possible that the RG level for COVID-19 could be lowered in the future, thereby reducing both the extent and the potential impact of COVID-19.

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Table 16-7: Risk Group Levels (RGs) with Example Diseases and Recommended Precautions

<table>
<thead>
<tr>
<th>Level</th>
<th>Examples</th>
<th>Typical Protection to Prevent Transmission</th>
</tr>
</thead>
<tbody>
<tr>
<td>RG 1</td>
<td>E. Coli</td>
<td>Precautions are minimal, most likely involving gloves and some sort of facial protection. Usually, contaminated materials are left in open (but separately indicated) waste receptacles. Decontamination procedures for this level are similar in most respects to modern precautions against everyday viruses (i.e.: washing one's hands with anti-bacterial soap, washing all exposed surfaces of the lab with disinfectants, etc.).</td>
</tr>
<tr>
<td>RG 2</td>
<td>Chicken Pox</td>
<td>These bacteria and viruses cause mild disease in humans or are difficult to contract via aerosol. Routine diagnostic work with clinical specimens can be done safely at BSL-2, using BSL-2 practices and procedures.</td>
</tr>
<tr>
<td></td>
<td>Hepatitis A, B, C</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Lyme disease</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Salmonella</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Mumps</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Measles</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Malaria</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Scrapie</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Dengue Fever</td>
<td></td>
</tr>
<tr>
<td></td>
<td>HIV</td>
<td></td>
</tr>
</tbody>
</table>

---

### RG 3

<table>
<thead>
<tr>
<th>Anthrax</th>
<th>West Nile Virus</th>
</tr>
</thead>
<tbody>
<tr>
<td>SARS Virus (Including COVID-19)</td>
<td>Tuberculosis</td>
</tr>
<tr>
<td>Typhus</td>
<td>Yellow Fever</td>
</tr>
<tr>
<td>Hantaviruses</td>
<td>Avian Flu</td>
</tr>
</tbody>
</table>

These bacteria and viruses cause severe to fatal disease in human, but vaccines or other treatments do exist to combat them. Laboratory personnel have specific training in handling pathogenic and potentially lethal agents and are supervised by competent scientists who are experienced in working with these agents. This is considered a neutral or warm zone.

### RG 4

<table>
<thead>
<tr>
<th>H5N1 (Bird Flu)</th>
<th>Dengue Hemorrhagic Fever</th>
</tr>
</thead>
<tbody>
<tr>
<td>Marburg Virus</td>
<td>Ebola Virus</td>
</tr>
<tr>
<td>Smallpox</td>
<td>Lassa Fever</td>
</tr>
<tr>
<td>Crimean-Congo Hemorrhagic Fever</td>
<td>Other Hemorrhagic Diseases</td>
</tr>
</tbody>
</table>

These viruses and bacteria cause severe to fatal disease in humans, for which vaccines or other treatments are not available. When dealing with biological hazards at this level the use of a Hazmat suit and a self-contained oxygen supply is mandatory. The entrance and exit of a BSL-4 lab will contain multiple showers, a vacuum room, an ultraviolet light room, autonomous detection system, and other safety precautions designed to destroy all traces of the biohazard. Multiple airlocks are employed and are electronically secured to prevent both doors opening at the same time. All air and water service going to and coming from a BSL-4 lab will undergo similar decontamination procedures to eliminate the possibility of an accidental release.

### Probability of Future Occurrence of the Hazard

There have been cases of a variety of communicable disease throughout the CSU system, including COVID-19 (SARS-CoV-2), Meningitis, Measles, Influenza (Including H1N1/Swine Flu), Tuberculosis, Norovirus, Mumps, E. Coli, and Sexually Transmitted Diseases (STDs). However, there are significant data limitations regarding non-COVID-19 communicable disease cases, as the information thereof is outdated, anecdotal, and/or inadequate. As a result, it is not feasible to provide quantitative probabilities of future occurrence for non-COVID-19 communicable disease hazards. However, based on the limited data, it is feasible to present qualitative probabilities of future occurrence based on ranges of communicable disease frequency.
Table 16-9 shows a probability scale of future occurrence for the nine (9) communicable disease hazards profiled in this assessment. This scale is divided into four (4) levels of probability:

Table 16-8: Likelihood of Future Hazard Occurrence

<table>
<thead>
<tr>
<th>Likelihood</th>
<th>Parameters for Determining Likelihood</th>
</tr>
</thead>
<tbody>
<tr>
<td>Highly Likely</td>
<td>76 – 100% probability that hazard will occur annually (high to very high frequency)</td>
</tr>
<tr>
<td>Likely</td>
<td>50 – 75% probability that hazard will occur annually (moderate to high frequency)</td>
</tr>
<tr>
<td>Possible</td>
<td>11 – 49% probability that hazard will occur annually (low to moderate frequency)</td>
</tr>
<tr>
<td>Unlikely</td>
<td>0 – 10% probability that hazard will occur annually (very low to low frequency)</td>
</tr>
</tbody>
</table>

Due to significant data limitations surrounding non-COVID communicable diseases, the probability of future occurrence of CSU-system-wide communicable disease is measured by the proportion of campuses that have identified a particular communicable disease as having an impact on the campus community. In this measure, the more frequent a communicable disease is seen as impactful CSU-wide, the greater the probability of future occurrence. Note: Each communicable disease’s probability of future occurrence ranking CSU-system-wide reflects the ranking at the individual CSU campus level unless noted otherwise.

Table 17-9: Probability of Future Occurrence of Communicable Disease Hazard for CSU System

<table>
<thead>
<tr>
<th>Collective List of Communicable Diseases Identified by All CSU Campuses</th>
<th>Number of CSU Campuses (Including Chancellor’s Office) Identifying Communicable Disease Having Significant Impact</th>
<th>Proportion of CSU Campuses Identifying Communicable Disease as Having Significant Impact System-Wide</th>
<th>CSU System-Wide Probability Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>COVID-19 (SARS-CoV-2)</td>
<td>24</td>
<td>1.00</td>
<td>Highly Likely</td>
</tr>
<tr>
<td>Meningitis</td>
<td>7</td>
<td>0.29</td>
<td>Possible</td>
</tr>
<tr>
<td>Measles</td>
<td>6</td>
<td>0.25</td>
<td>Possible</td>
</tr>
<tr>
<td>Influenza (Including H1N1/Swine Flu)</td>
<td>6</td>
<td>0.25</td>
<td>Possible</td>
</tr>
<tr>
<td>Tuberculosis</td>
<td>5</td>
<td>0.21</td>
<td>Possible</td>
</tr>
</tbody>
</table>
Norovirus | 4 | 0.17 | Possible
Mumps | 2 | 0.08 | Unlikely
E. Coli | 2 | 0.08 | Unlikely
Sexually Transmitted Diseases (STDs) | 2 | 0.08 | Unlikely

(Source: Interviews with staff at CSU campuses and at the CSU Chancellor’s Office.)

Vulnerability to the Hazard

Vulnerability to a communicable diseases hazard resides in the population of a given area – both human and animal – not in the infrastructure or physical assets. While CSU assets and infrastructure could be impacted indirectly by the communicable disease hazard, these impacts would be secondary to the impact that the communicable disease hazard would have on students, faculty, staff, and visitors at CSU campuses. CSU campus settings are geographically diverse, with locations ranging from small towns to medium-sized cities to densely populated urban areas. Hundreds of thousands of people work, study, and/or pass through CSU campuses on any given day. (As of Fall 2019, CSU - Northridge had 38,391 students and additional faculty and staff.)\(^{15,16}\) Each of these persons is vulnerable to communicable disease, particularly if it is a pathogen that individual has not been immunized against, or for which no immunization exists. Prolonged outbreaks could result in a loss of services, failure of infrastructure (from lack of operators or maintenance), and closure of facilities. This exact scenario has played out in the current COVID-19 pandemic at CSUN.

Estimate of Potential Losses

COVID-19 Pandemic Health Impact on CSU Campuses and Surrounding Communities

The most prescient metric for estimating losses from COVID-19 is loss of life. The nationwide campus-related COVID-19 death rate of 0.02% remains well below the average COVID-19 death rate in the U.S. However, due to data limitations, there is no information on CSU-campus-specific deaths by COVID-19 or by any other communicable diseases. In fact, COVID-19 is the only communicable disease for which case reports have been readily available for CSU campuses.

At some point in the future, CSU campuses will return to full capacity. Without adequate surveillance regarding campus access and student and employee interaction, CSU campuses (including CSUN) are at risk of developing an extreme

\(^{15}\) The California State University. Enrollment. Retrieved 05.03.2021 from: https://www2.calstate.edu/csu-system/about-the-csu/facts-about-the-csu/enrollment/Pages/default.aspx

\(^{16}\) The California State University. Employee Head Count by Campus. Retrieved 05.03.2021 from: https://www2.calstate.edu/csu-system/faculty-staff/employee-profile/csu-workforce/Pages/employee-headcount-by-campus.aspx
incidence of COVID-19, and may become “super-spreaders” for adjacent communities. The emergence of more virulent COVID-19 variants would only add to the potential for high negative impacts on life safety, operations, and service delivery across the CSU system. (Other communicable diseases would also re-emerge, but with low to moderate negative impacts on life safety, operations, and service delivery.)

**Economic Impact of COVID-19 Pandemic on CSU Financial Health**

During the first few months of the COVID-19 pandemic in 2020, the CSU system suffered tremendous negative fiscal impacts. From March through July of 2020 alone, over $146 million worth of revenue losses were sustained across the CSU system due to refunds to students for parking, housing and dining service fees during Spring Semester, 2020. (See Figure 16-2 below for the economic impact to the SJSU campus). Several CSU campuses saw refund losses surpass $10 million. (See Figure 16-2.)

Figure 16-2: CSU COVID-19 Cost Tracking Showing Revenue Refund Losses and Increased Costs

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Mitigative Relief from Federal Assistance

The $1.5 billion in total federal assistance sent to the CSU system will help relieve the losses of revenues from services like dorms, parking and dining services during a year of mainly empty campuses. (See Table 16-11.) However, because of staggering COVID-related revenue losses, the CSU system is planning for three (3) years of fiscal duress.

Table 16-10: Total Federal Assistance to CSU for COVID-19 Related Losses, 2020 – 2021

<table>
<thead>
<tr>
<th>Institution</th>
<th>December 2020 Stimulus</th>
<th>CARES Act</th>
<th>APLU Projection of HEERF Total ARP Act Funding Allocation</th>
<th>Total Estimated Federal COVID Relief Funding</th>
</tr>
</thead>
<tbody>
<tr>
<td>California Polytechnic State University</td>
<td>$20,752,799</td>
<td>$14,725,000</td>
<td>$37,000,928</td>
<td>$72,478,727</td>
</tr>
<tr>
<td>California State Polytechnic University, Pomona</td>
<td>$48,614,353</td>
<td>$31,102,000</td>
<td>$86,044,649</td>
<td>$165,761,002</td>
</tr>
<tr>
<td>California State University Channel Islands</td>
<td>$14,288,099</td>
<td>$8,512,000</td>
<td>$24,915,170</td>
<td>$47,715,269</td>
</tr>
<tr>
<td>California State University Maritime Academy</td>
<td>$1,381,700</td>
<td>$1,204,000</td>
<td>$2,472,622</td>
<td>$5,058,322</td>
</tr>
<tr>
<td>California State University - Sacramento</td>
<td>$59,891,260</td>
<td>$35,643,000</td>
<td>$104,900,133</td>
<td>$200,434,393</td>
</tr>
<tr>
<td>California State University, Bakersfield</td>
<td>$22,855,632</td>
<td>$12,483,000</td>
<td>$40,285,565</td>
<td>$75,624,197</td>
</tr>
</tbody>
</table>


<table>
<thead>
<tr>
<th>University</th>
<th>2011-12</th>
<th>2012-13</th>
<th>2013-14</th>
<th>2014-15</th>
</tr>
</thead>
<tbody>
<tr>
<td>California State University, Chico</td>
<td>$31,603,856</td>
<td>$20,019,000</td>
<td>$55,754,538</td>
<td>$107,377,394</td>
</tr>
<tr>
<td>California State University, Dominguez Hills</td>
<td>$31,843,563</td>
<td>$18,312,000</td>
<td>$55,915,410</td>
<td>$106,070,973</td>
</tr>
<tr>
<td>California State University, East Bay</td>
<td>$24,243,652</td>
<td>$14,394,000</td>
<td>$42,929,208</td>
<td>$81,566,860</td>
</tr>
<tr>
<td>California State University, Fresno</td>
<td>$52,725,317</td>
<td>$32,557,000</td>
<td>$92,926,594</td>
<td>$178,208,911</td>
</tr>
<tr>
<td>California State University, Fullerton</td>
<td>$67,736,949</td>
<td>$41,088,000</td>
<td>$120,859,884</td>
<td>$229,684,833</td>
</tr>
<tr>
<td>California State University, Long Beach</td>
<td>$67,421,424</td>
<td>$41,202,000</td>
<td>$119,508,329</td>
<td>$228,131,753</td>
</tr>
<tr>
<td>California State University, Los Angeles</td>
<td>$61,905,561</td>
<td>$40,067,000</td>
<td>$108,543,672</td>
<td>$210,516,233</td>
</tr>
<tr>
<td>California State University, Monterey Bay</td>
<td>$13,455,716</td>
<td>$8,705,000</td>
<td>$23,922,768</td>
<td>$46,083,484</td>
</tr>
<tr>
<td><strong>California State University, Northridge</strong></td>
<td><strong>$74,004,088</strong></td>
<td><strong>$47,458,000</strong></td>
<td><strong>$131,021,450</strong></td>
<td><strong>$252,483,538</strong></td>
</tr>
<tr>
<td>California State University, San Bernardino</td>
<td>$42,438,131</td>
<td>$27,924,000</td>
<td>$74,982,459</td>
<td>$145,344,590</td>
</tr>
<tr>
<td>California State University, San Marcos</td>
<td>$26,602,684</td>
<td>$15,542,000</td>
<td>$46,496,808</td>
<td>$88,641,492</td>
</tr>
<tr>
<td>California State University, Stanislaus</td>
<td>$22,007,207</td>
<td>$12,928,000</td>
<td>$38,636,391</td>
<td>$73,571,598</td>
</tr>
<tr>
<td>Humboldt State University</td>
<td>$16,130,016</td>
<td>$11,146,000</td>
<td>$28,831,619</td>
<td>$56,107,635</td>
</tr>
<tr>
<td>San Diego State University</td>
<td>$45,914,127</td>
<td>$30,394,000</td>
<td>$80,592,385</td>
<td>$156,900,512</td>
</tr>
<tr>
<td>San Francisco State University</td>
<td>$47,404,409</td>
<td>$30,000,000</td>
<td>$83,075,470</td>
<td>$160,479,879</td>
</tr>
</tbody>
</table>
Vulnerability Assessment Conclusions

Before the COVID-19 pandemic, populations at all CSU campuses and CSU-affiliated facilities were substantial. Collectively, as of Fall 2019, CSU campuses had 480,541 students and 53,763 faculty and staff. All were at risk from the communicable disease events, with 534,304 people being directly vulnerable. The COVID-19 pandemic has caused campus population numbers to plummet to a small fraction of full capacity.

At some point in the future, campus population numbers will return to their pre-pandemic levels, and students, faculty, and staff will again be vulnerable to the communicable disease hazard. *If just 10% of the total CSU population were to become ill with a highly infective communicable disease like influenza or another strain of SARS, this would mean that approximately 53,430 people would be sick at the same time.* This scenario would likely overwhelm available on-campus medical services could even overwhelm portions of the larger community’s medical resources – especially if there were large numbers of infected people with immune system compromises or other underlying health problems.

See Table 16-12 below for the “10% outbreak scenario” projections both for each CSU campus and for the entire CSU system.

Table 17-11: Scenario of Communicable Disease Hazard Affecting 10% of the CSU Population

<table>
<thead>
<tr>
<th>CSU Campus</th>
<th>Approximate Enrollment Population (Fall 2019)</th>
<th>Approximate Total FT/PT Faculty/Staff Population (Fall 2019)</th>
<th>Total Combined Approximate Student and Faculty/Staff Population</th>
<th>10% Outbreak Scenario (Students and Faculty/Staff Combined)</th>
</tr>
</thead>
<tbody>
<tr>
<td>CSU Bakersfield</td>
<td>11,199</td>
<td>1,277</td>
<td>12,476</td>
<td>1,248</td>
</tr>
<tr>
<td>CSU Channel Islands</td>
<td>7,093</td>
<td>994</td>
<td>8,087</td>
<td>809</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Institution</th>
<th>Fall '20</th>
<th>Spring '21</th>
<th>Fall '22</th>
<th>Spring '22</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chico State</td>
<td>17,019</td>
<td>1,969</td>
<td>18,988</td>
<td>1,899</td>
</tr>
<tr>
<td>CSU Dominguez Hills</td>
<td>17,027</td>
<td>1,761</td>
<td>18,788</td>
<td>1,879</td>
</tr>
<tr>
<td>Cal State East Bay</td>
<td>14,705</td>
<td>1,764</td>
<td>16,469</td>
<td>1,647</td>
</tr>
<tr>
<td>Fresno State</td>
<td>24,139</td>
<td>2,534</td>
<td>26,673</td>
<td>2,667</td>
</tr>
<tr>
<td>Cal State Fullerton</td>
<td>39,868</td>
<td>3,736</td>
<td>43,604</td>
<td>4,360</td>
</tr>
<tr>
<td>Humboldt State</td>
<td>6,983</td>
<td>1,171</td>
<td>8,154</td>
<td>815</td>
</tr>
<tr>
<td>Cal State Long Beach</td>
<td>38,074</td>
<td>4,004</td>
<td>42,078</td>
<td>4,208</td>
</tr>
<tr>
<td>Cal State LA</td>
<td>26,361</td>
<td>2,821</td>
<td>29,182</td>
<td>2,918</td>
</tr>
<tr>
<td>Cal Maritime</td>
<td>911</td>
<td>329</td>
<td>1,240</td>
<td>124</td>
</tr>
<tr>
<td>CSU Monterey Bay</td>
<td>7,123</td>
<td>1,059</td>
<td>8,182</td>
<td>818</td>
</tr>
<tr>
<td><strong>CSUN (Northridge)</strong></td>
<td><strong>38,391</strong></td>
<td><strong>3,832</strong></td>
<td><strong>42,223</strong></td>
<td><strong>4,222</strong></td>
</tr>
<tr>
<td>Cal Poly Pomona</td>
<td>27,914</td>
<td>2,650</td>
<td>30,564</td>
<td>3,056</td>
</tr>
<tr>
<td>Sacramento State</td>
<td>31,156</td>
<td>3,228</td>
<td>34,384</td>
<td>3,438</td>
</tr>
<tr>
<td>Cal State San Bernardino</td>
<td>20,311</td>
<td>2,118</td>
<td>22,429</td>
<td>2,243</td>
</tr>
<tr>
<td>San Diego State</td>
<td>35,081</td>
<td>3,702</td>
<td>38,783</td>
<td>3,878</td>
</tr>
<tr>
<td>San Francisco State</td>
<td>28,880</td>
<td>3,401</td>
<td>32,281</td>
<td>3,228</td>
</tr>
<tr>
<td>San José State</td>
<td>33,282</td>
<td>3,568</td>
<td>36,850</td>
<td>3,685</td>
</tr>
<tr>
<td>Cal Poly San Luis Obispo</td>
<td>21,242</td>
<td>2,871</td>
<td>24,113</td>
<td>2,411</td>
</tr>
<tr>
<td>CSU San Marcos</td>
<td>14,519</td>
<td>1,687</td>
<td>16,206</td>
<td>1,621</td>
</tr>
<tr>
<td>Sonoma State</td>
<td>8,649</td>
<td>1,338</td>
<td>9,987</td>
<td>999</td>
</tr>
<tr>
<td>Stanislaus State</td>
<td>10,614</td>
<td>1,276</td>
<td>11,890</td>
<td>1,189</td>
</tr>
<tr>
<td>Office of the Chancellor</td>
<td>0</td>
<td>673</td>
<td>673</td>
<td>67</td>
</tr>
<tr>
<td><strong>CSU System-Wide</strong></td>
<td><strong>480,541</strong></td>
<td><strong>53,763</strong></td>
<td><strong>534,304</strong></td>
<td><strong>53,430</strong></td>
</tr>
</tbody>
</table>

*Note: Enrollment figures do not include non-specific CSU campus International Programs (455 students) or CALStateTEACH Program (933 students).*

While the case numbers of COVID-19 have been significantly lower (about 1% of the total CSU population) than those in the 10% scenario, the degree of virulence and resultant morbidity and mortality caused by COVID-19 have led to widespread campus
shutdowns, educational disruption, and economic harm to the CSU system (including CSU Northridge). In short, the real-time COVID-19 communicable disease outbreak scenario has proven far more devastating than the 10% simulated scenario.

Identified Data Limitations

There is a wealth of technical information available for communicable disease. However, there is also limited non-COVID-19 communicable disease data available regarding risk or vulnerability of specific populations throughout the CSU. Much of the data that does exist is protected by privacy policies, and therefore cannot be obtained for more specific populations. As a result, performing a detailed quantitative assessment for this hazard is difficult.

Data that could be collected prior to the next update in order to improve this methodology includes:

- Data regarding infection rates at the campus level and for specific populations;
- Data regarding communicable disease case numbers and outcomes, by CSU campus;
- Data regarding projected population changes;
- Data regarding absenteeism; and
- Data regarding increased operating costs as a result of absenteeism (i.e., temporary shifting of duties resulting in business interruption).

**Dam and Levee Failure**

Description of the Hazard

A dam failure represents the structural collapse of a dam that stores water in a reservoir behind the dam. These failures are typically the result of structural age, damage to the structure caused by earthquake or flooding, inadequate discharge or spillway capacity, inadequate maintenance, improper construction materials, or extreme inflow of water into the reservoir. Prolonged precipitation may result in overtopping of the dam resulting in structural compromise. The tremendous energy generated by a sudden breach of the dam will have significant downstream effects. Flood damage resulting from dam failures potentially will result in economic losses, environmental damage, destruction of agriculture, and human casualties. This type of incident is extremely dangerous as it can occur rapidly, with no warning resulting in an inability to effectively evacuate threatened communities.

A levee failure is similar to dam failures as the result will be a breach causing flooding on the dry side of the levee. Levees are embankments whose primary purpose is to
furnish flood protection from seasonal high water or divert the flow of water. Most levees in California are intended to withstand peak water levels generated by heavy precipitation or rapid snowmelt in a watershed. Other levees are designed to withstand fluctuating water levels on a continuous basis such as those in the California Delta exposed to tidal influences. Levees routinely extend for lengthy distances immediately protecting communities. Levees can be found throughout the state but are most prominent in the Sacramento and San Joaquin Valleys.

Levee failures can vary from over toppings to small uncontrolled discharge to catastrophic failure. Areas downstream of the failure will be subject to inundation dependent on the volume of water released. These levee failures are also typically the result of structural age, damage to the structure caused by earthquake or flooding, slumping, seepage underneath the levee, high velocity flows eroding the levee, inadequate capacity, inadequate maintenance, improper construction materials, or extreme inflow of water into the system. Flood damage resulting from levee failures potentially will result in economic losses, environmental damage, destruction of agriculture, and human casualties.

A Dam or levee failure flooding will vary depending on a number of factors including the extent of the collapse or breach, the volume of water behind the structure, and the nature of the exposed downstream features. This unpredictable flooding presents a threat to life and property in addition to critical infrastructure. Lifelines and supply routes will likely be damaged or made impassible by flood erosion or standing water. Water quality and health concerns would likely be cascading effects of dam or levee failures.

Location of the Hazard

Los Angeles County is home to a variety of flood control facilities and levee systems mostly along the base of the various mountains and hills throughout the county. Levees have been constructed along numerous flood control channels providing community protection. The CSU Northridge campus is in general proximity to dams along the Los Angeles River and tributary systems in addition to flood control channels lined with levees within the San Fernando Valley.

There are a number of dam facilities along the base of the Santa Monica, Santa Susana, San Gabriel, and Verdugo Mountains and along the river systems extending from the mountains. The larger facilities include the Los Angeles Reservoir, Lower San Fernando (Van Norman) Dam, Chatsworth Dam, and Encino Dam. Each of these facilities regulate water flow into the San Fernando Valley and Los Angeles River systems. The CSU Northridge campus lies outside of dam inundation zones for these facilities.

Figure 16-4: Lower San Fernando Dam Breach Inundation Map\textsuperscript{25}

\textsuperscript{25} California Department of Water Resources, Dam Breach Inundation Map Publisher, https://fmds.water.ca.gov/webgis/?appid=dam_prototype_v2
A number of flood control systems feed into the Los Angeles River from the mountains and San Fernando Valley. The Aliso Canyon Wash is a flood control channel ½ mile west of the campus. The channel extends from the Santa Susana Mountains north of campus to the Los Angeles River in the southern portions of the San Fernando Valley. The campus is identified as being located within the levee protected zone from the Aliso Canyon Wash. This zone covers the entire campus with the exception of the southeast corner including Jeanne Chisholm Hall, Monterey Hall, and the G3 Parking Structure.

The Bull Creek channel is an additional flood control channel that is located approximately 1 ½ miles east of the campus. The 7-mile channel feeds into the Los Angeles River at the Sepulveda Basin. The channel drains the Los Angeles and Lower San Fernando Reservoirs. The CSU Northridge campus is not within a flood protected zone for Bull Creek.

Extent of the Hazard
Dams are classified according to the hazard that they pose to life and property in the event of failure, rather than the likelihood of that failure.

- **High hazard potential dams** may result in loss of human life, and will likely result in economic, environmental, or lifeline losses.
- **Significant hazard potential dams** are not expected to result in loss of life, but are expected to cause economic, environmental, and lifeline losses.
- **Low hazard potential dams** are not expected to result in loss of life, and there is a low expectation of economic, environmental, or lifeline losses. What losses do occur are generally limited to the dam owner.

Dams classified as high hazard are required to have Emergency Action Plans (EAP). EAPS are formal documents that identify potential emergency conditions at the dam and specify preplanned actions to be followed in case of failure. An EAP is required for all high hazard dams and is recommended for all significant hazard dams.

**Table 16-12: Los Angeles County Dams in Proximity to CSU Northridge**

<table>
<thead>
<tr>
<th>River</th>
<th>Dam</th>
<th>Storage</th>
<th>Hazard Severity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Los Angeles</td>
<td>Chatsworth</td>
<td>9,886af</td>
<td>High Hazard</td>
</tr>
<tr>
<td>Encino</td>
<td>Encino</td>
<td>9,789af</td>
<td>High Hazard</td>
</tr>
<tr>
<td>San Fernando</td>
<td>Los Angeles Reservoir</td>
<td>10,000af</td>
<td>Significant Hazard</td>
</tr>
<tr>
<td>San Fernando</td>
<td>Lower San Fernando</td>
<td>9,843af</td>
<td>High Hazard</td>
</tr>
<tr>
<td>Pacoima</td>
<td>Pacoima</td>
<td>3,777af</td>
<td>High Hazard</td>
</tr>
</tbody>
</table>

The CSU Northridge campus lies outside of the inundation zone of the dams listed above. In the event of a catastrophic failure of the identified dams, the CSU Northridge campus is expected to remain out of the inundation area. The inundation area is expected to spread water in areas to the east and south from the campus. Additionally, there are multiple transportation corridors that lie within the dam inundation zones that could compromise access, evacuation, and supply routes. The inundation areas have the potential to threaten areas the campus community reside or work. Primary impacts to the campus would be disruption of transportation routes and potentially the interruption of campus operations. Based on these factors, the planning committee ranks the extent of the hazard as **Low**.

**Extent – Levee Failures**

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16-29
Levees are used along numerous flood control channels and other waterways including the Los Angeles River and Aliso Canyon Wash. The CSU Northridge campus lies within the levee flood protected area of the Aliso Canyon Wash. In the event any of these channels were flowing at elevated levels and a failure of a levee were to occur, the campus and community surrounding the campus would likely experience flood related damages. This specific hazard could alter the ability of the campus to maintain operations as damages would be extensive. Depending on the location of a breach, the campus community would be heavily affected with the loss of life and homes, access to campus would be limited, and student financial capacity to support ongoing education being diminished. Based on these factors, the planning committee ranks the extent of the hazard as Moderate.

History of the Hazard

There are no records of dam of levee failures in areas that present a threat to the CSU Northridge campus. Los Angeles County has experienced the following dam failures:

Table 16-13: Los Angeles County Dam Failures

<table>
<thead>
<tr>
<th>Date</th>
<th>Dam</th>
<th>Release</th>
<th>Damage</th>
</tr>
</thead>
<tbody>
<tr>
<td>3/12/1928</td>
<td>St. Francis</td>
<td>38,000af</td>
<td>Extensive; 450 fatalities</td>
</tr>
<tr>
<td>12/14/1963</td>
<td>Baldwin Hills</td>
<td>770af</td>
<td>277 residences, 5 fatalities</td>
</tr>
</tbody>
</table>

In addition to the above incidents, the February 11971 San Fernando Earthquake caused significant damage to Lower San Fernando Dam (Van Norman Dam). At the time of the earthquake, the reservoir was half full, containing approximately 5,500-acre feet of water. The intense shaking resulted in the top 30 feet of the dam edifice crumbling, with water only six feet from the top. The dam did not fail but expected heavy after-shocks required rapid pumping, de-watering operations, and the evacuation of 80,000 people. This facility is 4 miles away from the CSU Northridge campus.

Potential Impacts of the Hazard

Dam Failure Impacts - Water that is released due to a dam that has failed generates tremendous energy and force causing a flood that will be catastrophic to life and property. Water levels from the failed dam could be significantly higher than those experienced in worst case scenario flood events. Areas closer to the failed dam will be more likely to experience complete devastation while other areas within the inundation zone will see varying levels of flood waters. The extent of the impacts of a failed dam would vary based on a number of factors such as the volume of water released, the base flow of the river, the time of the failure, the amount of warning provided, and the distance from the dam. Impacts resulting from a dam failure include:
- Loss of life
- Property destruction or damage
- Loss of property contents
- Infrastructure damage
- Flooded or destroyed lifelines/supply routes
- Damaged or destroyed utilities
- Loss of community economic base
- Employment losses
- Agricultural (crops and livestock) damages or destruction
- Environmental damage
- Floods generating threats to public health
- Flood generated debris

**Levee Failure Impacts**

A levee failure may result in substantial amounts of water to enter into developed areas protected by the levee. The force and volume of water that is generated by a levee failure may cause extensive structural damage in close proximity to the breach and effects of flooding spreading well beyond the point of the failure. The extent of the impacts would vary based on a number of factors such as the volume of water released, the time of the failure, the amount of warning provided, the location of the breach, elevation, and distance from the breach. Potential impacts resulting from a levee failure include:

- Loss of life
- Property destruction or damage
- Loss of property contents
- Infrastructure damage
- Public health hazards resulting from mold, mildew, and disease due to flood water
- Flooded or destroyed lifelines/supply routes
- Damaged or destroyed utilities
- Loss of community economic base
- Employment losses
- Agricultural (crops and livestock) damages or destruction
- Environmental damage
- Prolonged periods of necessary dewatering
- Disruptions to education delivery to community

**Probability of Future Occurrence of the Hazard**

Los Angeles County is determined to be at risk from dam and levee failure in many parts of the county. The location of the CSU Northridge campus downstream from the Van Norman Reservoir Complex and in proximity to Aliso Canyon flood control channel along demonstrates that the potential exists for future dam and levee related issues. Much of the San Fernando Valley resides within the dam inundation zone for
the Van Norman Reservoir. However, the campus remains outside of and to the west of the inundation zone. Levees protecting the Aliso Canyon Wash flood control channel are located ½ of a mile west of the campus. The campus resides within the levee protected zone for Aliso Canyon. There are no official recurrence intervals that have been calculated for dam or levee failures. Based on no historical experience of levee failure for this levee, and recognizing the regulations, inspections, monitoring and maintenance in place, the likelihood of this hazard is low.

The probability of future occurrence for both dam and levee failures is Unlikely.

Vulnerability to the Hazard

Given high priority monitoring and maintenance practices in place, a catastrophic dam or levee failure is highly unlikely. In addition, the campus does not lie within an inundation zone. As such, the campus is not considered to be truly vulnerable on a daily basis. However, in the unlikely event of a catastrophic failure, the effects of flooding from compromised dams and levees on campus would most likely be limited to indirect or secondary effects in terms of disruption to regional transportation networks and services, and the amount of time to respond to the needs of the campus community prior to inundation will be limited.

Any breach along a levee is impossible to predict where a failure may occur. It is likely that response action will not be fully implemented until the incident situational intelligence provides adequate information as to compromised locations. These variables place all those working and living within the dam inundation and flood protection zones in vulnerable locations in the event of a low probability, catastrophic event.

Vulnerability to a dam or levee failure on the CSU Northridge campus will vary depending on the degree of breach or structural failure and when the failure were to occur. The risk to the campus population will be lessened during periods when classes are not in session or during periods of breaks. Conversely, during the days and hours that classes are in session and staff are at their workplaces, the human vulnerability increases. However, in region-wide events this vulnerability may be shared with the homes and workplaces of members of the campus community and their families.

Certain campus populations will experience greater challenges to a post-flood / failure environment. Vulnerable populations will likely need to navigate through flood generated debris, face extreme health safety issues from flood waters, experience extreme stresses of a disaster, an inability to communicate to or gain access to support networks, and find difficulty in accessing equipment or supplies to aid in a specific need.

Estimate of Potential Losses
Estimates of potential losses will be influenced by a variety of factors. The volume and force of the water will determine the scale of damages affecting campus infrastructure, equipment, and other impacted features. The proximity to the failure and elevation above flood waters will affect the level of damage and individuals exposed. The time of the academic year, the day of week, and hour in which the failure was to occur will influence the number of people on campus and potential casualties. Losses will be generated by the physical damages, the loss of revenue, loss of academic research, loss of building contents, and community wide economic reductions.

Based on estimate replacement costs of facilities and structures on campus, the total replacement costs due to earthquake are $550,272,157. However, it is unlikely for a dam or levee failure event to cause catastrophic destruction at CSU Northridge.

Vulnerability Assessment Conclusions

While the occurrence of dam and levee failures have not been historically relevant near the CSU Northridge campus, the potential for hazards related to the region’s levees and dams still exist. However, the presence of earthquake faults in proximity to the existing dam and levee structures presents a valid danger to downstream locations in the event of an earthquake. In the unlikely event of a high priority dam’s total failure, the consequences would be catastrophic to downstream communities. The potential for dam or levee failure further generates the added potential for a number of cascading effects such as disruptions to the local economy, utility failures, disruptions to providing for the needs of the community, and development of public health hazards. These effects would be exacerbated by effects of seasonal flooding, ongoing heavy precipitation, or excessive run-off from the watershed contributing to the river system. The potential for widespread flooding and damage of structures due to the force of water has exponentially powerful impacts on particular populations among the campus community including those with access or functional needs, international students, the homeless, and students residing in the residence halls.
Identified Data Limitations

Data limitations include missing campus structural replacement costs, and an incomplete inventory of both building construction features and mitigation efforts to lessen the impact due to flood inundation.

**Drought**

Description of the Hazard

Drought is defined as a condition where moisture levels fall significantly below normal for an extended period of time over a large area that adversely affects plants, animal life, and humans. Drought is a gradual phenomenon. Although droughts are sometimes characterized as emergencies, they differ from typical emergency events. Most natural disasters, such as floods or forest fires, occur relatively rapidly and afford little time for preparing for disaster response. Droughts occur slowly, over a multi-year period, and it is often not obvious or easy to quantify when a drought begins and ends.

Throughout California, one dry year does not normally constitute a drought. California’s extensive system of water supply infrastructure (reservoirs, groundwater basins, and conveyance assets) mitigates the effect of short-term dry periods for most water users. Defining when a drought begins is a function of drought impacts to water users. Drought in one location may not constitute a drought for all water users, as some users in relative proximity may have a different water supply. For example, individual water suppliers may use a combination of sources such as rainfall/runoff, water in storage, or expected supply from a water wholesaler to define their water supply conditions.

Drought can be characterized as one or more of the following types:

- **Meteorological drought** is defined on the basis of the degree of dryness (in comparison to some “normal” or average amount) and the duration of the dry period. A meteorological drought must be considered as region-specific since the atmospheric conditions that result in deficiencies of precipitation are highly variable from region to region.

- **Hydrological drought** is associated with the effects of periods of precipitation (including snowfall) shortfalls on surface or subsurface water supply (e.g., streamflow, reservoir and lake levels, ground water). The frequency and severity of hydrological drought is often defined on a watershed or river basin scale. Although all droughts originate with a deficiency of precipitation, hydrologists are more concerned with how this deficiency plays out through the hydrologic system. Hydrological droughts are usually out of phase with or lag the occurrence of meteorological and agricultural droughts. It takes longer for precipitation deficiencies to show up in components of the hydrological system such as soil moisture, streamflow, and ground water and reservoir levels. As a result, these impacts are out of phase with impacts in other economic sectors.
- **Agricultural drought** focus is on soil moisture deficiencies, differences between actual and potential evaporation, reduced ground water or reservoir levels, and so forth. Plant water demand depends on prevailing weather conditions, biological characteristics of the specific plant, its stage of growth, and the physical and biological properties of the soil.
- **Socioeconomic drought** refers to when physical water shortage begins to affect health, well-being, and quality of life of people, or when the drought starts to affect the supply and demand of an economic product that relies on water.

The drought issue in California is further compounded by water rights. The central challenge is how to prioritize water usage among a broad variety of contexts. It is for this reason that water is a commodity possessed and utilized under a variety of legal doctrines. As such, many competing sets of interests create a dynamic prioritization process between, for example, farming and federally protected fish habitats and water supply for municipal/public use (including usage for CSU - Northridge) versus water usage for wildfire abatement or natural resource protection.

**Location of the Hazard**

Drought conditions have been identified throughout Los Angeles County where CSU - Northridge is located. Drought is not a location-specific hazard and affects the entire planning area equally. Drought location is not isolated to each campus footprint but occurs as a geographic sub-set of drought conditions occurring at larger scales. From 2000-2020, drought conditions existed continuously somewhere in the state, with 80-100% of the state impacted for 12 of the last 20 years.  

**Extent of the Hazard**

Given the historical occurrence of severe drought impacts throughout Los Angeles County which surrounds the planning area and the potential future impact exacerbated by climate change, the CSU Planning Committee recognizes that drought will continue to pose a high degree of risk statewide, potentially impacting crops, livestock, water resources, the natural environment at large, buildings and infrastructure (from land subsidence), and local economies.

In addition, although drought affects the entire CSU system wide planning area, the potential impacts are variable and specific to each campus/jurisdiction, depending on contextual factors such as the degree of assets and activities, historically impacted by drought within each jurisdiction.

Also, land subsidence has occurred and will continue in areas where the groundwater basin has been subject to overdraft and long-term recharge is inadequate to maintain the water table elevation, leaving underground voids. Subsidence levels in California have been measured up to 30-feet with subsidence bowls covering hundreds of

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square miles. As such, drought-related subsidence may result in serious structural damage to buildings, roads, irrigation ditches, underground utilities, and pipelines. Such impacts have not occurred on campus but remain issues of concern over the long term.

For CSU – Northridge, the extent of the hazard is Low (corresponding to D0-D1 on the extent scale below). However, the campus planning committee recognizes that the potential for more severe conditions exists and is tied to regional water resource vulnerabilities.

The U.S. Drought Monitor developed tables of impacts reported during past droughts in California in order to depict the extent of drought risk for each level of drought on the U.S. These possible extent conditions for California complement the general impacts column of the U.S. Drought Monitor Classification Scheme.

Table 16-14: Impacts of Drought Levels as Determined by US Drought Monitor²⁸

<table>
<thead>
<tr>
<th>Category</th>
<th>Impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>D0</td>
<td>Soil is dry; irrigation delivery begins early</td>
</tr>
<tr>
<td></td>
<td>Dryland crop germination is stunted</td>
</tr>
<tr>
<td></td>
<td>Active fire season begins</td>
</tr>
<tr>
<td></td>
<td>Winter resort visitation is low; snowpack is minimal</td>
</tr>
<tr>
<td>D1</td>
<td>Dryland pasture growth is stunted; producers give supplemental feed to cattle</td>
</tr>
<tr>
<td></td>
<td>Landscaping and gardens need irrigation earlier; wildlife patterns begin to change</td>
</tr>
<tr>
<td></td>
<td>Stock ponds and creeks are lower than usual</td>
</tr>
<tr>
<td>D2</td>
<td>Grazing land is inadequate</td>
</tr>
<tr>
<td></td>
<td>Producers increase water efficiency methods and drought-resistant crops</td>
</tr>
<tr>
<td></td>
<td>Fire season is longer, with high burn intensity, dry fuels, and large fire spatial extent; more fire crews are on staff</td>
</tr>
<tr>
<td></td>
<td>Wine country tourism increases; lake- and river-based tourism declines; boat ramps close</td>
</tr>
<tr>
<td></td>
<td>Trees are stressed; plants increase reproductive mechanisms; wildlife diseases increase</td>
</tr>
<tr>
<td></td>
<td>Water temperature increases; programs to divert water to protect fish begin</td>
</tr>
<tr>
<td></td>
<td>River flows decrease; reservoir levels are low and banks are exposed</td>
</tr>
</tbody>
</table>

²⁸ United States Drought Monitor. Drought Classification. Retrieved 05.04.2021 from: [https://droughtmonitor.unl.edu/About/AbouttheData/DroughtClassification.aspx](https://droughtmonitor.unl.edu/About/AbouttheData/DroughtClassification.aspx)
Livestock need expensive supplemental feed, cattle and horses are sold; little pasture remains, producers find it difficult to maintain organic meat requirements

<table>
<thead>
<tr>
<th>D3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fruit trees bud early; producers begin irrigating in the winter</td>
</tr>
<tr>
<td>Federal water is not adequate to meet irrigation contracts; extracting supplemental groundwater is expensive</td>
</tr>
<tr>
<td>Dairy operations close</td>
</tr>
<tr>
<td>Marijuana growers illegally tap water out of rivers</td>
</tr>
<tr>
<td>Fire season lasts year-round; fires occur in typically wet parts of state; burn bans are implemented</td>
</tr>
<tr>
<td>Ski and rafting business is low, mountain communities suffer</td>
</tr>
<tr>
<td>Orchard removal and well drilling company business increase; panning for gold increases</td>
</tr>
<tr>
<td>Low river levels impede fish migration and cause lower survival rates</td>
</tr>
<tr>
<td>Wildlife encroach on developed areas; little native food and water is available for bears, which hibernate less</td>
</tr>
<tr>
<td>Water sanitation is a concern, reservoir levels drop significantly, surface water is nearly dry, flows are very low; water theft occurs</td>
</tr>
<tr>
<td>Wells and aquifer levels decrease; homeowners drill new wells</td>
</tr>
<tr>
<td>Water conservation rebate programs increase; water use restrictions are implemented; water transfers increase</td>
</tr>
<tr>
<td>Water is inadequate for agriculture, wildlife, and urban needs; reservoirs are extremely low; hydropower is restricted</td>
</tr>
<tr>
<td>Fields are left fallow; orchards are removed; vegetable yields are low; honey harvest is small</td>
</tr>
<tr>
<td>Fire season is very costly; number of fires and area burned are extensive</td>
</tr>
<tr>
<td>Many recreational activities are affected</td>
</tr>
<tr>
<td>Fish rescue and relocation begins; pine beetle infestation occurs; forest mortality is high; wetlands dry up; survival of native plants and animals is low; fewer wildflowers bloom; wildlife death is widespread; algae blooms appear</td>
</tr>
<tr>
<td>Policy change; agriculture unemployment is high, food aid is needed</td>
</tr>
<tr>
<td>Poor air quality affects health; greenhouse gas emissions increase as hydropower production decreases; West Nile Virus outbreaks rise</td>
</tr>
<tr>
<td>Water shortages are widespread; surface water is depleted; federal irrigation water deliveries are extremely low; junior water rights are</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>D4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fields are left fallow; orchards are removed; vegetable yields are low; honey harvest is small</td>
</tr>
<tr>
<td>Fire season is very costly; number of fires and area burned are extensive</td>
</tr>
<tr>
<td>Many recreational activities are affected</td>
</tr>
<tr>
<td>Fish rescue and relocation begins; pine beetle infestation occurs; forest mortality is high; wetlands dry up; survival of native plants and animals is low; fewer wildflowers bloom; wildlife death is widespread; algae blooms appear</td>
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</tr>
<tr>
<td>Water shortages are widespread; surface water is depleted; federal irrigation water deliveries are extremely low; junior water rights are</td>
</tr>
</tbody>
</table>
History of the Hazard

Historically, drought has been so prevalent in California that its presence is almost continuous. Los Angeles County has experienced 6 or more periods of drought covering over 12 years from 2000-2021, which includes the CSU - Northridge footprint. Though drought occurrences are not identified specifically for the campus, the planning committee reports intermittent drought-related air quality issues.

Figure 16-5: Periods of Drought in Los Angeles County, CA, 2001 – 2021

According to the National Drought Mitigation Center, over 3,500 reports and publications covering 370 drought-related events took place across the state (many of which were statewide events) between 2000-2020. In addition, the National Center for Environmental Information (NCEI) reports more than 500 events statewide during this same time period. These events produced a comprehensive range of impacts to water supply, regulations and allocations to businesses and municipalities, budgets and resources for firefighting, water law and policy, and physical impacts to built and natural environments. As such, data records of previous occurrences can be viewed as separate time and event demarcations for a hazard almost continuously in effect across the state with cascading impact potential.

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30 NCEI. Storm Events. Retrieved 5.4.2021 from: [https://www.ncdc.noaa.gov/stormevents](https://www.ncdc.noaa.gov/stormevents)
According to the Department of Water Resources, droughts exceeding three years are relatively common in Southern California, but relatively rare in Northern California - the region is the geographic source of much of the state’s developed water supply. The 1929-34 drought established the criteria commonly used in designing storage capacity and yield of large Northern California reservoirs. 31

According to the US Drought Monitor’s time series data, from 2000-2021 (with the exception of a 2–3-month period in 2000 and 2011), some degree of drought conditions have been continuously in effect somewhere in California. In fact, 80% - 100% of the state has been subjected to drought conditions for 12 of the last 20 years, with the most severe drought being the 100% state-wide event from 2012-2017.

Figure 16-5: Periods of Drought in State of California, 2001 – 202132

Given the extent of the drought risk in California, the following drought event was selected as an exemplar due to its broad and significant impacts on Los Angeles County where the CSU - Northridge campus planning area is located:

2012 – 2017 – Drought produced severe impacts to water wells throughout the state of California, with a high number of wells running dry. Land subsidence due to increased groundwater pumping also occurred in numerous areas of the state such as the San Joaquin and Central Valleys. Crop damage was widespread as well. Water allotments were drastically reduced in many towns and water agencies, with extremely high costs for procuring water. In addition, job loss occurred with many families requiring food supply assistance, and water supply assistance provided to home-owners with dry wells. According to a report released by UC Davis Center for Watershed Sciences, the 2012-2017 period of the California drought cost the state’s agriculture industry about $1 billion in lost revenue, with a total statewide economic cost of the drought calculated to be $2.2 billion. The report says, “it is responsible for the greatest water loss ever seen in California agriculture - about one third less than normal”. The report

calls the groundwater situation in California "a slow-moving train wreck." Spring snowpack at Donner Summit reached record low levels in 2014, exceeded in 2015 by a remarkable April 1 snow-water-equivalent value of only 5% of average. Decreased precipitation since contributed to near-record low levels in the Shasta Reservoir. The ongoing drought has contributed to declines in crop values across the state. For example, crops including cotton, corn silage and barley (the field crop category) fell by 42 percent. 

**Potential Impacts of the Hazard**

Drought impacts are wide-reaching and may be economic, environmental, and/or societal. This assessment of its impact recognizes that although historic impacts on campus have been minimal, the potential impacts throughout the planning area are a sub-set of larger and inter-connected local and regional droughts, and that the (related) historic impacts provide a sound basis for understanding potential (future) impacts.

The most significant potential impact associated with drought across the CSU - Northridge campus planning area is a reduction in water availability for the municipal area tied to each campus. Other potential impacts include crop loss and damage to trees and other natural resources (See Tree Mortality below). The footprint of CSU - Northridge to some extent includes these vulnerable resources based on the campus landscape (trees) and the presence (and footprint size) of any agricultural research crops and/or field stations. Though water resources remain stable for the campus, the planning committee reports that the campus utilizes sustainable, drought tolerant landscaping to minimize potential water source or use limitations.

As a secondary impact of drought, wildfire is directly attributable to dry atmospheric conditions. Wildfires almost always coincide with drought in California, though not limited to such. However, the wildfire hazard is analyzed separately in this plan. (See wildfire section).

In reviewing the occurrences of drought for Los Angeles County (surrounding the CSU – Northridge footprint), the US Drought Monitor and the National Drought Mitigation Center report that tens of millions of trees died during the (2014-2017) state-wide drought disaster. Though data sources do not provide data for tree mortality specific to CSU - Northridge, the broad geographic extent of the impact makes it likely that tree mortality occurred to some degree on the campuses. Due to the lasting and ongoing effects of drought on the landscape, trees will continue to be impacted within the municipalities, counties and regions wherein lies the CSU campus system as long as drought conditions continue.


Given the absence of data, in order for the CSU Committee to assess the impact of tree mortality, it is useful to view it as a risk sub-set to the probability, location, extent, severity and duration of the drought hazard within each campus-located municipality, county and region. Regarding potential impacts, standing dead trees could fall, posing a risk to people, buildings, power lines, roads and other infrastructure. In addition, drought-impacted trees become susceptible to diseases and insect infestations (bark beetle) further adding to the risk of tree mortality and related potential impacts. No data is currently available for tree mortality on campus; however, the CSU Planning Team will pursue data on this issue in the future.

As a potential tertiary impact, prolonged and repeated drought conditions over time can produce land subsidence and the risk of damage to building foundations and infrastructure on campus resulting from ground instability and collapse. Land subsidence is defined as the vertical sinking of the land over manmade or natural underground voids. Subsidence is often the direct result of groundwater over-extraction in response to drought conditions, as well as oil and gas extraction. Weight can accelerate the process of subsidence resulting from surface development and infrastructure such as roads and buildings, vibrations from construction blasting and heavy truck or train traffic. For example, the State Water Project’s 444-mile-long California Aqueduct has required repairs such as the raising of canal linings, bridges, and water control structures on the Aqueduct – in the Central Valley a five-mile reach of the Eastside Bypass was impacted by subsidence, and the Department of Water Resources estimated that it may cost in the range of $250 million to acquire flowage easements and levee improvements to restore the design capacity of the subsided area. 35

At present, drought related damage to campus buildings and infrastructure at CSU - Northridge has not been reported, but the potential for such impacts is possible over the long term. With regard to overall potential impact, water supply/availability for CSU - Northridge is ultimately tied to broader inter-dependent, and more intensive modes of water use at local and regional scales such as agriculture and ranching, wildfire protection, larger metropolitan/municipal usage, manufacturing and commerce, tourism, recreation, and wildlife preservation. During drought periods, the State of California’s regulated water allocations are modified and often reduced, which can result in reduced water availability for all usage contexts, including CSU - Northridge. A reduction of electric power generation and water quality deterioration are also potential impact factors.

Table 5-15: Summary of Drought Impacts on Water Resources

<table>
<thead>
<tr>
<th>Resource</th>
<th>Type of Impact</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sea Level</td>
<td>Direct</td>
<td>Sea level is rising and will likely impact coastal areas</td>
</tr>
<tr>
<td>Soil Moisture</td>
<td>Direct</td>
<td>Prolonged dry seasons can lead to decreases in soil moisture; drier vegetation</td>
</tr>
<tr>
<td>Vegetation</td>
<td>Indirect</td>
<td>Longer and more intense fire season with increased extent of area burned</td>
</tr>
<tr>
<td>Stream Conditions</td>
<td>Direct</td>
<td>Increases in water temperature; potential effects on fish</td>
</tr>
<tr>
<td>Snowpack</td>
<td>Indirect</td>
<td>Increases in temperature will lead to decreases in snowpack</td>
</tr>
<tr>
<td>Runoff</td>
<td>Direct</td>
<td>Warmer temperatures are likely to lead to a shift in peak runoff from spring to winter and a likely decrease in summer base flow</td>
</tr>
<tr>
<td>Hydropower</td>
<td>Indirect</td>
<td>Decreased summer flows resulting from earlier snowmelt and a shift in peak runoff could affect hydropower generation during summer months</td>
</tr>
<tr>
<td>Precipitation</td>
<td>Direct</td>
<td>Warmer winter temperatures will result in a greater percentage of precipitation falling as rain rather than as snow</td>
</tr>
<tr>
<td>Groundwater</td>
<td>Indirect</td>
<td>Reduction in snowpack and extended periods of drought are likely to increase dependency on groundwater</td>
</tr>
</tbody>
</table>

Probability of Future Occurrence of the Hazard

Highly Likely — The US Drought Monitor’s time series data (2000-2020) indicates that some degree of drought has nearly a 100% probability of occurrence somewhere in the state in any given year. Given that CSU - Northridge lies within a drought impacted region, it is prudent to extend this likelihood of occurrence to the planning area.

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Vulnerability to the Hazard

In California, rising temperatures are projected to increase the average lowest elevation at which snow falls, reducing water storage in the snowpack, particularly at those lower mountain elevations which are now on the margins of reliable snowpack accumulation. Higher spring temperatures will also result in earlier melting of the snowpack. The shift in snow melt to earlier in the season is critical for California’s water supply because flood control rules require that water be allowed to flow downstream and that water cannot be stored in reservoirs for use in the dry season. As such, state-level drought risk factors that have led to drought’s state-wide severity and extent, and potential impacts also create drought vulnerabilities at the level of the CSU - Northridge campus.

Moreover, climate change will likely adversely impact the vulnerability of watersheds and ecosystems in their ability to deliver important ecosystem services. These changes may limit the natural capacity of healthy forests to capture water and regulate stream flows. Sierra Nevada mountain winters and springs are warming, and on average, precipitation as snowfall relative to rain is decreasing. A warming climate with reduced snowpack will result in earlier snowmelt and will subsequently reduce downstream water availability during summer and early fall.

As such, the state and the CSU - Northridge planning area stakeholders potentially have less capacity to address future drought risks due to projected temperature increases and shortages in water; ground-water withdrawals have been occurring at a deficit rate of 1 – 2-million-acre feet per year, where the impacts of drought include decreased availability of water for agriculture and environmental uses. 37 In forested and other vegetated areas, prolonged drought decreases the moisture content of forest fuels and increases the risk of high severity wildfires.

It should be pointed out that California is the single most productive agricultural state and its agricultural industry relies heavily on reservoir water supplied by snowmelt and rainfall runoff. Yearly variations in snowpack depths have implications for water availability as snowmelt from the winter snowpack feeds a network of reservoirs. Spring snowpack at Donner Summit reached record low levels in 2014, exceeded in 2015 by a remarkable April 1 snow-water-equivalent value of only 5% of average. Decreased precipitation since 2011 has contributed to near-record low levels in the Shasta Reservoir. 38

Vulnerability of Populations

Drought vulnerabilities include agricultural sector job loss, secondary economic losses to local businesses and public recreational resources, increased cost to local and state government for large-scale water acquisition and delivery, and water rationing and water wells running dry for individuals and families. As drought is often accompanied by prolonged periods of extreme heat, negative health impacts such as dehydration can also occur, where children and elderly are most susceptible. Air quality often declines in times of drought which can affect those with respiratory ailments. These same vulnerability measures apply to the students, faculty and staff of the CSU - Northridge campus.

Property Vulnerability

Drought vulnerabilities include crop loss, injury and death of livestock and pets, and damage to infrastructure, homes and other buildings resulting from the secondary drought impact of land subsidence. The related drought impacts of tree mortality and land subsidence pose risks to vulnerable critical infrastructure and property. These same vulnerability measures apply to the properties of the CSU - Northridge campus.

Natural Environment Vulnerability

The historical and potential impacts of drought on the natural environment are widespread throughout public and private lands within the state, including tree mortality, impacts to all flora and fauna, and destabilization (subsidence) of land along streams and rivers, and within watersheds.

The core issue shaping drought vulnerabilities on campus and throughout California is water supply and demand. Several factors play into the issue including groundwater basins, surface water run-off, public and agricultural demand, and surface water storage water sheds. A USGS led analysis was first conducted in 2010 through the Forest and Rangeland Assessment and ongoing through the USGS Forest and Rangeland Ecosystem Science Center to identify threats and assets where water supply would benefit from environmental management designed to protect or enhance water resources, the key effort which, in part, both defines and mitigates the severity of drought risk and vulnerabilities.

With regard to overall threat and asset findings shaping the potential severity of drought, the watersheds in the Sierra region contribute most greatly to the state’s water supply, but are under threat from climate change, wildfire and development. In addition, groundwater basins in the San Joaquin Valley and Sacramento Valley bioregions are an abundant resource that is heavily threatened by over pumping. 39

Critical Facilities Vulnerabilities

CSU - Northridge’s critical facilities’ vulnerabilities include water shortfalls for facility operations and critical functions, and potential structural destabilization and damage resulting from land subsidence.

Estimate of Potential Losses

An estimate of potential losses from drought has not been calculated for the campus or the CSU system as a whole. However, drought related losses to the City of Northridge, County of Los Angeles, and the surrounding region such as crop loss and cost increases for water resources have re-occurred over time. Please consult city and county level government, and/or state agricultural agencies for data on the financial impacts from drought.

Vulnerability Assessment Conclusions

The CSU Planning Committee understands that the high degree of vulnerability posed by drought will be exacerbated by greater climate variation in the future and therefore greater variation and uncertainty regarding the availability of water supplies which are already under tremendous stress. In response to such vulnerability, state legislation passed in 2014 requires local governments to regulate pumping and recharge to better manage groundwater supplies, and groundwater-dependent regions are required to halt overdraft and bring basins into sustainable levels of pumping and recharge by the early 2040s. That said, the Committee will continue to work with local, regional and state partners and stakeholders to explore solutions for mitigating the drought hazard on its campuses by accessing the best available data and resources on climate change and its relationship to drought.

Identified Data Limitations

Data is limited concerning campus-related agricultural assets as well as data on campus tree mortality.
Earthquake

Description of the Hazard

An earthquake is a sudden motion or shaking caused by the release of pressure accumulated along the edge of tectonic plates covering the earth. These huge plates are constantly moving and move ever so slowly under, over, or by passing one another. This movement is gradual however the plates may lock together accumulating enormous amounts of energy. When this energy builds, stress develops, and the adjoining plates will eventually break free and result in ground shaking – an earthquake.

Large earthquakes may result in fissuring, ground settlement, and/or vertical or horizontal displacement. Earthquakes occur without warning and can result in extensive damages and human casualties. Damages associated to earthquake generated ground shaking is normally confined to a narrow area along fault trend from the earthquake epicenter. However, seismic waves may generate ground shaking resulting in damages in areas outside of the fault trend.

Fault Rupture – The rupture of faults is the differential movement of the two sides of the earth’s plates at the point of the fault. Horizontal or vertical displacement may be significant and occur over great distances. The movement and energy that occurs along a fault is released in waves resulting in ground shaking. The intensity of ground shaking varies based on the magnitude of the earthquake, the proximity to the earthquake epicenter, the composition of the ground sediment or rock the waves travel through, and the depth of the earthquake.

Liquefaction – In addition to the primary fault rupture that occurs right along a fault during an earthquake, the ground many miles away can also fail during intense shaking. As seismic waves travel through saturated granular soil; the soil begins to liquefy and act as a fluid. Soil strength and stability is lost causing the effects of ground shaking to intensify and for ground deformation to occur. These water saturated soils when shaken quickly lose the ability to support buildings, bridges, utilities, and other structures. Areas susceptible to liquefaction include places where sandy sediments have been deposited by rivers along their course or by wave action along beaches. The greater the magnitude of an earthquake and longer duration of strong ground shaking will result in an enhanced potential for liquefaction to occur. Settlement can cause damage when the amount settlement varies significantly across the length of a structure. Lateral spreading occurs when liquefaction occurs on gently sloping ground and the liquefied material at depth allows the area to slide, often toward a vertical discontinuity or “free face” such as a creek or stream channel. Liquefaction can occur in susceptible soils below bodies of water, and settlement and lateral spreading can damage structures built on or adjacent to these areas. Transportation bridges across water bodies, wharves, piers and other structures at ports and harbors, and underwater utility lines can be severely damaged by this hidden hazard.
**Subsidence** - Changes in the local environment that cause subsidence or sinkholes are called triggering mechanisms. Water is the primary factor that affects the local environment and causes subsidence. Water level decline, changes in groundwater flow, increased loading, and deterioration (such as abandoned mines) are all triggering mechanisms. Water level decline may occur naturally, or it may be the result of human action. Factors that lead to water decline are pumping (from wells), localized drainage (for construction activities), dewatering, or drought. Changes in groundwater flow can result from an increase in the velocity of groundwater movement, and increase in the frequency of water table fluctuations, and changes in discharge (either increase or decrease). Increased loading can cause pressure in the soil, leading to the failure of underground cavities and space, such as caves. Vibrations from earthquakes, heavy machinery, and blasting may result in structural collapse, followed by surface resettlement.

**Location of the Hazard**

The State of California is particularly vulnerable to earthquake activity due to California’s location residing between two large tectonic plates. CSU Northridge is located in the eastern portion of the Los Angeles Basin. In general, fault systems surround and traverse through Los Angeles and Orange Counties including the area of CSU Northridge. Throughout the basin the ground is saturated with sediment eroded from the mountains and foothills via multiple stream and river channels and resulting in liquefaction zones scattered across the region.

The Pacific Plate and the North American Plate come together at the San Andreas Fault 30 miles northeast of the CSU Northridge campus. In addition to the San Andreas Fault, Los Angeles County is home to or near additional fault systems with the potential to generate strong ground shaking. The Northridge Hills is a fault close to the CSU Northridge campus crossing to the northwest just beyond the northern boundary of the campus. The Santa Susana Fault extends across the base of the Santa Susana Mountains in an east to west direction 4 miles north of the campus. The Sierra Madre Fault is 8 miles east of the campus running along the base of the San Gabriel Mountains. The Hollywood-Raymond Fault is another east to west fault 13 miles south of the campus connecting Arcadia and Beverly Hills. The Northridge Fault extends in a northwest direction from Kagel Canyon through Santa Clarita 8 miles northeast of the campus. The Verdugo Fault extends from South Pasadena northwest to San Fernando 7 miles to the east of the campus. There are numerous additional faults in the area on all sides of the campus.
The CSU Northridge campus is located outside of areas designated to be liquefaction zones. No campus facilities are located within the liquefaction zone. However, substantial areas of the community to the south and east of the campus do reside within the liquefaction zone. This also includes major transportation corridors including Interstate 5, Interstate 405, US Highway 101, State Route 134, State Route 170, Reseda Blvd., Roscoe Blvd., and the Southern Pacific Railroad. The liquefaction zone generally follows the base of the Santa Monica Mountains.

Figure 16-7: Liquefaction Zones in Proximity to CSU Northridge

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Extent of the Hazard

The extent or severity of earthquake damage is expressed in terms of magnitude, intensity, and duration. The amount of energy released during an earthquake is normally conveyed as a magnitude measured from a seismogram. Magnitude is expressed in numbers and decimals representing the physical size of the earthquake. The strength and effect of the shaking on the surface of the earth is classified as the intensity. Intensity is further defined from the effects the earthquake has on people, structures, and the natural environment. The intensity of an earthquake in terms of measuring magnitude and evaluating its effects is generally expressed using the Modified Mercalli (MM) Intensity Scale. Duration is the length of time the earthquake’s energy is released. The Richter magnitude scale was developed in 1935 by Charles F. Richter of the California Institute of Technology as a mathematical device to compare the size of earthquakes. The Richter Scale is the best-known scale for measuring the magnitude of earthquakes. The magnitude value is proportional to the logarithm of the amplitude of the strongest wave during an earthquake. A recording of 7, for example, indicates a disturbance with ground motion 10 times as large as a recording.
of 6. The energy released by an earthquake increases by a factor of 31 for every unit increase in the Richter scale.

Table 16-16: Earthquake Intensity and Frequency Comparisons

<table>
<thead>
<tr>
<th>Magnitude</th>
<th>Mercalli Intensity</th>
<th>Potential Damage</th>
<th>Global Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 2.0</td>
<td>I</td>
<td>None</td>
<td>Continually</td>
</tr>
<tr>
<td>2.0 - 2.9</td>
<td>I to II</td>
<td></td>
<td>&gt; 1M per year</td>
</tr>
<tr>
<td>3.0 - 3.9</td>
<td>II to IV</td>
<td></td>
<td>&gt; 100,000 per year</td>
</tr>
<tr>
<td>4.0 - 4.9</td>
<td>IV to VII</td>
<td>Light</td>
<td>10K to 15 K per year</td>
</tr>
<tr>
<td>5.0 - 5.9</td>
<td>VI to VII</td>
<td>Moderate</td>
<td>1K to 1,500 per year</td>
</tr>
<tr>
<td>6.0 - 6.9</td>
<td>VII to X</td>
<td>Heavy</td>
<td>100 to 150 per year</td>
</tr>
<tr>
<td>7.0 - 7.9</td>
<td>VII &lt;</td>
<td>Very Heavy</td>
<td>10 - 20 per year</td>
</tr>
<tr>
<td>8.0 - 8.9</td>
<td>VII &lt;</td>
<td></td>
<td>1 per year</td>
</tr>
<tr>
<td>&gt; 9.0</td>
<td>VII &lt;</td>
<td></td>
<td>1 per 10-50 years</td>
</tr>
</tbody>
</table>

The Modified Mercalli Intensity Scale provides descriptive values of earthquake intensity that may provide greater meaning to the broader population as the description of intensity refers to the effects actually experienced. This scale uses an arbitrary ranking based on observed earthquake effects. The scale is composed of increasing levels of intensity ranging from shaking that is not recognizable to intense shaking resulting in catastrophic damages and casualties. The Modified Mercalli Intensity Scale is demonstrated below:

Table 16-17: Modified Mercalli Intensity Scale

<table>
<thead>
<tr>
<th>Intensity</th>
<th>Shaking</th>
<th>Description / Damage</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Not felt</td>
<td>Not felt except by a very few under especially favorable conditions.</td>
</tr>
<tr>
<td>II</td>
<td>Weak</td>
<td>Felt only by a few persons at rest, especially on upper floors of buildings.</td>
</tr>
<tr>
<td>III</td>
<td>Weak</td>
<td>Felt quite noticeably by persons indoors, especially on upper floors of buildings. Many people do not recognize it as an earthquake. Standing motor cars may rock slightly.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Intensity</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>IV</td>
<td>Light</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>V</td>
<td>Moderate</td>
</tr>
<tr>
<td>VI</td>
<td>Strong</td>
</tr>
<tr>
<td>VII</td>
<td>Very strong</td>
</tr>
<tr>
<td>VIII</td>
<td>Severe</td>
</tr>
<tr>
<td>IX</td>
<td>Violent</td>
</tr>
<tr>
<td>X</td>
<td>Extreme</td>
</tr>
</tbody>
</table>

The graph below illustrates the increasing intensity of energy that is released and as the measured magnitude increases. While each whole number increases in magnitude represents a tenfold increase in the measured amplitude, it represents an increasing rate of 32 times more energy released in the same increase in magnitude. As the
The magnitude of an earthquake is measured higher, the intensity of the earthquake worsens progressively from one category to the next.

Figure 16-8: Earthquake Magnitude and Equivalent Energy Release

Numerous fault systems surround and traverse the areas surrounding the campus. Though the campus is not in a liquefaction zone, such zones are located near the campus. In addition, several severe and catastrophic events have taken place in the region, in particular the Northridge event in 1994. Based on these factors, the planning committee ranks the extent of the hazard for the campus as Moderate to High.

History of the Hazard

The State of California has a long history of chronic and destructive earthquakes throughout the state. On average, earthquakes strong enough to result in structural damages occur three to four times a year in California, while earthquakes Magnitude 6.0 to 6.9 occur once every two to three years. Los Angeles County also has a long history of earthquake activity. The entire area of Los Angeles County is at risk to seismic activity and has a history of significant earthquakes resulting in damages.

Table 16-18: Historic Earthquakes Near Northridge, CA

<table>
<thead>
<tr>
<th>Date</th>
<th>Location</th>
<th>Magnitude</th>
<th>Damages</th>
</tr>
</thead>
<tbody>
<tr>
<td>12/8/1812</td>
<td>San Juan Capistrano</td>
<td>7.5</td>
<td>120 fatalities, $40 million</td>
</tr>
<tr>
<td>3/10/1933</td>
<td>Long Beach</td>
<td>6.4</td>
<td>120 fatalities, $40 million</td>
</tr>
<tr>
<td>2/9/1971</td>
<td>San Fernando</td>
<td>6.6</td>
<td>58-65 fatalities, $553 million</td>
</tr>
<tr>
<td>10/1/1987</td>
<td>Whittier</td>
<td>5.9</td>
<td>8 fatalities, $358 million</td>
</tr>
<tr>
<td>2/28/1990</td>
<td>Upland</td>
<td>5.7</td>
<td>30 injuries, $12.7 million</td>
</tr>
<tr>
<td>6/28/1991</td>
<td>Sierra Madre</td>
<td>5.6</td>
<td>1 fatality, $40 million</td>
</tr>
<tr>
<td>1/17/1994</td>
<td>Northridge</td>
<td>6.7</td>
<td>57 fatalities, $40 billion</td>
</tr>
<tr>
<td>7/29/2008</td>
<td>Chino Hills</td>
<td>5.5</td>
<td>Minor</td>
</tr>
<tr>
<td>3/28/2014</td>
<td>La Habra</td>
<td>5.1</td>
<td>$10 million</td>
</tr>
</tbody>
</table>

The January 9, 1994 Northridge Earthquake became the costliest seismic event in California history. The earthquake caused extensive damage to structures, the transportation infrastructure, utility systems, water storage, communications, and critical facilities. This level of damage due to the fault that ruptured was directly underneath a densely populated urban area. The Northridge Earthquake was found to raise the nearby mountains by as much as 70 centimeters. The earthquake was provided a federal disaster declaration (DR-1008).

The October 1, 1987 Whittier Narrows Earthquake shook a large part of southern California. The earthquake caused $358 million in damages, especially in the Alhambra, Pasadena, and Whittier areas. The earthquake resulted in extensive infrastructure damages, multiple injuries, and 8 fatalities. The earthquake was provided a federal disaster declaration (DR-799).

The February 9, 1971 Magnitude 6.5 San Fernando Earthquake struck the San Fernando Valley in Los Angeles just after 6am. The intense shaking caused the collapse of freeway overpasses, hospitals, and other infrastructure. It damaged thousands of homes and businesses, a reservoir, and critical infrastructure. 65 people were killed and 2,000 more were injured. The shaking was felt for 300 miles including in Las Vegas, Nevada. The earthquake was provided a federal disaster declaration (DR-299).

43 2019 County of Los Angeles All-Hazards Mitigation Plan, 2019
The March 10, 1933 Long Beach Earthquake registered at a Magnitude 6.4 occurred along the Newport-Inglewood Fault. The earthquake resulted in over $50 million in damages, 500 injuries, and 120 fatalities. Unreinforced masonry structures were the source of most of the casualties. 70 schools were destroyed and 120 were damaged. This earthquake promoted statewide standards in building design and construction for schools and other structures to better withstand seismic events.

Potential Impacts of the Hazard

The shaking of the ground from earthquakes can result in building collapse, bridge failure, utility disruptions and other structural collapse. Large earthquakes can additionally cause natural gas lines to break resulting in structure fires. The proximity to the unstable soils to the south and east of the campus presents a potential for liquefaction creating greater ground instability during seismic events. A major earthquake in the Los Angeles area would likely result in region-wide social disruptions in addition to structural damages. The region-wide structural damages may disrupt lifelines and supply chain routes limiting the campus from effective evacuation routes and receiving necessary supplies or equipment.

Most injuries resulting from earthquakes are from collapsing walls, flying glass, or other objects moved by ground shaking. The lack of warning allows individuals minimal time to react and find areas of safety. A moderate earthquake occurring near Northridge could cause injuries or fatalities to members of the campus community or support networks the campus relies on. These earthquake effects might be aggravated by collateral incidents such as fire, flooding, hazardous material spills, dam/levee compromises, and other cascading events. A catastrophic earthquake near Northridge could result in extensive casualties, expansive structural damages, panic, widespread utility outages, communication failures, and secondary emergencies such as fire. A catastrophic earthquake would certainly affect the broader San Fernando Valley and Los Angeles County region limiting immediate assistance that the campus may normally expect.

Local impacts to CSU Northridge campus caused by an earthquake could include:

- Damage and secondary fires to industrial buildings to the west of the campus
- Potential hazardous material releases on and off campus
- Infrastructure damage to freeway system
- Damages to rail lines and rail cars ½ mile to south of campus
- Structural damage to bridges over waterways and flood control channels
- Potential isolation of campus from community
- Potential isolation among on-campus residents
- Damages to homes and apartment complexes surrounding the campus and throughout the San Fernando Valley
- Structural damage to Aliso Canyon Wash levees
- Damage to flood control and drainage systems including the Lower San Fernando Dam
- Structural damage to campus academic and support buildings
- Structural damages to parking structures
- Structural damage to residence halls resulting in displaced student populations
- Structural damage to nearby residences
- Community members arriving on campus for refuge from damaged homes
- Damaged university communications, computer systems, and networks
- Considerable stress and fear among community
- Closure or reduction of service to campus operations
- Reduction of campus revenue

Probability of Future Occurrence of the Hazard

The Working Group on California Earthquake Probabilities (WGCEP), a collaboration between the United States Geological Survey (USGS), the Southern California Earthquake Center (SCEC), and the California Geological Survey (CGS) develops Uniform California Earthquake Forecasts (UCERFs) using the best currently available science and technology. The UCERF version 3 provides a three-dimensional view of the likelihood a region in California will experience a Magnitude 6.7 or greater earthquake in the next 30 years. The likelihood for the Los Angeles County fault systems surrounding Los Angeles and San Fernando Valley is included in the following table.

Table 16-19: Major Potentially Active Faults in Proximity to CSU Northridge

<table>
<thead>
<tr>
<th>Fault Zone</th>
<th>Recurrence</th>
<th>Maximum Magnitude</th>
<th>UCERF3 Likelihood</th>
</tr>
</thead>
<tbody>
<tr>
<td>Compton</td>
<td>Historic: Unknown</td>
<td>6.5 to 7.1</td>
<td>1%</td>
</tr>
<tr>
<td>Elysian Park</td>
<td>Historic: Unknown</td>
<td>5.8 to 6.5</td>
<td>1%</td>
</tr>
<tr>
<td>Hollywood</td>
<td>Historic: 1,600 years</td>
<td>5.8 to 6.5</td>
<td>1-2%</td>
</tr>
<tr>
<td>Newport-Inglewood</td>
<td>Historic: Unknown</td>
<td>6.0 to 7.4</td>
<td>1%</td>
</tr>
<tr>
<td>Northridge</td>
<td>Historic: Unknown</td>
<td>6.0 to 7.0</td>
<td>1%</td>
</tr>
<tr>
<td>Northridge Hills</td>
<td>Historic: Unknown</td>
<td>Unknown</td>
<td>1%</td>
</tr>
<tr>
<td>Palos Verdes</td>
<td>Historic: Unknown</td>
<td>6.0 to 7.0</td>
<td>3%</td>
</tr>
</tbody>
</table>

44 2019 County of Los Angeles All-Hazards Mitigation Plan, 2019
45 Southern California Earthquake Center, Earthquake Information, [https://scedc.caltech.edu/earthquake/faults.html](https://scedc.caltech.edu/earthquake/faults.html)
<table>
<thead>
<tr>
<th>Fault System</th>
<th>Age/Other Information</th>
<th>Magnitude Range</th>
<th>Probability</th>
</tr>
</thead>
<tbody>
<tr>
<td>San Andreas</td>
<td>Varies: 100-300 years</td>
<td>6.8 to 8.0</td>
<td>18-20%</td>
</tr>
<tr>
<td>Santa Monica</td>
<td>Historic: Unknown</td>
<td>6.0 to 7.0</td>
<td>1%</td>
</tr>
<tr>
<td>Santa Susana</td>
<td>Historic: 138 years</td>
<td>6.6</td>
<td>2-3%</td>
</tr>
<tr>
<td>Sierra Madre</td>
<td>Historic: 1,000-3,000 years</td>
<td>6.0 to 7.0</td>
<td>1-2%</td>
</tr>
<tr>
<td>Simi-Santa Rosa</td>
<td>Historic: 933 years</td>
<td>6.7</td>
<td>1-2%</td>
</tr>
<tr>
<td>Verdugo</td>
<td>Historic: Unknown</td>
<td>6.0 to 6.8</td>
<td>1%</td>
</tr>
<tr>
<td>Whittier</td>
<td>Historic: Unknown</td>
<td>6.0 to 7.2</td>
<td>1%</td>
</tr>
</tbody>
</table>

Based on the earthquake shaking potential in the San Fernando Valley and Los Angeles Basin, the proximity to the above listed fault systems, the probability of seismic ground shaking generating damage is considered **Possible**.

**Vulnerability to the Hazard**

A considerable challenge regarding earthquakes is they generally occur without warning. The fault systems surrounding the region all cross major transportation routes potentially reducing the availability of access and the supply chain. The geographic location of CSU Northridge places the campus in an urban/suburban community near residential, commercial, and industrial areas that is moderately populated. Earthquake effects experienced in the neighboring local community will likely spill over onto the campus.

The known fault systems generating the threat to the San Fernando Valley generally surround the area and some cross into the city including near the CSU Northridge campus. For example, the Northridge Hills Fault traverses the northern edge of the campus. The proximity and potential for large earthquake development from these surrounding systems expose significant vulnerabilities. The potential for earthquake damaged structures being left uninhabitable including campus residence halls will result in numerous displaced individuals and households. The lack of earthquake insurance will cause extreme financial burdens on those affected. Campus buildings and equipment would be vulnerable to damages from building, seismic shaking, secondary fires, and secondary building floods from broken pipes.

Elements of the vulnerability to a major earthquake on the CSU Northridge campus will vary depending on when the earthquake were to strike. The primary basis of vulnerability is based on the population affected and the built environment exposed. In general, newer construction will be more earthquake resistant than older buildings as building codes and construction technology have improved. A locally centered earthquake, even from moderate events, would have the potential for more damaging results when associated with the moderate liquefaction zones of the city. This would particularly be seen with greater damages to unreinforced masonry buildings.
The risk to the campus population will be lessened during periods when classes are not in session or during periods of breaks. Conversely, during the days and hours that classes are in session and staff are at their workplaces, the human vulnerability increases. Generally, people are safer when at home in wood frame structures as earthquakes tend to generate less structural damage to wood construction than in commercial or industrial facilities. The greater number of people on campus at the time of an earthquake will result in more people being exposed to effects from damaged campus facilities or equipment and require greater evacuation assistance. However, in region-wide events this vulnerability may simply shift to the homes and workplaces of members of the campus community and their families.

The aftermath of a major earthquake will likely result in widespread search and rescue operations for trapped and injured individuals. The demand on emergency services will be great, potentially requiring the campus community to be prepared for these scenarios and initiate response actions as needed. There will be needs for emergency medical care, shelter, water, and food for individuals who have been displaced by the earthquake. In earthquakes causing significant damages, there may be a necessity to provide assistance with identification and support to local agencies in mass fatality management.

There may be a need to evacuate members of the campus community from the campus and to other locations that are deemed to be safer locations. Roadways surrounding the campus providing critical access to and from the campus will likely become heavily congested in a major earthquake. As the CSU Northridge campus is downstream from dam facilities, the decision to evacuate will need to take into account whether flood control facilities are filled with water and the actual threat to the dam or levees.

Certain campus populations will experience greater challenges to a post-earthquake environment. Vulnerable populations including those that rely on specific services, require electrical power, homeless students, experience disabilities, non-English speakers, those whose age make evacuating difficult, and others will be most affected. These individuals will likely need to navigate through earthquake generated debris, extreme stresses of a disaster, an inability to communicate to or gain access to support networks, and find difficulty in accessing equipment or supplies to aid in a specific need.

Estimate of Potential Losses

Estimates of potential losses will be influenced by a variety of factors. The intensity of the earthquake will determine what scale of damages affecting campus infrastructure, equipment, and other impacted features. Losses will be generated by the physical damages, the loss of revenue, loss of academic research, loss of building contents, and community wide economic reductions. Based on estimate replacement costs of facilities and structures on campus, the total replacement costs due to earthquake are $550,272,157.
Based on estimate replacement costs of facilities and structures on campus, the maximum total replacement costs due to earthquake are $550,272,157.

Table 16-20: HAZUS Peak Ground Acceleration Zone (PGA) Estimated Losses

<table>
<thead>
<tr>
<th>PGA Zone Designation</th>
<th>Intensity</th>
<th>No of Buildings</th>
<th>Maximum Replacement Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Extreme</td>
<td>X+</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Violent</td>
<td>IX</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Severe</td>
<td>VIII</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Very Strong</td>
<td>VII</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Strong</td>
<td>VI</td>
<td>78</td>
<td>$550,272,157</td>
</tr>
<tr>
<td>Moderate</td>
<td>V</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Light</td>
<td>IV</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Weak</td>
<td>II-III</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Not Felt</td>
<td>I</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>NA</td>
<td>NA</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>No Building Value Data Provided*</td>
<td>NA</td>
<td>39</td>
<td>Unknown</td>
</tr>
</tbody>
</table>

*Buildings with no value defined are also included in the respective Zones they are found in.

Vulnerability Assessment Conclusions

It is difficult to predict the severity of casualties, property, and cascading impacts generated by future seismic events affecting the greater Los Angeles Basin, San Fernando Valley, and the CSU Northridge campus. Each of the earthquake generated effects will vary widely based on the intensity of the earthquake, location of the epicenter, proximity to people and development, time of day and year, the soil composition under the impacted structures, building construction, among others. In any case, the potential for a major earthquake exists affecting the campus and causing extensive challenges to the CSU Northridge campus and community.

In the event that a major earthquake was to strike along the many fault systems surrounding Northridge, the effects could be significant to the campus community and campus operations. The widespread impacts generated by a major earthquake would extend the effects of casualties, damages, and other impacts to the broader Los Angeles Basin and San Fernando Valley region creating large-scale regionwide needs for critical assistance and a heavy demand on limited emergency resources. The threat and impacts presented to the campus will be shared with the campus community from their homes and places of work. The campus will likely be required to address critical needs independently during early phases of the disaster.
Vulnerabilities will be seen in the physical infrastructure on the campus and the human population of the campus community. Campus infrastructure is vulnerable to severe shaking particularly in areas where the ground is loose or susceptible to liquefaction. Specifically older buildings, masonry constructed buildings, and other structures susceptible to shaking related damage are the most vulnerable. Communication systems, computer networks, and other electronic systems may be vulnerable when overwhelmed by increased demand during emergencies or by shaking related damages. The people of the campus community are vulnerable to effects of intense shaking in the form of injuries from falling debris, exposure to secondary floods or fires, loss of employment, extreme disaster induced stress, and loss of access to critical services or social contacts.

The campus population are additionally vulnerable to the effects of major ground shaking that are far reaching. The psychological and social impacts a major earthquake will give rise to will potentially harm individuals and cause tremendous fear. The willingness to return indoors may be hampered especially as after-shocks continue. These effects are magnified for populations having specific vulnerabilities or access limitations. Populations having various limitations or specific needs may be vulnerable to reduced or eliminated access to essential services that have been rendered incapable to respond.

Identified Data Limitations

Data limitations include missing campus structural replacement costs, and lack of a complete inventory of building construction types to include status of earthquake retrofitting. HAZUS generated analysis is focused on the broader community level versus fine-tuning the analysis to the micro-level for facilities such as a university campus.

Erosion

Description of the Hazard

The US Geological Survey (USGS) defines erosion as “the process whereby materials of the earth’s crust are loosened, dissolved, or worn away and simultaneously moved from one place to another”. Erosion may occur in areas of streams and rivers, along bluffs, around immovable objects (such as buildings or bridge abutments), or as a cascading result of other natural hazards, such as earthquakes or wildfires. When erosion occurs along bodies of water, the removal of material causes the shore to move further landward.

Forces such as sea level rise and changes in sediment supply impact erosion gradually and can be difficult to recognize. In contrast, the impacts of short-term events, such as storms and flooding, can be severe and are immediately recognizable.

Location of the Hazard

Erosion is a relatively non-spatial hazard that can occur in any location with conducive soil structure and a source of movement such as water or wind. An area’s potential for erosion is determined by several factors, including rainfall, topography, soil characteristics, and vegetative cover. Streambank and bluff erosion can occur near any riverine area. For the purpose of this campus-level analysis, the erosion hazard poses a consistent risk across those areas of the campus with erosion-prone characteristics. In the future, campus leadership may investigate whether or not and to what extent specific erosion prone locations are present on the campus.

Extent of the Hazard

There is no published scale of severity or extent for this geologic hazard. If conditions are favorable, erosion is likely to occur. Based on no history of occurrence and no known erosion prone locations, the planning committee ranks its extent on campus as Low.

History of the Hazard

There have been no recorded incidents of erosion on the CSU Northridge campus.

Potential Impacts of the Hazard

Erosion causes instability in soil. During high-intensity rain events, for example, eroded areas will continue to erode, resulting in additional loss of soil and ground stability in the area. This removal of sediment can result in damage to infrastructure, public health, and safety. On campus, areas of erosion can create pedestrian and transportation hazards, and structures may become unsafe if erosion is not controlled.

Probability of Future Occurrence of the Hazard

Erosion is an on-going and dynamic process that occurs regularly. As climate change induces more frequent and intense weather events, such as wildfires and flooding, erosion may generally become more widespread or severe. These events can cause erosion or exacerbate areas already experiencing erosion. As a result, and in consideration of the potential extent of erosion, the probability of at least a limited degree of erosion occurring somewhere on the campus in the future is high over the long term.

Vulnerability to the Hazard

Topography, soil structure, land use, and precipitation are all factors of erosion. CSU Northridge infrastructure and buildings located on steep slopes, in areas with little vegetation, or in areas with conducive soil types are more vulnerable to erosion.
In the wider Northridge community, erosion vulnerabilities include agricultural sector job loss, degradation of riverine ecosystems, and loss of water quality.
Estimate of Potential Losses

The historic and potential impacts of erosion on property statewide include reduced agricultural productivity, lower surface water quality, and damaged drainage networks.

Current modeling is not precise enough to allow for an assessment of potential losses to buildings and infrastructure on campus.

Vulnerability Assessment Conclusions

While the ability to predict future erosion on the CSU Northridge campus is limited, the core issues shaping erosion vulnerability on campus are flora and landscaping. If left unchecked, erosion can cause significant damage to campus infrastructure and the surrounding environment.

Identified Data Limitations

The complex interactions between soil erosion factors make predictive modeling, determination of hazard areas, and quantification of loss difficult. Localized data on this hazard is also limited, resulting in more generalized findings.

Extreme Temperatures (Includes Extreme Cold and Extreme Heat)

Description of the Hazard (Extreme Heat)

What is considered an excessively hot temperature varies according to the normal climate for that region. However, when temperatures are extremely high, people are at higher risk for heat-related illnesses, such as dehydration, heat exhaustion, heat stroke, and in severe cases, death.  

Hazards from extreme heat are made worse when high temperatures are accompanied by high levels of humidity, which is defined as the amount of moisture in the air. As the temperature climbs, the air is able to hold more moisture. High humidity prevents the human body from cooling down naturally, which leads people to perceive that the temperatures “feel” hotter. The combination of temperature and humidity is known as the heat index.

Heat stroke, the most serious heat-related illness, occurs when the body is unable to control its temperature. Body temperature rises rapidly, the sweating mechanism fails,
and the body cannot cool down. In extreme causes, heat stroke can cause confusion and unconsciousness, so the victim is unable to seek treatment without assistance.

There are several groups of people who are uniquely vulnerable to the effects of extreme heat, such as infants and children, older adults aged 65 and up, athletes and outdoor workers, low-income households, and individuals with certain chronic medical conditions.

Location of the Hazard

Extreme heat events are a non-spatial hazard, and may occur throughout the CSU Northridge (CSUN) campus.

Extent of the Hazard

Extreme heat has a wide range of extent and severity markers and characteristics. Monthly average maximum temperatures in June through October range approximately from the low 80s to the low 90s in the Northridge area of Los Angeles County. According to data from the National Climatic Data Center (NCDC), the highest daily temperature recorded at the CSUN campus was 113°F on July 22, 2006. This high temperature was related to an extended period of excessive heat affecting San Luis Obispo, Santa Barbara, Ventura, Los Angeles, and many other Southern California counties. Heat index values ranged from 100°F to 119°F. Given over 200 extreme heat days from 1990-2015, the planning committee ranks the extent of the hazard as **Moderate** – the rare occurrence of humidity coinciding with such frequently high temperatures reduces the hazard ranking from rising above Moderate.

The National Weather Service issues a Heat Advisory when the heat index value is expected to reach 100°F – 104°F within the next 12 to 24 hours. Excessive Heat Warnings are issued when there is an anticipated heat index of 105°F or greater that will last for two (2) or more hours. Excessive Heat Warnings are issued by the county when any location in the county is expected to reach those criteria. In anticipation of an Excessive Heat Warning, an Excessive Heat Watch may be issued 1 to 2 days in advance, when the Heat Warning criteria is 50 – 79% likely to occur.

Figure 16-9 (following) depicts the National Weather Service’s methodology for determining the heat index, using the % humidity and the actual temperature.

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As the heat index rises, so does the potential danger to people and animals. Table 16-22 (following) shows the health hazards associated with extreme heat.

Table 16-21: Health Risks Associated with Heat Index

<table>
<thead>
<tr>
<th>Category</th>
<th>Heat Index</th>
<th>Health Hazards</th>
</tr>
</thead>
<tbody>
<tr>
<td>Extreme Danger</td>
<td>130° F or higher</td>
<td>Heat stroke / sunstroke is likely with continued exposure.</td>
</tr>
<tr>
<td>Danger</td>
<td>105° – 129° F</td>
<td>Sunstroke, heat cramps, and/or heat exhaustion is likely with prolonged exposure and/or physical activity.</td>
</tr>
<tr>
<td>Extreme Caution</td>
<td>90° – 104° F</td>
<td>Sunstroke, heat cramps, and/or heat exhaustion is possible with prolonged exposure and/or physical activity.</td>
</tr>
<tr>
<td>Caution</td>
<td>80° – 89° F</td>
<td>Fatigue is possible with prolonged exposure and/or physical activity.</td>
</tr>
</tbody>
</table>

History of the Hazard

Based on data gathered from the National Centers for Environmental Information (NCEI) Storm Events Database, there have been five excessive heat events in Los Angeles County since 2007. These events were grouped together as part of the same heat waves.

**August 30, 2007; September 1, 2007; September 3, 2007:** A combination of high temperatures and high humidity produced an extreme heat event across Southern California. Heat index values ranged from 105° to 112° F. There were eight deaths attributable to this excessive heat event.

**June 20-21, 2008:** During this large-scale heat wave that impacted much of the state, afternoon high temperatures climbed as high as 114° F. The heat resulted in several power outages due to excessive electrical use.

**Note:** The NCDC database also lists more than 200 additional dates that the recorded temperature at the CSUN campus has reached 100° F or greater between 1990 and 2015.

Potential Impacts of the Hazard

CSUN may experience impacts from extreme heat due to cancelled classes or postponed outdoor events in order to protect students, faculty, and staff from the weather.

In addition to the threat extreme heat poses to humans, high temperatures also pose a threat to utility production, which in turn threaten facilities and operations that rely on utilities. As temperatures rise, more people stay indoors, increasing the demand for air conditioning, fans, and other electronics. This puts a strain on the electrical grid, which can cause temporary outages. These outages can impact operations throughout campus, resulting in interruptions and delays in service. Outages may also negatively impact research efforts on campus, as the inability to maintain a steady, constant temperature may impact research specimens and experimental results.

Probability of Future Occurrence of the Hazard

According to NCDC and NCEI data, Los Angeles County has experienced over 200 days with temperatures above 100 degrees from 1990-2015. This translates to 8 extreme heat events per year over the 25-year period. Therefore, using the scale provided, it is **Highly Likely** that the hazard will occur annually, though only **Possible** for extreme heat to be accompanied by high humidity levels. The City of Los Angeles, of which Northridge is a part, does not consider extreme heat to be a primary hazard, because the combination of high temperature and high humidity, which are the
Vulnerability to the Hazard

When dealing with an extreme heat event, the most common impacts are those generally felt by the people living in the targeted area. For people in particular, heat can kill when the body is pushed beyond its limits. Most heat disorders occur because the victim has been overexposed to heat. As discussed, the major human risks associated with extreme heat include dehydration, sunburn, fatigue, heat exhaustion, heat stroke, and in severe cases, death.

Some portions of the population are more at risk to the effects of extreme heat. The very young, the elderly, and certain groups with chronic medical conditions (such as asthma or other pulmonary illnesses, heart disease, poor blood circulation, neurological illnesses, and obesity) are generally more vulnerable to the effects of extreme heat, and are more likely to suffer illness or death as a result. This is especially true if exposure is extended for a period of time and preventative measures are not taken immediately.

CSUN is aware of the potential for extreme heat events, and in particular, for the potential for the frequency of these events to increase. The campus will issue its own heat warnings (in addition to any warning issued by the City of Los Angeles) for students’ safety. When it comes to staff safety, supervisors are reminded of Occupational Safety and Health Administration (OSHA) regulations that protect workers from extreme heat. Under OSHA law, employers must provide workplaces free of known safety hazards, which includes protecting workers from extreme heat, and any employer with workers exposed to high temperatures should establish a heat illness prevention program that includes monitoring workers for signs of illness and providing them with water, rest, and shade. The campus also issues alerts and information about the warning signs for heat-related illnesses. These warnings are communicated through the student health office.

CSUN monitors power usage to ensure that air-conditioning is running in campus facilities during hot days. The campus has experienced broken air-conditioning units and has installed a few back-up generators to keep the campus population cool. Some units are portable and can be moved to various buildings as needed.

Therefore, although this is not a hazard that the campus should experience with regularity, CSUN has ample preparation in place to handle the risks and vulnerabilities.

Estimate of Potential Losses

Based on the previous historical occurrences, annualized losses are considered to be negligible. In an extreme heat event, loss of human life or health impacts are a greater concern than is property damage.

Vulnerability Assessment Conclusions

While the ability to predict future heat events at the CSUN campus is limited, the effects of climate change may provide some information. According to the Environmental Protection Agency (EPA), Southern California has warmed about three degrees on average over the last century, with less rainfall. This may lead to stronger and more frequent heat events, drought, and an increased risk of wildfires.\textsuperscript{58}

Identified Data Limitations

Numerous public and private actors conduct research, acquire data and disseminate meteorological information and forecasting to the general public, including the CSU university system. Currently, it is assumed that, apart from regular access to climate change models on changes to temperature extremes over time, the CSU community maintains sufficient access to the data needed to plan for, respond to, and mitigate the effects of extreme heat and cold.

\textit{Flood}

Description of the Hazard

The incredible geographic diversity in California presents tremendous challenges for flood planning and response. The state is home to extensive mountain ranges such as the Sierra Nevada, Cascades, Klamath, Coastal Ranges, and the Southern California Transverse Range all creating tremendous watersheds. Large river systems drain the mountains traveling through populated communities including the Sacramento and San Joaquin Rivers draining into the California Delta. The state has a complex system of reservoirs, dams, and levees providing water storage and flood protection. Finally, California’s 840-mile coastline exposes the coastal regions to tidal influences.

Floods are characterized by the rising and overflowing of excess water from a water source such as a stream, river, lake, canal, or coastal body onto an area of normally dry floodplain. A floodplain is a lowland area downstream and adjacent to water

bodies that are subject to flood events. Flooding is a naturally occurring event that becomes hazardous when populations and property are affected.

Flooding can result from excessive precipitation from weather systems generating prolonged rainfall, excessive snowmelt from watersheds upstream from the floodplain, infrastructure failure, exceeding the capacity of dams or levees, tidal influences, or a combination from any of the previous factors.

Flooding represents one of the costliest and most frequent natural disasters that influences human suffering and economic impact in the United States. Flooding will likely result in significant damage to structures, infrastructure, utilities, landscapes, and the environment. Erosion of stream banks, roadways, other features may result from the movement of flood waters. The saturated ground resulting from standing flood waters may cause ground instability, collapse, erosion, or other damages. Further, floods will often generate substantial debris that will accumulate and be deposited throughout the flooded areas.

Flooding can be either slow-rise or rapid onset floods. With slow rise floods, there is often warning preceding water rise by hours or days before dangerous conditions present themselves. Slow rise floods that are expected to enter into populated areas generally allow for some time to initiate evacuation and sand bagging efforts. Flooding that occurs rapidly conversely are water events that present with extremely limited warning times and a limited ability to take response actions until flooding has already begun to occur.

Flooding may take on different forms:

- **Flash Flooding** – Flash flooding is typically characterized by a rapid rise, short duration, and large volume of water in a localized area. Heavy rainfall in areas that have limited drainage capacities often contribute to flash flooding conditions. These flooding events frequently occur with limited notice requiring immediate evacuation or rapid response efforts such as sand bagging. Flash flooding may arrive with fast moving water creating added hazardous conditions.

- **Riverine Flooding** – Riverine flooding is usually caused by prolonged rainfall or rainfall combined with heavy snowmelt. When soils are already saturated, the ability for the ground to absorb water is minimized. In a riverine flood, the water way exceeds channel capacity and extends into areas outside of the channel, often in developed communities. In California, riverine flooding is most likely to occur from November through April. The duration of riverine floods may vary from a period of hours to weeks.

- **Localized Flooding** – Localized flooding is commonly the result of stormwater drainage systems being overwhelmed by unusually heavy rainfall. These flooding events frequently occur in areas that are urbanized or developed with greater amounts of impervious surfaces not allowing ground absorption. This generates added runoff into the drainage systems and onto roadways creating backups.
- **Infrastructure Failure** – Failures of dams or levees presents a serious flooding concern for areas downstream from the compromised structure. This situation may result in a catastrophic flood with limited warning time and widespread areas affected. This hazard is addressed in Section XX

- **Coastal Flooding** – Coastal flooding can occur in multiple areas along the California coastline. Flooding may result from intense storms coming from the Pacific Ocean that generate elevated water levels or storm surge. The size, duration, winds generated, and intensity of the storm will influence the effect the waves will have on the shoreline. Periods of high tide can aggravate the conditions allowing greater wave impingement into coastal areas.

**Atmospheric Rivers**

California, including the location of this campus, is subject to the effects of a phenomenon referred to as atmospheric rivers. These weather events consist of long, narrow regions in the atmosphere transporting tremendous amounts of water vapor from the tropics. These weather regions behave like rivers in the sky. They can carry heavy volumes of water vapor compared to the amount of water flow at the mouth of the Mississippi River. As these atmospheric rivers arrive into California, they tend to generate significant rain and snow.

Atmospheric rivers can arrive in many different shapes and sizes. The larger events are able to generate extreme rainfall amounts resulting in flooding. They can stall over watersheds vulnerable to flooding, often saturated with heavy snow amounts. The atmospheric rivers known as a “Pineapple Express” coming from the tropics and arriving with warmer air may produce heavy rains that will melt ground snow adding to the water volume that will be added in the flood runoff.

These events can produce heavy amounts of precipitation creating extensive damages. However, these events may present as weaker systems that produce precipitation that is enough to be beneficial for the local water supply. At the higher elevations in the California mountains, these events have the potential to generate a tremendous snowpack providing a source of water during the dry summer months.
Location of the Hazard

CSU Northridge is located in the San Fernando Valley portion of Los Angeles. The San Fernando Valley is surrounded by mountainous terrain on all sides. The Los Angeles River begins in the San Fernando Valley on west side where the Arroyo Calabasas and Bell Creek join. There is an extensive network of flood control channels that drain the mountains and the surface streets in the valley all leading to the Los Angeles River. Each of the mountain ranges and hills that surround the San Fernando Valley provide a potential for developing substantial water run-off during heavy localized precipitation events. These channels are dry for the majority of the year. The area surrounding the campus is a developed suburban environment predominantly consisting of residential and commercial land uses. There are industrial facilities and distribution centers located to the south and east of the campus. The Southern Pacific Railroad have tracks located ½ mile south of the campus.

Figure 16-11: Flood Hazard Zones in Greater Los Angeles, CA

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The CSU Northridge campus is located not in proximity to any significant waterways or flood control systems. The entire CSU Northridge campus sits within a Special Flood Hazard Area (SFHA) Zone X: Area of Minimal Flood Risk designation on the Flood Insurance Rate Map. This minimal flood risk rating extends throughout the western San Fernando Valley with the exception of specific areas near flood control channels. The flood control channels are designated as Zone AE: 1% Annual Chance Flood Hazard and some areas adjacent to flood control channels are designated as Zone X: 0.2% Annual Chance Flood Hazard, and critical services in proximity to the campus are found outside of designated flood risks.

Extent of the Hazard

The CSU Northridge campus is entirely located in a designated Zone X: Area of Minimal Flood Hazard. The access routes into and out of the campus servicing locations in all directions are also found in areas primarily designated as Zone X: Area of Minimal Flood Hazard. Based on the location of the campus and access routes entirely in Zone X and no history of flooding, the planning committee ranks the extent of the hazard as **Low**.
In support of the NFIP, FEMA identifies those areas that are more vulnerable to flooding by producing Flood Hazard Boundary Maps (FHBM), Flood Insurance Rate Maps (FIRM), and Flood Boundary and Floodway Maps (FBFM). Several areas of flood hazards are commonly identified on these maps, including the 1% annual chance flood zone. Flood zones are further delineated by risk and are assigned a letter signifier. The flood zone designations are defined and described in the following table.

Table 16-22: Flood Zone Designations and Descriptions

<table>
<thead>
<tr>
<th>Zone Designation</th>
<th>Percent Annual Chance of Flood</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Zone V</td>
<td>1%</td>
<td>Areas along coasts subject to inundation by the 1% annual chance of flooding with additional hazards associated with storm-induced waves. Because hydraulic analyses have not been performed, no BFEs or flood depths are shown.</td>
</tr>
<tr>
<td>Zones VE and V1-30</td>
<td>1%</td>
<td>Areas along coasts subject to inundation by the 1% annual chance of flooding with additional hazards associated with storm-induced waves. BFEs derived from detailed hydraulic analyses are shown within these zones. (Zone VE is used on new and revised map in place of Zones V1-30.)</td>
</tr>
<tr>
<td>Zone A</td>
<td>1%</td>
<td>Areas with a 1% annual chance of flooding and a 26% chance of flooding over the life of a 30-year mortgage. Because detailed analyses are not performed for such areas, no depths or base flood elevations are shown within these areas.</td>
</tr>
<tr>
<td>Zone AE</td>
<td>1%</td>
<td>Areas with a 1% annual chance of flooding and a 26% chance of flooding over the life of a 30-year mortgage. In most instances, BFEs derived from detailed analyses are shown at selected intervals within these zones.</td>
</tr>
<tr>
<td>Zone AH</td>
<td>1%</td>
<td>Areas with a 1% annual chance of flooding where shallow flooding (usually areas of ponding) can occur with average depths between 1 – 3 feet.</td>
</tr>
</tbody>
</table>
### Zone AO

1%

Areas with a 1% annual chance of flooding, where shallow flooding average depths are between 1 – 3 feet.

### Zone X (shaded)

0.2%

Represents areas between the limits of the 1% annual chance flooding and 0.2% chance flooding.

### Zone X (unshaded)

**Undetermined**

Areas outside of the 1% annual chance floodplain and 0.2% annual chance floodplain, areas of 1% annual chance sheet flow flooding where average depths are less than one (1) foot, areas of 1% annual chance stream flooding where the contributing drainage area is less than one (1) square mile, or areas protected from the 1% annual chance flood by levees. No BFEs or depths are shown within this zone.

### History of the Hazard

Flooding in Northridge and the broader Los Angeles County region have typically occurred during the winter months when Pacific storms are more common. The occurrences of significant flooding typically have been the result of successive intense storms with heavy precipitation. The region has experienced flood events that have caused tens of millions of dollars in damages and casualties. The following provides insight into information of past flooding events that are significant to the CSU Northridge campus. On campus, occasional flooding is limited to small, isolated pockets of ponding in low lying areas. No records of flooding are reported for the campus.

Table 16-23: Historic Flooding Events in Los Angeles County

<table>
<thead>
<tr>
<th>Date</th>
<th>Event</th>
<th>Declaration</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>March 1962</td>
<td>Flood</td>
<td>DR-122-CA</td>
<td>Countywide</td>
</tr>
<tr>
<td>October 1962</td>
<td>Flood</td>
<td>DR-138-CA</td>
<td>Countywide</td>
</tr>
<tr>
<td>February 1963</td>
<td>Flood; Heavy Rains</td>
<td>DR-145-CA</td>
<td>Countywide</td>
</tr>
<tr>
<td>February 1978</td>
<td>Flood; Winter Storms</td>
<td>DR-547-CA</td>
<td>Countywide</td>
</tr>
<tr>
<td>February 1980</td>
<td>Flood; Winter Storms</td>
<td>DR-615-CA</td>
<td>Countywide</td>
</tr>
</tbody>
</table>

60 2019 County of Los Angeles All-Hazard Mitigation Plan, 2019
### Potential Impacts of the Hazard

A flood will potentially result in extensive amounts of water entering onto developed areas. The force and volume of water that is generated by a flood may cause extensive structural damage in areas subject to standing or moving water. The effects of flooding may spread over significant distances covering large areas of land. The extent of the impacts would vary based on a number of factors such as the volume of water flooding, the time of the flood event, the amount of warning provided, the location and extent of the flood boundary, facility elevation, and distance from the flood source.

Potential impacts resulting from flooding include:

- Injuries or loss of life
- Property destruction or damage
- Loss of property contents
- Infrastructure damage including roadways, bridges, other transportation means
- Public health hazards resulting from mold, mildew, and disease due to flood water
- Flooded or destroyed lifelines/supply routes
- Damaged or destroyed utilities
- Loss of community economic base
- Employment losses
- Agricultural (crops and livestock) damages or destruction
- Environmental damage
- Prolonged periods of necessary dewatering
- Flooding erosion may alter natural drainage channels
- Societal and community impacts
- Psychological impacts of impacted populations
- Threat or damage to on campus Associated Students Children’s Center
- Disruptions to education delivery to community
- Damage or destruction of academic materials, fine arts, and research
- Damage or destruction of university computer systems and networks
- Damaged university infrastructure
- Inability for campus operations to resume
- Reduced or eliminated student engagement with academic programs
- Reductions in campus revenues

Individuals who were unable to evacuate in time or refused to leave will likely need assistance or rescue from the flooded area. Remaining in or being trapped by flood waters places individuals in significant risk of injury or death. The impacts extend beyond the danger placed upon the affected individual and places greater resource demands on agencies and organizations making efforts to rescue trapped individuals.

Probability of Future Occurrence of the Hazard

Los Angeles County is determined have considerable portions of the county to be at high risk from flooding. The repeated historic occurrences have shown that the region is subject to flooding in any given year. Floods can occur at any time but are most common in the Los Angeles area with winter storms that are saturated with subtropical moisture. Although there are specific buildings on and areas of the CSUN campus that have a greater risk for isolated flooding, the area surrounding the CSU Northridge campus does not generally promote conditions for flood waters to accumulate. The CSU Northridge campus is located within a Zone X Special Flood Hazard Area (Area of Minimal Flood Hazard) and not in close proximity to areas with greater flood risk. However, there is a historic record of isolated urban or street flood events provides a demonstration of potential flood activity.

The probability of future occurrence for flooding is Unlikely.

Vulnerability to the Hazard

The CSU Northridge campus is subject to the effects of limited and isolated flooding or ponding resulting primarily from excessive precipitation and isolated strong
storms. There is a more remote potential for flooding and damage on campus and surrounding residential and commercial areas of Northridge in low lying areas due to overflow or damage to flood control systems. The channels and extending irrigation systems that surround the campus have limited storage or volume capacities. The campus and the campus community are vulnerable to the effects generated by flooding from these systems.

Vulnerability to flooding on the CSU Northridge campus will vary depending on when the flood was to occur and the location of any people and/or assets in low lying areas. The risk to the campus population will be lessened during periods when classes are not in session or during periods of breaks. Conversely, during the days and hours that classes are in session and staff are at their workplaces, the human vulnerability increases. Members of the campus community in low lying areas may become trapped on campus depending on the level of flooding occurring on surface streets. However, in very rare, region-wide events this vulnerability may be extended to the homes and workplaces of members of the campus community and their families.

CSU Northridge is in proximity to a variety of industrial and commercial facilities in the surrounding communities. When these facilities are inundated with flood water, the potential for chemical release exists presenting possible exposures to individuals from the campus community. These facilities additionally line many of the primary access routes in and out of the campus. Access routes into and out of the campus may be inundated creating human vulnerabilities in access to medical care, ability to gain access to critical services, access to necessary supplies, and ability to evacuate. The human vulnerabilities would also include the dangers of large volumes of moving or standing water, electrical shock in high water events, and biological contaminants from backed up sewers, mold infestation, and other vectors.

During low probability, severe flood events, some campus buildings and infrastructure would be vulnerable to large-scale flooding if it reaches the university. Campus utilities and communication capabilities in any low lying areas might be impacted by flood waters rendering them disabled. A rare flood covering a large portion of the city might affect communication capabilities well beyond the boundaries of the campus. Remaining flood waters will leave behind molds and other health concerns in affected campus buildings and facilities likely requiring extensive restoration or demolishing. The residents of the on-campus residence halls in any low lying areas may have transportation limitations requiring evacuation and alternative housing procedures to be implemented if populated. In such areas, flood waters may result in damage to campus equipment, communication systems, protected documents, artwork, academic materials, computer systems, research, and other critical activities on lower levels of building.

Certain campus populations will experience greater challenges to a post-flood / failure environment. Vulnerable populations will likely need to navigate through flood generated debris, face extreme health safety issues from flood waters, experience extreme stresses of a disaster, an inability to communicate to or gain access to
support networks, and find difficulty in accessing equipment or supplies to aid in a specific need. Students remaining on campus such as those residing in the residence halls would be particularly vulnerable especially those without access to adequate transportation.

**Estimate of Potential Losses**

Estimates of potential losses will be influenced by a variety of factors. The volume and force of the water will determine the scale of damages affecting campus infrastructure, equipment, and other impacted features. The location and elevation above flood waters will affect the level of damage and individuals exposed. The time of the academic year, the day of week, and hour in which the flooding was to occur will influence the number of people on campus and potential casualties. The severity of the storms producing precipitation, the speed of the storms moving across the area, the level of snowpack in the higher elevations, and amount of resulting snowmelt will produce varying effects on damages produced and costs incurred. Losses will be generated by the physical damages, the loss of revenue, loss of academic research, loss of building contents, and community wide economic reductions.

Based on estimate replacement costs of facilities and structures on campus, the maximum total replacement costs due to flood are $550,272,157. However, it is unlikely for flood to cause destructive losses to the entire campus.

**Table 16-24: Special Flood Hazard Area (SFHA) Estimated Losses**

<table>
<thead>
<tr>
<th>Zone Designation</th>
<th>No of Buildings</th>
<th>Maximum Replacement Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Zone V</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Zone VE &amp; V 1-30</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Zone A</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Zone AE</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Zone AH</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Zone AO</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Zone X .2%</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Zone X Minimal Risk</td>
<td>78</td>
<td>$550,272,157</td>
</tr>
<tr>
<td>Not in a SFHA</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>No Building Value Data Provided*</td>
<td>39</td>
<td>Unknown</td>
</tr>
</tbody>
</table>

*Buildings with no value defined are also included in the respective Zones they are found in.
Vulnerability Assessment Conclusions

While the campus is located in an area of minimal flood potential (Zone X), the primary vulnerabilities to flood on campus are people and assets in low lying areas exposed to mostly localized flooding and ponding from overflow of campus creeks or low probability, large-scale storms that produce heavy amounts of precipitation directly over the campus and surrounding neighborhoods. In addition to the vulnerabilities posed by localized floods, the proximity to the Aliso Canyon Wash and Los Angeles River further presents a minimal hazard facing the campus.

The potential for flooding generates the potential for a number of cascading effects such as disruptions to the local economy, utility failures, disruptions to providing for the needs of the community, and development of public health hazards. These effects would be exacerbated by effects of seasonal flooding, ongoing heavy precipitation, or excessive run-off from the watershed contributing to the river system. The potential for rare, widespread flooding and damage of structures due to the force of water, while unlikely, has exponentially powerful impacts on particular populations among the campus community including those with access or functional needs, international students, the homeless, and students residing in the residence halls.

Identified Data Limitations

Data limitations include missing campus structural replacement costs, and an incomplete inventory of both building construction features and mitigation efforts to lessen the impact due to flood inundation. HAZUS generated analysis is focused on the broader community level versus fine-tuning the analysis to the micro-level for facilities such as a university campus.
**Hazardous Materials**

**Description of the Hazard**

A hazardous material is defined in California’s State Hazardous Materials Incident Contingency Plan (1991) as “a substance or combination of substances which, because of quantity, concentration, physical, chemical, or infectious characteristics may: cause, or significantly contribute to an increase in deaths or serious illnesses; and/or pose a substantial present or potential hazard to humans or the environment.” Hazardous materials are one or more of the following: flammable, corrosive or an irritant, oxidizing, explosive, toxic (poisonous or infectious), thermally unstable or reactive, or radioactive. Hazardous materials are ubiquitous in modern society and may be found at all stages of production, consumption, and disposal.

Federal and state laws permit the intentional release of some hazardous materials into the environment such that the risk to human health and the environment is thought to be acceptable. However, sometimes releases are unintentional, resulting from leaks, accidents, or natural hazards. This section focuses on such accidental releases and fall into the following key categories:

**Fixed Hazardous Materials Incident:** A fixed hazardous materials incident is the accidental release of chemical substances or mixtures during production or handling at a fixed facility.

**Transportation Hazardous Materials Incident:** A transportation hazardous materials incident is the accidental release of chemical substances or mixtures during highway, waterway or air transport. Populations, built and natural environments are potentially impacted.

**Pipeline Incident:** A pipeline transportation incident occurs when a break in a pipeline creates the potential for an explosion or leak of a dangerous substance (oil, gas, etc.) possibly requiring evacuation. An underground pipeline incident can be caused by environmental disruption, accidental damage, or sabotage. Incidents can range from a small, slow leak to a large rupture where an explosion is possible. Inspection and maintenance of the pipeline system along with marked gas line locations and an early warning and response procedure can lessen the risk to those near the pipelines.

Hazardous materials can also be classified according to worker safety and health. Information provided by California Division of Safety and Health includes guidelines related to:

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- **Safety hazards**: fire and fire byproducts, electricity, flammable gases, unstable structures, demolition, sharp or flying objects, excavations
- **Health hazards**: carbon monoxide ash, soot and dust; asbestos; hazardous liquids; other hazardous substances; heat illness

**Natural-Technological Incidents (Natechs)**: During the past two decades, increasing attention has been given to hazardous materials releases resulting from Natechs or a natural disaster event that triggers a technological hazard event. Natechs are of particular concern for the following reasons:

- They can produce a simultaneous effect on many industrial facilities
- Can overwhelm response capacity
- Containment systems may fail
- May produce cascading disasters
- Response may be hindered by a disaster’s impact on the physical environment

**Location of the Hazard**

Hazardous materials and infrastructure such as fuel tanks, rail lines, chemicals, hazardous waste sites and gas pipelines to varying degrees are located within the CSU system and/or within its surrounding communities. Please refer to Annex ? for the map identifying the types and locations of hazardous materials and infrastructure on or near the CSU – Northridge campus. The planning committee indicates that chemicals are located in science labs on campus, some of which have radiological properties. Also, the committee indicates that some chemicals may be present but unaccounted for, resulting from an incomplete paper trail for chemicals entering campus. At larger scales (beyond the campus planning area) hazardous materials and infrastructure are located throughout the city of Northridge and county of Los Angeles, and reflect different types, configurations and scales dispersed across these geographic areas.

**Extent of the Hazard**

There is no comprehensive statewide vulnerability assessment available at this time. As such, the true extent of the hazardous materials risk in California and its communities is not known, meaning no overarching conclusions have been reached which have been able to integrate all qualitative and quantitative risk factors to produce a comprehensive measure of the extent of the hazard.

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However, for the CSU – Northridge planning committee, although no events have taken place on campus, lack of procedural oversight and security/management of chemicals inventory and access increases the extent of the hazard risk greatly. In addition, an extensive and dense array of gas pipelines, rail lines, chemical and hazardous waste sites are located close to the campus. Based on these factors, it is prudent to rank the extent of the hazard for the CSU – Northridge campus as Moderate to High, and to consider worst case scenarios as the main driver of policy in order to fully mitigate all possible hazardous materials event outcomes.

For example, according to the 2018 CA State Hazard Mitigation Plan, 400 hazardous materials problems are tied to 32 past earthquakes, including over 150 problems from the Loma Prieta Earthquake alone. That said, the plan indicates that it is likely that many such hazardous materials releases have received little attention in the past because public authorities, the media, and the public have overlooked them in the rush to address and recover from immediate disaster threats, and that responsible parties may have an incentive to understate the extent of releases or not to report them at all.

History of the Hazard

According to the CA Governor’s Office of Emergency Services’ Hazardous Materials Spill Report, the state experiences from 10 to 30 spill events daily. As of April 20th, 2021 already 2096 spill events had occurred. Such events have occurred in all the cities and/or counties where CSU campuses are located.

According to the 2018 CA State Hazard Mitigation Plan, with regard to natural-technological hazard events (Natechs), 400 hazardous materials events are tied to 32 past earthquakes, including over 150 Natech events from the Loma Prieta Earthquake alone.

According to the campus planning committee, as a result of the 1994 Northridge Earthquake, CSU - Northridge laboratories and chemical storage rooms experienced multiple chemical spills which produced a significant response from students, faculty, staff, and first responders including building evacuation. No events have taken place since that time.

Potential Impacts of the Hazard

A large hazardous materials release could affect an entire community or city under certain conditions related to direction of air flow (air-based chemical release) and population density or the contamination of a community’s main water supply. Either type of release could necessitate large scale evacuation. By contrast, in the rural 66 US Geological Survey. *The Loma Prieta, California, Earthquake of October 17, 1989 – Fire, Police, Transportation and hazardous Materials* Retrieved 04.19.2021 from: https://pubs.usgs.gov/pp/pp1553/pp1553c/

unincorporated areas where population densities are low, even in the event of a large release, the number of homes that may need to be evacuated would be significantly lower than in an urban environment. The occurrence of a hazmat incident can also result in the shut-down of transportation corridors which can last for hours at a time while the impacted area is stabilized.

The release of some toxic gases may cause immediate death, disablement, or sickness if absorbed through the skin, injected, ingested, or inhaled. Contaminated water resources become unsafe and unusable, depending on the amount of contaminant. Some chemicals cause painful and damaging burns if they come in direct contact with skin. Prolonged and concentrated exposure to such chemicals can produce severe long-term impacts to respiratory, endocrine and nervous systems, heart and brain health.

The potential impacts of chemicals and toxic gases discussed here also apply to the students, staff and environment on the CSU – Northridge campus.

With regard to the natural environment overall, contamination of air, ground, or water may result in harm to fish, wildlife, livestock, and crops. The release of hazardous materials into the environment may cause debilitation, disease, or birth defects over a long period of time. Loss of livestock and crops may lead to economic hardships within the community.

Recent California examples include the 2016 Aliso Canyon methane gas leak, which caused evacuation of nearby residents, many of whom experienced temporary health problems such as difficulty breathing and eye irritation; and the 2016 Fruitland metal recycle plant fire in Maywood, which released heavy metals such as lead, magnesium, copper, aluminum, antimony, calcium, iron, sulfur, tin, potassium, and zinc which pose severe risks to public health. 68 Health effects from exposure to these metals included short-term symptoms such as irritation to the eyes, nose, throat, and lungs.

Potential Impacts of the Hazard (Natechs)

Natural disasters, including earthquake, flood, and fire also pose risks to public health and the environment. For example, following the Northridge Earthquake, California State University (CSU) Northridge laboratories and chemical storage rooms experienced multiple chemical spills. Such incidents, triggered by a natural disaster, pose a significant risk to students, faculty, staff, and first responders. At a minimum, all CSU campuses with a science lab (as exemplified by the event at CSU – Northridge) is at risk of potential impact from a natural-technological (combined impact) event.

In a severe flood event, floodwaters are often contaminated with hazardous materials posing a threat to public and animal health, groundwater, and other parts of the

environment. These hazardous materials may be released from damaged or flooded underground tank sites (e.g., gas stations or chemical storage facilities), propane tanks, manure or human waste handling facilities, fertilizer and pesticide storage, agricultural sites, and household hazardous waste.

In a fire event, (such as the October 2017 Northern California firestorms which destroyed approximately 6,000 residences) entire neighborhoods can be burned to the ground. Hazardous material release creates public health concerns which can delay the initial steps of fire recovery, including reopening burned areas to residents and initiating debris removal activities. The post-fire “toxic sweep” poses a risk of coming into contact with toxic substances due to the presence of synthetic and hazardous materials.

**Probability of Future Occurrence of the Hazard**

The probability of occurrence for a hazmat event on the CSU – Northridge campus can be viewed in two different ways: the history of occurrence serves as a sound predictor of future probability assuming current risk and vulnerability factors remain somewhat constant. For the purposes of the current estimate, no current data clearly indicates otherwise. As such, the probability of occurrence is Moderate to High - the campus has experienced chemical spill events and is in need of improvements in chemical labs access and chemical tracking and management protocols on campus. As such, the risk of occurrence is multiplied. In addition, nearby hazardous materials and infrastructure further increase vulnerability and probability of a campus-related event. Moreover, hazmat occurrences are largely based on human error, and any changes in risk and vulnerability factors such as a decreased vigilance in materials oversight and handling practices or changes in the amount of chemicals or exposure will likely increase the probability on campus.

**Vulnerability to the Hazard**

Hazardous materials pose a large risk to the CSU – Northridge campus. As identified by the campus planning committee and on the hazmat map (see section X), the following vulnerabilities are present on campus: chemicals are present in many science and research labs, and other storage facilities. However, tracking and oversight of chemicals and related protocols need improvement which increases vulnerabilities. In addition, gas pipelines and hazardous waste sites are extremely close to the campus footprint. Gases and chemicals or hazardous waste, if spilled or released, could severely impact human health and campus operations.

Although it is quite difficult to produce a quantitative measure of vulnerability because (unlike natural hazards) the probability of occurrence is dependent on human error, which itself is variable based upon a fluctuating set of interrelated factors, some of which lack prediction or control, given the complexity of how all natural and built environments and hazmat risks factors interrelate at the local or campus level, it is prudent to assume for planning purposes that the campus’ vulnerability is a sub-set of the larger community’s vulnerability. As such, the CSU – Northridge leadership
maintains vigilance to mitigate the campus’ vulnerabilities identified above at a minimum.

Estimate of Potential Losses

As discussed previously, it is difficult if not impossible to produce an accurate quantitative measure of vulnerability because of the variable nature of a hazardous materials spill. For example, the release of a toxic airborne chemical in a populated area has severe impact potential, whereas the impact potential of a small chemical spill in a remote or rural area is most likely limited to remediation of soil. And, in both cases, the probability of occurrence is dependent on human error, which itself is variable based upon a fluctuating set of interrelated factors, some of which lack prediction or control. In all cases, different types and amounts of hazardous materials interact with fluctuating combinations of human error to produce different event outcomes with variable impact costs.

Vulnerability Assessment Conclusions

It is well understood that with regards to hazmat vulnerability, each campus and its surrounding community (including CSU – Northridge) operates through a complex and dynamic interaction between industrial and commercial inputs and outputs and the natural and built environment. Such activity produces hazardous materials that move through the environment along both convergent and divergent routes and across all levels of land-use from site to campus to city and county and beyond. It is also clear from a review of the Los Angeles County hazard mitigation plan and Cal OES’ records of hazardous material spills, that such events occur with great frequency and varying degrees of severity across jurisdictions statewide. As such, in assessing the vulnerability of the CSU – Northridge campus, campus-level risks and vulnerabilities are not discreet or isolated but can become exacerbated or augmented through connections to broader community-level hazmat risks and vulnerabilities.

Finally, in order to draw conclusions on vulnerability, it should be noted that any identified vulnerabilities at the campus level and/or community level are circumscribed and potentially reduced by targeted policy and program interventions. Numerous policies and programs have been established in recent years in response to California’s widespread and complex and integrated hazardous materials risks - California established the Unified Program which consolidates and integrates the administrative requirements, permits, inspections, and enforcement activities of the following environmental and emergency response programs: the Aboveground Petroleum Storage Act (APSA) Program, Area Plans for Hazardous Materials Emergencies, the California Accidental Release Prevention (CalARP) Program, the Hazardous Materials Release Response Plans and Inventories (Business Plans), Hazardous Material Management Plan (HMMP) and Hazardous Material Inventory Statement (HMIS) requirements (California Fire Code), the Hazardous Waste Generator and Onsite Hazardous Waste Treatment (tiered permitting) Programs, and the Underground Storage Tank Program.
Identified Data Limitations

The CSU – Northridge planning committee has provided information on campus-level hazmat materials and risks. Data limitations pertain to a comprehensive understanding of human activity and error related to materials control over the long term.

Landslide

Description of the Hazard

A landslide is a down-slope movement of soil, rock, or other debris, and can also be referred to as a mass movement or slope failure. These geological hazards can range in size from a few feet to over a mile in length and width and, when heavy and rapidly moving, can cause serious damage and loss of life.

Landslides are classified based on the type of material and type of movement involved. They can range from slow-moving earth flows to fast-moving debris flows, though many large slope failures involve more than one type of movement. The primary natural triggers of slope failures are water, seismic activity, and volcanic activity. Slope saturation by water can occur from intense rainfall, snowmelt, changes in ground-water levels, and surface-water level changes along coastlines. In winter months, El Nino storms or other high rainfall events may saturate soils and trigger slope failure.

Deep-Seated Landslides

Deep-seated landslides, ranging in depth from ten to several hundred feet, occur as a result of geologic and hydraulic changes, such as earthquakes or increased levels of groundwater. These landslides can move slowly or quickly and can cause extensive property damage, but rarely result in loss of life.

Debris Flows Related to Shallow Landslides

Shallow landslides may mobilize into rapidly moving debris flows and typically occur after sudden saturation of the ground. These types of debris flows are typically more dangerous because they move rapidly, causing both property damage and loss of life.

Debris flows may also occur as a result of post-fire conditions, where wildfires have left barren ground exposed to heavy rainfall. Intense rainfall, generally greater than .5 inch per hour, has the potential to trigger a post-fire debris flow. These landslides may

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impact lives and properties within its deposition zone, and can result in downstream flooding. These post-fire debris flows often occur during the fall and winter following major summer fires.

**Location of the Hazard**

The susceptibility of an area to landslides depends on several variables, including magnitude of slope gradients, water content, ground cover, presence of erosion, and slope material and structure. However, landslides are most prevalent in terrain with weak material and steep slopes, and the highest risk is found in areas with high rainfall or high earthquake potential. Slope failures are also most likely to occur in areas where they have occurred in the past. In California, the most landslide-prone areas are found along the coast and in the northern Franciscan Formation.

General landslide vulnerability can be estimated from the distribution of weak rocks and steep slopes as seen in Figure 16-3. Based on the Figure (below), the CSU Northridge campus is located in an area with a low degree of susceptibility to landslide.
Figure 16-12: Deep-seated Landslide Susceptibility Surrounding CSU Northridge. 

Extent of the Hazard

In Northridge, landslides are more likely to occur in the steep slopes surrounding the city. The San Gabriel mountains, both steep and erosive, contain steeply walled canyons above areas with high population density. When heavy rain occurs, there is significant potential for floods and landslides throughout the County, and indirect impacts of landslides may cover a larger geographical extent. Based on the campus’ location removed from landslide susceptibility zones, the planning committee ranks the extent of the hazard as **Low**.

History of the Hazard

FEMA has declared thirteen major disasters involving landslides, mudslides, debris flows, or mud flows in Los Angeles County since 1978. NOAA has recorded five debris flow events in the County since 2004, most of which occurred in the areas directly

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surrounding metropolitan Los Angeles. The 2018 Southern California Mudflows damaged 40 to 45 homes in Sun Valley and caused a vehicle to strike a natural gas pipeline, which began to leak. The campus has no history of landslide occurrences.

Potential Impacts of the Hazard

CSU Northridge may be impacted by the disruption of services as a result of landslides in the region. Landslides can result in physical damage to buildings and property and have the potential to significantly effect infrastructure. As a landslide moves, it distresses structural foundations by settlement, cracking, and tilting. Fast-moving flows can remove entire structures in one instance, while other types of flows can cause damage gradually.

Transportation and utility infrastructure are particularly vulnerable to landslides, since the failure of any component can disrupt service over a large area. The loss of power and communication and disruption of transportation can have cascading effects throughout an area, including impaired disposal of sewage, contamination of water supplies, and the release of flammable fuels. Transportation routes are also often expensive to clean up, and prolonged obstruction can disrupt the movement of people and goods for long periods of time.

Probability of Future Occurrence of the Hazard

Slope failures are also often triggered by other natural hazards such as heavy rainfall and earthquakes, so landslide frequency is often related to the frequency of these other hazards. As climate change impacts the frequency and intensity of triggers such as rain events, fires, and coastal erosion, landslides may generally occur more often. According to the NCEI Storm Events Database, Los Angeles has been impacted by earthquakes, wildland fires, and severe storms at least every other year since 1960. Given the historic frequency of these contributary sources to landslides and of recorded landslides themselves, the probability of future occurrence for the City of Los Angeles is high. However, CSU Northridge campus itself is located in an area with a low degree of susceptibility to landslide, and there is no reported history of landslides on campus. As a result, the probability of a landslide occurring on campus on an annual basis is rated as **Unlikely**.

Vulnerability to the Hazard

The vulnerability of the built environment to landslides depends on exposure and is more likely to incur damage as a result of proximity, rather than inferior structural design. The structures most vulnerable to landslides are buildings and utility/transportation lifelines, which can be impacted by either impact or ground deformation. Utilities and transportation infrastructure are particularly vulnerable, due to their geographic extent and susceptibility to physical distress. Any population proximal to a landslide when it occurs is vulnerable to its impacts. That said, the campus’ vulnerability is limited to secondary effects of a landslide such as power outage or transportation disruption.
Estimate of Potential Losses

There are no current models for estimating potential losses from a landslide directly impacting the campus.

Although the economic impact of landslide damage can exceed that of the direct repair costs, there are currently no applicable methods for estimating indirect costs related to CSU Northridge.

Vulnerability Assessment Conclusions

Community exposure to landslides varies depending on their physical locations – whether in flat plains or on steep hillsides – and on their dependence on critical infrastructure located in landslide hazard zones.

Landslides could impact the campus in a variety of ways, primarily related to indirect impacts to transportation and utilities. Utility outages can impact health, particularly for vulnerable populations, and can cause interruptions in operations. Interruptions may impact student and employee’s ability to travel to campus and the delivery of classes and events.

Identified Data Limitations

The ability to predict future landslides at the CSU Northridge campus is limited. However, the USGS estimates that climate change-induced shifts in weather will increase the frequency of post-wildfire landslides, which are expected to occur almost every year in California.

Power Outage

Description of the Hazard

Northridge is a neighborhood of the City of Los Angeles located in the San Fernando Valley. It is also the home of CSU Northridge (CSUN).

Most aspects of modern life, and almost all aspects of urban life, rely on the availability of reliable utilities, such as electricity, water, and natural gas. An interruption in the supply or distribution of these commodities can leave highly populated areas like Northridge (and Los Angeles) without basic services, such as electricity or sanitation. These interruptions can be cascading effects from other hazard events, such as windstorms, floods, wildfires and earthquakes, or they can be caused by intentional disruptions of transmission lines.

A power outage event can interrupt day-to-day operations of the CSUN campus, like in-person classes, impede or limit digital, telephonic or radio communications, create traffic jams around the busy avenues and boulevards surrounding the campus, close the student health center, and close restaurants around campus and outside the campus. Additionally, thousands of CSUN student residents in on-campus housing would also be affected by a power outage on campus and in the area.
Additionally, a severe outage in Northridge and/or in the City of Los Angeles would also directly affect the campus and the community.

Electric power disruptions and outages fall into two categories: intentional and unintentional.

The four types of intentional disruptions are:

- Planned: Some disruptions are intentional and can be scheduled based on maintenance or upgrading needs.
- Unscheduled: Some intentional disruptions must be done "on the spot" in response to an emergency.
- Demand-Side Management: Some customers (i.e., on the demand side) have entered into an agreement with their utility provider to curtail their demand for electricity during periods of peak system loads.
- Load Shedding: When the power system is under extreme stress due to heavy demand and/or failure of critical components, it is sometimes necessary to intentionally interrupt the service to selected customers to prevent the entire system from collapsing. These intentional interruptions result in rolling blackouts.

Unintentional or unplanned disruptions are outages that come with essentially no advance notice or warning. This type of disruption is the most problematic. The following are categories of unplanned disruptions:

- Accident by the utility, utility contractor, or others.
- Malfunction or equipment failure.
- Equipment overload (utility company or customer).
- Reduced capability (equipment that cannot operate within its design criteria).
- Tree contact other than from storms.
- Vandalism or intentional damage.
- Weather, including lightning, wind, earthquake, flood, and broken tree limbs taking down power lines.
- Wildfire that damages transmission lines.

Location of the Hazard

Although power outages can take place within a certain area, as a hazard, it has the potential to occur and affect the entire planning area equally.

Extent of the Hazard

In order to anticipate outage conditions and reduce impacts, campus facility managers and others keep track of conditions and data provided by the media, municipal utilities and the California Independent System Operator (CAISO). CAISO is tasked with managing the power distribution grid that supplies most of California, except in areas served by municipal utilities, and is thus the entity that coordinates statewide flow of electrical supply. CAISO uses a series of stage alerts to the media based on system conditions. The alerts are:
Stage 1 - reserve margin falls below 7 percent.
Stage 2 - reserve margin falls below 5 percent.
Stage 3 - reserve margin falls below 1.5 percent.

Rotating blackouts become a possibility when Stage 3 is reached.

A power outage could affect the entire area of the campus, including the SJSU athletic fields, classrooms resident halls, administrative offices, virtual, telephonic and radio communications, leading to loss of lighting in campus parking structures, and creating a cascading hazard for commuters as they depart from or arrive to campus in the evening. Additionally, the university is located within proximity of highly utilized thoroughfares for the transportation of goods to throughout California, within one of the busiest areas of the Silicon Valley.

Given the prevalence of rolling blackouts and other power outages in California, the campus maintains safety precautions, situational awareness, access to emergency power generators and other protocols for managing campus power outages. However, given that recorded outages have taken place on campus, the planning committee ranks the extent of the power outage hazard as Moderate.

History of the Hazard

CSU Northridge has experienced power outages for various reasons. The following are examples of power outage events experienced over the last 10 years:

- May 15, 2015; CSU Northridge experienced a power outage. Commencement ceremonies scheduled for that evening took place as scheduled at 6pm.
- April 15, 2016; A windstorm early in the morning caused power outages throughout the area, including CSU Northridge. The campus remained open and continued to operate. The power outage affected multiple buildings on campus including Student Housing Complex, Chisholm Hall, Monterey Hall, Matador Bookstore, Klotz Student Health Center, Valley Performing Arts Center, Cypress Hall, Nordhoff Hall, Manzanita Hall, Santa Susana Hall, parking lots/structures B1, B2, B3, G3, as well as KCSN. Students in affected areas were able to report to class for further instruction, and employees report to their department.
- October 6, 2016; A power outage affected Sierra Hall, Redwood Hall, Manzanita Hall, and the Oviatt library. This power outage affected both the campus and the surrounding Northridge community.

Potential Impacts of the Hazard

Instructors, campus residents, staff, and administration rely on electricity for basic survival and operations. During a widespread power failure, it may take days to restore operations. Electrical power may be the only cooling source for many individuals around the campus and its community, and long-term outages can potentially put people’s health and life at risk. Disruptions in the supply of heating fuel may put people and property at risk during extremely cold weather if it relies on
electric generation or heating mechanisms instead of gas. Additionally, many medical devices, communications devices, and security rely on power to maintain their functions.

**Climate Change and Energy Shortage**

Climate change is expected to bring more frequent and intense natural disasters. These changes have created a variability at a rate that makes historical data a poor predictor of future climate. For example, the warmest years on record in California occurred in 2014, 2015, and 2016. The 2016-2017 year broke the record as the wettest ever recorded in the northern Sierra Nevada Mountains.

Changes in temperatures, precipitation patterns, extreme events, and sea-level rise have the potential to decrease the efficiency of thermal power plants and substations, decrease the capacity of transmission lines, render hydropower less reliable, spur an increase in electricity demand, and put energy infrastructure at risk of flooding.

With climate warming, higher costs from increased demand for cooling in the summer are expected to outweigh the decreases in heating costs in the cooler seasons. Hotter temperatures in California will mean more energy (typically measured in “cooling-degree days”) needed to cool homes and businesses both during heat waves and on a daily basis, during the daytime peak of the diurnal temperature cycle. During future heat waves, historically cooler coastal cities (e.g., San Francisco and Los Angeles) are projected to experience greater relative increases in temperature, such that areas that never before relied on air conditioning will experience new cooling demands.

Secondary impacts of energy shortages are most often felt by vulnerable populations. For example, those who rely on electric power for life-saving medical equipment, such as respirators, are extremely vulnerable to power outages. Also, during periods of extreme heat emergencies, the elderly and the very young are more vulnerable to the loss of cooling systems requiring power sources.

**Probability of Future Occurrence of the Hazard**

The probability of California experiencing a power outage can be difficult to quantify but is a hazard that occurs annually during the same seasonal periods of temperature variance throughout the calendar year. The City of Los Angeles and Los Angeles County experience such outages. As such, the probability ranking for the Los Angeles area is **Likely**. Since the CSU Northridge campus has also recorded power outage events, it is prudent to assign this same ranking for the campus.

Climate models suggest summer global temperatures are likely to increase while changes between temperature extremes would be more pronounced. As such, it is expected that power outages will occur more frequently in the future.

**Vulnerability to the Hazard**

Based on the data available, and in consideration of the increasing effects of climate change, the campus remains vulnerable to power outages in terms of impacts to...
people, power infrastructure and campus operations. Nonetheless, as discussed campus leadership works to reduce vulnerabilities through consistent use of safety and operational protocols and emergency power sources to ensure it is able to mitigate an interruption to electrical power.

Estimate of Potential Losses

The data provided by CSU Northridge does not report any value for potential losses due to power outage.

Vulnerability Assessment Conclusions

Elevators, entry ways, air filtration systems and lighting provide the campus community with the necessary infrastructure and systems to function and navigate through the campus and to maintain a safe campus environment and visibility during nighttime hours. The primary concern for campus leadership is that a loss of power can lead to potential hazards to students, faculty, and staff at CSU Northridge. Vulnerable populations (especially students with physical disabilities) may be the most heavily affected by loss of power, as they rely on elevators, entry ways with automatic doors, and locks and lights; a power outage would impede a disabled student’s ability to travel and utilize the campus and its structures safely.

The use of communication devices, billing, records, and electrical tools may also become unusable due to a loss of electricity. Many records and billing items may have to revert to “by-hand” procedures and paper copies may have to be kept continuing operations. Additionally, classrooms may not be usable if lighting equipment is not functioning impacting a semester or quarter’s progress for the academic year.

Identified Data Limitations

CSU Northridge did not report any monetary or life losses due to a power outage. Also, the campus did not report any incidents involving a power outage directly affecting the campus community and operations.
Volcano (Associated Air Quality)

Description of the Hazard
The US Geological Service defines volcanoes as “openings or vents where lava, tephra (small rocks), and steam erupt on to the Earth’s surface. Through a series of cracks within and beneath the volcano, the vent connects to one or more linked storage areas of molten or partially molten rock (magma). This connection to fresh magma allows the volcano to erupt over and over again in the same location.”72

A volcanic eruption occurs when magma, lighter than surrounding rock, is driven upwards by its buoyancy and by pressure from the dissolved gases contained within it. Gases are released from magma as it reaches the surface and pressure decreases. Magma can be erupted in several ways and violent eruptions typically cause tiny pieces of tephra (ash) to be carried away by the wind. This ash is hard, does not dissolve in water, is extremely abrasive and mildly corrosive, and conducts electricity when wet.73

The gases released in an eruption include carbon dioxide, sulfur dioxide, hydrogen sulfide, and hydrogen halides. Depending on their concentration, these are potentially hazardous to people, animals, agriculture, and property.

Location of the Hazard
There are eight volcanic areas located throughout California. Seven of these - Medicine Lake Volcano, Mount Shasta, Lassen Volcanic Center, Clear Lake Volcanic Field, Long Valley Volcanic Region, Coso Volcanic Field, and Salton Buttes – are considered active volcanoes. No portion of CSU Bakersfield or Kern County is within a volcano hazard zone.

Extent of the Hazard
Volcanic hazards are most severe within a few miles of the volcano vent and the severity generally decreases with distance. Ash impact zones can range from tens to hundreds of miles from the vent source. The US Geological Survey has estimated zones surrounding active volcanoes wherein 2 inches or more of ashfall following an eruption is possible. While CSU Northridge does not fall within an estimated ashfall zone, lighter dustings of ash outside of those areas may directly or indirectly impact the campus. As such, the planning committee ranks the extent of the hazard for the campus as Low. History of the Hazard

No historical eruption events in California have affected the campus. Over the last 1,000 years, there have been at least 12 eruptions in California.11 The most recent volcanic eruption in California occurred at Lassen Peak about 100 years ago, when a major explosion delivered windborne ash over 275 miles away.12

Potential Impacts of the Hazard

The specific impacts vary widely and depend on which type of volcano erupts, the style of explosion, the volume of lava, the eruption duration, and the local water conditions. As CSU Northridge is not proximal to an active volcano, only the potential impacts of ashfall and gases have been detailed. While both these hazards can be widespread, their most severe impacts are generally seen closer to the volcanic source.

Although ashfall is typically a nonlethal volcanic hazard, it is the most widespread and disruptive. Falling ash can damage crops, electronics, and machinery. It can also impact human health by irritating the respiratory tract, eyes, and skin. The particles may enter drinking water and structures and may cause structure failure if it is thick and heavy enough. Even a fine layer of ash can disrupt utilities. A portion of California’s major electric transmission lines, aerial telecommunication lifelines, transportation corridors, and water storage and conveyance lie within the state’s volcano hazard zones. Impacts to any of these can impact operations at CSU Northridge.

The potential impacts of gases released during volcanic eruptions are as follows:

- Carbon dioxide typically becomes diluted very quickly and is not life threatening. However, it can become trapped in higher concentrations in low-lying areas and has the potential to be fatal.
- Sulfur dioxide can cause acid rain and air pollution downwind of a volcano.
- Hydrogen sulfide can cause irritation of the upper respiratory tract. At high concentrations it can cause unconsciousness and death.
- Hydrogen halides can coat ash particles and, once deposited, poison drinking water, agricultural crops, and grazing land.

Probability of Future Occurrence of the Hazard

The US Geological Survey, based on the record of volcanic activity in California, estimates that the probability of another small- to moderate-sized eruption in the next thirty years is about 16 percent. As such, the annual probability of future occurrence for the campus is ranked by the committee as Unlikely.

Vulnerability to the Hazard

Populations living near volcanoes are the most vulnerable to eruptions and lava flows. However, volcanic ash can travel and affect populations miles away. The location and thickness of ash in any given area is a function of the severity of the eruption and wind speed and direction. For CSU Northridge, there is low vulnerability to the immediate impacts of volcanic eruptions due to the limited area affected and remote potential of an eruption. In the event of a widespread ashfall event, the elderly, infants, and populations with existing respiratory disease will be at higher risk.

Estimate of Potential Losses
Impacts to critical infrastructure, agriculture, and property from ashfall have the potential to cause widespread disruption, damage, and economic loss throughout the state. In the event of a widespread ashfall event, impacts will be immediate.

Current modeling is not precise enough to allow for an assessment of potential losses from ashfall to structures or infrastructure on or surrounding the campus.

Vulnerability Assessment Conclusions

CSU Northridge is unlikely to experience the direct impacts of a volcanic event. While the campus may be indirectly impacted by ashfall elsewhere in the state, direct ashfall impacts are generally unlikely but possible in a widespread event. However, the likelihood of any volcanic eruption in the state impacting the campus is very low.

Identified Data Limitations

Not all active volcanoes in California have been zoned for hazards by the US Geological Survey. This, together with the infrequent occurrence of volcanic explosions and number of factors determining type and extent of impacts, make the quantification of potential loss difficult.

Wildfire

Description of the Hazard

While wildfires are a natural part of California’s ecosystem, wildfires in California represent a hazard that presents one of the greatest probabilities of destruction along with a demonstrated history of catastrophic fire events in recent years. The destructive fire seasons of 2017 to 2020 illustrated the destructive forces fire presents to communities across the state. Wildfires may result in the structural loss, infrastructure loss, dangerous air quality, environmental damages, economic impacts, injuries, and loss of life. In many communities throughout California, wildfire presents greatest risk to human life and property.

Wildfires have been defined as any free burning vegetation fire that initiates from an unplanned ignition, whether natural or human caused demanding fire suppression actions to contain.\(^74\) These fires are prone to become uncontrolled, spreading through vegetative fuels rapidly exposing people and structures to harm. Wildfires present a significant risk to communities across the state, as evidenced by increasing trends of structural losses from wildland fires. This risk is elevated in areas where development and community growth has intersected, also known as the wildland-urban interface (WUI). In the interface setting, development itself can provide additional fuel for large fires. Recent fires have also demonstrated the ability of fire to consume populated areas in extreme conditions.

\(^74\) State of California Hazard Mitigation Plan, September 2018
California’s Mediterranean climate in combination with its geography and vast population create a combination of factors that promotes an optimal environment for large fire growth and consequences. As there is great diversity of geographic characteristics across the state, the risks and potential consequences of wildfire must be assessed locally. The physical location, weather patterns, local fuel types and volume, extent of the WUI, topography, and additional factors will factor differently from part of the state to another.

The behavior of wildfires in California is significantly influenced by three distinct geographic factors. These factors will help shape the size, direction of spread, rate of combustion, fire intensity, and ability to pre-heat fuels. The physical factors contributing to wildfire behavior include:

- **Topography** – The rate in which wildfires spread increases with greater slopes in topography. The greater the slope will result in more pre-heating of fuel above the advancing fire. The direction that a slope faces will also influence fire behavior as south facing slopes receive greater solar radiation and thus drier vegetation that is more susceptible to combustion. Ridgetops often denote the end of fire spread as fire has greater difficulty spreading downhill.

- **Weather** – Weather factors substantially in influencing the behavior of wildfires. Wind, temperature, humidity, lightning, and lack of precipitation all contribute to a fire’s ability or inability to spread and intensify. California routinely experiences conditions in which these factors are in alignment to contribute to extreme fire behavior during the summer and fall seasons. High winds, low humidity, and high temperatures provide an environment promoting extreme fire activity.

- **Fuels** – Certain types of vegetation are increasingly prone to igniting and promote more intense burning. Areas with greater “fuel loading” (amount of fuel present in terms of weight of fuel per unit of area) increases the amount of fuel to fuel a fire. Greater volumes of dead or dry vegetation compared to live plants is a critical factor. Vegetation during drought conditions will experience decrease in moisture content increasing the conditions for combustion. Fuels close proximity to one another allows for rapid spread through contact or radiant exposures.

A risk assessment for wildfires should be implemented within a geospatial context focusing on the specific location features and incorporates the three components of the wildfire risk triangle – likelihood, intensity, and susceptibility.

**Location of the Hazard**

Substantial portions of the State of California are exceptionally vulnerable to wildfire activity or reside in a wildland-urban interface (WUI) area due to the vast open spaces, rangelands, forests and other lands with high susceptibility to fire occurring throughout the state. CSU Northridge and the San Fernando Valley are located in a densely populated area of north Los Angeles. This area near the university is
dominated by urban and suburban communities with limited direct exposures to wildland fire. CSU Northridge has extensive residential neighborhoods to the north, east, and south of campus. The western side of the campus is largely a commercial area. Industrial land uses are located to the southwest of the campus.

The CSU Northridge campus is located in the center of the San Fernando Valley within the City of Los Angeles. The campus is 4 miles south of the Santa Susana Mountains, the closest area designated as having a high fire hazard where there are large areas of hillsides with moderate to heavy vegetative fuels. The campus is not located next to areas with a fire hazard potential making direct impacts by fire on the campus unlikely.

However, the CSU Northridge campus is surrounded by mountains and extensive areas of fire hazards further away. Surrounding the Los Angeles Basin are large mountain ranges including the San Gabriel, San Bernardino, and Santa Ana Mountains. These mountain ranges host three national forests with extensive history of large fire development. The fires that burn in these areas have the potential to develop vast quantities of smoke that can fill the basin in the right wind conditions. The geography of the Los Angeles Basin and San Gabriel, San Fernando, and San Bernardino valleys creates a topography that captures air pollutants including smoke within surrounding mountains and the development of inversion layers. The CSU Northridge campus is located in a region in which wildfire smoke can saturate the air around the campus.
Extent of the Hazard

The area immediately surrounding the CSU Northridge campus is not in proximity to fire hazard zones designated as a High Fire Hazard Severity Zones, and the campus does not have a history of wildfire activity occurring within proximity to the campus. However, the San Fernando Valley is surrounded by mountain ranges containing forests with an extensive history of large wildfire development and smoke generation. As a result, the planning committee ranks the extent of the wildfire hazard for the SJSU campus as Moderate.

The National Fire Danger Rating System (NFDRS) is the current system in use for rating and classifying the potential danger of fire. The NFDRS tracks the effects of previous weather events on both dead and live fuel loads and adjusts accordingly based on future or predicted weather conditions. These complex relationships and equations are computed, and the outputs are expressed in terms that users can quickly and easily understand. The current NFDRS is used by all federal and most state agencies to assess fire danger conditions. The following table depicts the NFDRS, from the US Forest Service’s Wildland Fire Assessment System.

Table 5-25: National Fire Danger Rating System

<table>
<thead>
<tr>
<th>Rating</th>
<th>Basic Description</th>
<th>Detailed Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>CLASS 1: Low Danger</td>
<td>Fires not easily started</td>
<td>Fuels do not ignite readily from small firebrands. Fires in open or cured grassland may burn freely a few hours after rain, but wood fires spread slowly by creeping or smoldering and burn in irregular fingers. There is little danger of spotting.</td>
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<tr>
<td>(L)</td>
<td></td>
<td></td>
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<tr>
<td>COLOR CODE: Green</td>
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</tr>
<tr>
<td>CLASS 2: Moderate</td>
<td>Fires start easily and spread at a moderate rate</td>
<td>Fires can start from most accidental causes. Fires in open cured grassland will burn briskly and spread rapidly on windy days. Woods fires spread slowly to moderately fast. The average fire is of moderate intensity, although heavy concentrations of fuel – especially draped fuel -- may burn hot. Short-distance spotting may occur but is not persistent. Fires are not likely to become serious and control is relatively easy.</td>
</tr>
<tr>
<td>Danger (M)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>COLOR CODE: Blue</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CLASS 3: High Danger</td>
<td>Fires start easily and spread at a rapid rate</td>
<td>All fine dead fuels ignite readily, and fires start easily from most causes. Unattended brush and campfires are likely to escape. Fires spread rapidly and short-distance spotting is common. High intensity burning may develop on slopes or in concentrations of fine fuel. Fires may become serious and their control difficult, unless they are hit hard and fast while small.</td>
</tr>
<tr>
<td>(H)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>COLOR CODE: Yellow</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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<table>
<thead>
<tr>
<th>CLASS 4: Very High Danger (VH)</th>
<th>Fires start very easily and spread at a very fast rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>COLOR CODE: Orange</td>
<td>Fires start easily from all causes and immediately after ignition, spread rapidly and increase quickly in intensity. Spot fires are a constant danger. Fires burning in light fuels may quickly develop high-intensity characteristics - such as long-distance spotting - and fire whirlwinds when they burn into heavier fuels. Direct attack at the head of such fires is rarely possible after they have been burning more than a few minutes.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>CLASS 5: Extreme (E)</th>
<th>Fire situation is explosive and can result in extensive property damage</th>
</tr>
</thead>
<tbody>
<tr>
<td>COLOR CODE: Red</td>
<td>Fires under extreme conditions start quickly, spread furiously, and burn intensely. All fires are potentially serious. Development into high intensity burning will usually be faster and occur from smaller fires than in the Very High Danger class (4). Direct attack is rarely possible and may be dangerous, except immediately after ignition. Fires that develop headway in heavy slash or in conifer stands may be unmanageable while the extreme burning condition lasts. Under these conditions, the only effective and safe control action is on the flanks, until the weather changes or the fuel supply lessens.</td>
</tr>
</tbody>
</table>

Due to the impacts of wildfires on public health, agencies across the nation have adopted the use of the Air Quality Index (AQI) to communicate and provide a consistent approach to air quality measurements and categorization. The AQI primarily focuses on the health effects caused by pollutants in the air such as smoke. The goal of the AQI is to provide advisories to assist the public in determining when to reduce exposures to inhalation of air pollution as pollution levels rise.
History of the Hazard

The State of California has a long history of chronic and destructive wildfires throughout the state. On average, 8,300 wildfires have caused burnt 928,245 acres across the state over the 20-year period between 2000 and 2020. Los Angeles County also has a long history of wildfire activity primarily in the foothills and mountains of the San Gabriel and Santa Monica Mountains. Wildfires occurring in Los Angeles County have resulted in hundreds of thousands of acres burned and hundreds of millions of dollars in damages.

The area immediately surrounding the CSU Northridge campus is not in proximity to fire hazard zones designated as a High Fire Hazard Severity Zones. The campus does not have a history of wildfire activity occurring within proximity to the campus. However, the County is surrounded by areas that are considered to be of high fire threat that would produce vast quantities of smoke and/particulates into the air. The Northridge campus has experienced multiple days of poor air quality due to fires burning in Los Angeles, Orange, Riverside, and San Bernardino Counties. The 2017, 2018, and 2020 fire seasons in particular illustrated the increase in wildfire generated smoke saturating the air of communities throughout the state including Los Angeles County. CSU Northridge personnel reported the ongoing development of policies and procedures to address the response to poor air quality days.

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78 California Department of Forestry and Fire Protection, Stats and Events, https://www.fire.ca.gov/stats-events/
Figure 16-15: Historic Large-Scale Fires Near CSU Northridge

<table>
<thead>
<tr>
<th>Date</th>
<th>Fire</th>
<th>Location</th>
<th>Declaration</th>
<th>Damages</th>
</tr>
</thead>
<tbody>
<tr>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
</tr>
</tbody>
</table>

**Potential Impacts of the Hazard**

The location of the CSU Northridge campus surrounded by areas of urban development removed from areas with a fire hazard places a minimal direct threat from wildfire to the campus. The potential impacts to wildfire exist with members of the campus community who reside or work in these fire hazard zones.

Potential impacts to the campus community resulting from wildfires include:

- Injuries or loss of life
- Campus property destruction or damage
- Residential property destruction or damage
- Commercial property destruction or damage
- Loss of property contents
- Infrastructure damage
- Threat or damage to on campus child care facilities
- Damaged or destroyed lifelines/supply routes
- Damaged or destroyed utilities
- Damaged or destroyed critical facilities supporting campus emergency support needs
- Loss of community economic base
- Employment losses
- Loss to ground supporting vegetation on hillsides resulting in erosion or landslides in future precipitation events
- Agricultural (crops and livestock) damages or destruction
- Environmental damage
- Societal and community impacts
- Damage or reduction of capacity to organizations and facilities providing support services to vulnerable populations
- Greater evacuation challenges for those most vulnerable
- Psychological impacts of impacted populations
- Disruptions to education delivery to community

Potential impacts resulting from wildfire generated smoke include:

- Dangerous levels of air pollution
- Human Health Effects

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79 2019 Los Angeles County All-Hazards Mitigation Plan, 2019
Similar health impacts to pets

- Air conditioning systems overwhelmed
- Greater demands on air filtration systems
- Greater demands on healthcare systems
- Reduced outdoor work productivity
- Closures of academic sessions

Additionally, there remains a number of secondary impacts from wildfires that could affect the campus community. Utilities feeding areas of Los Angeles County including the campus may be damaged resulting in power outages. Fire-related damage in the watersheds will likely cause future landslides, degradation to plants supporting hillsides, and impact the hydroelectric power capabilities. Fires may present threats to areas of recreation, scenic value, and wildlife that are a part of the culture of the campus community. Finally, the campus may experience effects of evacuated individuals arriving on campus from other areas as a location of refuge.

Probability of Future Occurrence of the Hazard

Based on the minimal wildfire threat potential in the area surrounding the CSU Northridge campus, including the distance to Fire Hazard Severity Zones and density of residential and commercial development, the probability of wildfire related damage is considered Unlikely.

Based on the wildfire threat potential in the area surrounding Southern California including the hills and mountains throughout the region, the volume of areas in elevated Fire Hazard Severity Zones throughout the southern portions of the state, and the historic occurrences of smoke, the probability of wildfire generated smoke impacts to air quality is considered Possible.

Vulnerability to the Hazard

The CSU Northridge campus is not likely to be subject to direct impact from wildfire due to the campus location in an urban/suburban area of the San Fernando Valley. The vulnerabilities to the effects of wildfire would largely lie within the campus community who may reside or work in locations that are exposed to the Fire Hazard Severity Zones outside of the urban areas of Los Angeles. Wildfires occurring in other areas of the region may result in the displacement of large numbers of people. These effects may spill onto the campus in the form of evacuees or facility support to emergency resources.

Fire directly threatening the campus would likely take the form of localized fires involving single structures or small areas. Smaller vegetation fires are possible surrounding the campus in the urban forest or fields surrounding the city. These incidents would likely have little impact to the campus.

The primary basis of vulnerability is based on the population affected and the built environment exposed. In general, newer construction will be more fire resistant than
older buildings as building and fire codes and construction technology have improved. Density of buildings and proximity of fuels to buildings or equipment at risk of combustion would additionally influence the fire’s ability to spread to structures.

Some areas of particular vulnerability on the campus includes:

- Students and staff engaging in outdoor activities when the air is determined to be unhealthy are vulnerable to adverse health effects.
- Buildings with ineffective HVAC or do not have HVAC will cause limitations in filtering of air during smoke filled days
- Power outages or brownouts during days with high levels of smoke will limit shelter in place options during heat events in summer.

The greater concerns regarding vulnerabilities to wildfire on CSU Northridge are related to the smoke that fires in the area would produce. The recent summer seasons have clearly demonstrated the reality of large wildfires producing enough smoke to fill the Los Angeles Basin even from substantial distances away. These recent fires have displayed how the effects of this smoke impact the general population and especially vulnerable populations. CSU Northridge students, faculty, and staff both on campus and off campus face these same vulnerabilities related to smoke filled air.

Smoke generated from large wildfires pose a threat in terms of diminished air quality that would be exposed to the population within the area of smoke distribution. Individuals with existing health problems such as respiratory or cardiac illnesses are increasingly vulnerable to wildfire generated smoke. Staff who work in roles requiring outdoor activity will be increasingly exposed during days where the air quality index is considered unhealthy or worse. Student athletes participating in outdoor sports and engaging in aerobic activities are increasingly vulnerable to the effects of wildfire.

The vulnerability to members of the campus community in which wildfire generated smoke on the CSU Northridge campus will vary depending on when the air quality was to reach unhealthy levels. The risk to the campus population will be lessened during periods when classes are not in session or during periods of breaks. Conversely, during the days and hours that classes are in session and staff are at their workplaces, the human vulnerability increases. However, in region-wide events this vulnerability may be shared with the homes and workplaces of members of the campus community and their families.

Vulnerable populations will likely face disproportionate health safety issues from smoke filled air, experience increased stresses, may require the need to remain away from the campus enclosed at home, and may find difficulty in accessing equipment or supplies to aid in a specific need.

Estimate of Potential Losses

Estimates of potential losses will be influenced by a variety of factors. Costs would also be likely to include mitigation or repairs of HVAC systems, sealing of doors and windows, and other methods of keeping smoke from entering buildings. Secondary
costs would include lost academic days during campus closures, lost staff on campus productivity, and health and medical interventions for affected members of the campus community.

Based on estimate replacement costs of facilities and structures on campus, the maximum total replacement costs due to wildfire are $550,272,157. Due to the lack of a complete inventory of building and facility costs, the total replacement estimate is likely much higher. However, the location of the campus in an urban/suburban setting removed from hazard prone areas makes wildfire related damages unlikely.

Table 16-26: Wildfire Hazard Potential (WHP) Zone Estimated Losses

<table>
<thead>
<tr>
<th>WHP Zone</th>
<th>No of Buildings</th>
<th>Maximum Replacement Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Extreme</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Very High</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>High</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Moderate</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Low</td>
<td>14</td>
<td>$110,707,848</td>
</tr>
<tr>
<td>Very Low</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Non-Burnable</td>
<td>64</td>
<td>$439,564,309</td>
</tr>
<tr>
<td>No Building Value Data Provided*</td>
<td>28</td>
<td>Unknown</td>
</tr>
</tbody>
</table>

*Buildings with no value defined are also included in the respective Zones they are found in.

Vulnerability Assessment Conclusions

The occurrence of wildfires has been a frequent event in Los Angeles County; however, wildfire incidents do not pose a direct risk to the CSU Northridge campus. The location of the CSU Northridge campus surrounded by densely developed residential, commercial, and industrial land uses mitigates any vulnerabilities of wildfire hazards to the campus community or facilities.

Communities located within or near the Wildland Urban Interface may be subject to damaging fires. These same communities may be home to members of the campus community. The students, faculty, and staff of CSU Northridge who live or work in these hazard areas may experience vulnerabilities to the direct exposure to wildfire not likely at the campus. These effects may create tremendous challenges that could impact their ability to maintain engagement with university academic or professional activities. The potential for large-scale wildfires in the region further generates the added potential for a number of cascading effects such as disruptions to the local...
economy, utility failures, disruptions to providing for the needs of the community, and development of public health hazards.

Additionally, the topography of Southern California surrounded by mountains allows for smoke filled air to linger in the valleys of the Los Angeles Basin with the potential for unhealthy air quality depending on wind conditions. Fires in surrounding mountains generating tremendous quantities of smoke present tremendous health related vulnerabilities to members of the campus community. The campus community exposed to these unhealthy air conditions are vulnerable to a variety of potential health related effects.

**Identified Data Limitations**

Data limitations include missing campus structural replacement costs, and lack of both a complete inventory of building construction types and mitigation efforts to lessen the impact due to fire activity. HAZUS generated analysis is focused on the broader community level versus fine-tuning the analysis to the micro-level for facilities such as a university campus.

**16.4 Social Resilience Assessment**

**Overview**

While every person is vulnerable to risk, individuals from diverse populations such as those with access and functional needs are disproportionately more vulnerable and may be at a higher risk to harm in a disaster event. In addition to physical vulnerabilities, the intersectionality between physical hazard risks and population social vulnerabilities must be considered to holistically address overall campus risk.

As inclusivity is a high priority for CSU, addressing campus risk and resilience must be done through the lens of inclusion and equity. Addressing social vulnerability is an increasingly critical requirement of state and national doctrines and described in Section 4.4 of the HVRA Base Plan. Every individual of the campus’s richly diverse population group needs to have the capacity, skills, and knowledge in order to understand, access, and participate in risk reduction and disaster response in ways that are meaningful to their own unique situation. In a campus community, having strong social support networks and active involvement in community disaster responses may negatively or positively impact these opportunities and reduce the resilience-building process. This section offers a glimpse into the CSU Northridge campus’s unique social construct, population demographics, strengths and concerns and presents a high-level assessment of the resilience, coping capacities and potential social vulnerabilities of students, staff and faculty. The research variables that were asked are often considered sensitive subjects, and few are traditionally included in emergency management/hazard mitigation planning.
This social resilience assessment of college campuses is the first of its kind in the nation. The research methodology unfolded as the interviews with campuses progressed. The assessment data presented are not definitive or authoritative. The answers, analysis, and suggested trends are strictly indicators for potential social risk. They do not represent an accurate data capture as limitations on the data gathering process influenced an ability to provide accuracy. This assessment provides indications of increased risk, not accuracy of response or a true reflection of the situation of the campus. The information presented is to be considered in the context of the more detailed system-wide CSU social vulnerability assessment that is included in the baseline HVRA.

Campus-Identified Populations of Concern

During the campus interview, the following responses were provided when asked, “In considering the diverse population group(s) amongst student body, faculty and staff, which are of the most concern in your emergency management planning?”

<table>
<thead>
<tr>
<th>Question</th>
<th>Campus Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>Which population groups amongst the student body, faculty, and staff, are of the most concern for physical and social vulnerabilities in emergency management planning?</td>
<td>Deaf students</td>
</tr>
<tr>
<td>Which population groups are most difficult to reach in an event?</td>
<td>• Deaf students</td>
</tr>
<tr>
<td></td>
<td>• Commuter students</td>
</tr>
<tr>
<td>Which population groups have little/limited support networks if impacted by an event?</td>
<td>• Deaf students</td>
</tr>
<tr>
<td></td>
<td>• Students in &quot;their&quot; housing, under- resourced</td>
</tr>
</tbody>
</table>
Resilience Variables Related to Campus Emergency Management

The interviewees were asked to reflect on a set of 12 variables for the campus populations of student, faculty and staff: homelessness (*housing insecurity*), food security, health and wellness, disability/access and functional needs (AFN), racial equity, digital equity, communications, international students, immigrants/immigration status issues (*undocumented, DACA, etc.*), LGBTQI (Lesbian Gay Bisexual Transgender Questioning (or queer) Intersex), and transportation dependency. They were also offered an opportunity to add any other factor they wanted to include. The following two questions were asked:

- Is this factor a particular issue of concern for emergency management on your campus? Responses were summarized as *Very High, High, Medium, Low*
- Is this factor reflected in the emergency plans and processes for your campus? Responses were summarized as *Yes, No, In Progress, NA*

In order to provide a high-level qualitative response for the answers, the approach of averaging response was taken. If conflicting answers were expressed by the interviewees, the answer (code) was averaged out. A detailed explanation of the response averaging approach is included in the base HVRA.
Table 16-28: Campus-specific emergency management issues of concern and inclusion in emergency management plans and processes.

<table>
<thead>
<tr>
<th>Issue of Concern</th>
<th>Plans &amp; Processes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Homelessness (Housing Insecurity)</td>
<td>Medium</td>
</tr>
<tr>
<td></td>
<td>No</td>
</tr>
<tr>
<td>Food Security</td>
<td>Low</td>
</tr>
<tr>
<td></td>
<td>No</td>
</tr>
<tr>
<td>Health &amp; Wellness</td>
<td>High</td>
</tr>
<tr>
<td></td>
<td>Yes</td>
</tr>
<tr>
<td>AFN</td>
<td>Medium</td>
</tr>
<tr>
<td></td>
<td>Yes</td>
</tr>
<tr>
<td>Digital Equity</td>
<td>Low</td>
</tr>
<tr>
<td></td>
<td>No</td>
</tr>
<tr>
<td>Comms.</td>
<td>Low</td>
</tr>
<tr>
<td></td>
<td>Yes</td>
</tr>
<tr>
<td>International Students</td>
<td>Medium</td>
</tr>
<tr>
<td></td>
<td>Yes</td>
</tr>
<tr>
<td>Immigrants / Immigration Status</td>
<td>Low</td>
</tr>
<tr>
<td></td>
<td>No</td>
</tr>
<tr>
<td>LGBTQI</td>
<td>Low</td>
</tr>
<tr>
<td></td>
<td>No</td>
</tr>
</tbody>
</table>

Qualitative Narrative: Campus Overview of Potential Resilience Vulnerabilities

The following are interview notes of interest:

- pride self on being open and aware of the many facets of the culture; 2nd most diverse population group for students.
- DAFN is baked into the EOP; noted that the City of Los Angeles went through a lawsuit
- International students in the extended learning; community approach is working with their EOP that is an annex to the campus EOP
- Campus social media teams monitors Nextdoor

Campus High Hazards and Potentially Vulnerable Populations

This section provides a brief introduction to the link between socially vulnerable populations and a particular hazard type. While extensive research has been conducted on the impacts of hazards, not all linkages have been documented or published, and detail for finding them are beyond the scope of this assessment. It’s important to note, the intersectional nature of what makes an individual’s personal
experience and resilience to an event is played out by unique factors for that individual or population. The nuanced social vulnerabilities often come from the social and physical environment in which a person is embedded.

In order to aid in further assessing campus resilience, below is a general description of the known impacts. From some hazards, the descriptions are robust, while others are only brief introductions.

Table 16-29: CSU Northridge *Highly Likely, Likely and Possible* Hazards

<table>
<thead>
<tr>
<th>Hazard</th>
<th>Future Occurrence Probability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Communicable Disease</td>
<td>Highly Likely</td>
</tr>
<tr>
<td>Drought</td>
<td>Highly Likely</td>
</tr>
<tr>
<td>Earthquake</td>
<td>Possible</td>
</tr>
<tr>
<td>Erosion</td>
<td>Likely</td>
</tr>
<tr>
<td>Extreme Temperature</td>
<td>Possible (Heat only)</td>
</tr>
<tr>
<td>Hazardous Materials</td>
<td>Possible</td>
</tr>
<tr>
<td>Landslide</td>
<td>Possible</td>
</tr>
<tr>
<td>Power Outage</td>
<td>Likely</td>
</tr>
<tr>
<td>Wildfire</td>
<td>Unlikely (Fire); Possible (Smoke)</td>
</tr>
</tbody>
</table>
**Drought**

The 2012-2016 drought had severe effects on two vulnerable sectors of our population: those in low-income brackets, and those, especially Native Americans, who rely on subsistence fishing for their livelihoods. Water bills increased throughout the state. Due to rising water prices, for the working poor, many have paid four to five percent of their income for water. Since many CSU students are commuters, and many living with families, future drought impacts may potentially affect a percentage of non-resident students. NASA’s modeling shows that future droughts are likely to last longer and be more intense, even leading to “megadroughts” in the western states. Fresh water supplies are predicted to be full of extremes, with both droughts and extreme precipitation events being more severe. The interrelationship between drought and other hazard conditions may lead to a set of secondary impacts. Drought conditions lead to water quality issues due to loss of drinking water, increased fire danger that leads to drought-induced fires and elevated AQI levels, as well as extreme heat or prolonged heat events.

**Earthquake**

Impacts on populations from earthquakes are complex, with long-term implications on social stability for all populations. In addition to the physical impact exposure during a no-notice earthquake event and the social and logistical challenges of a recovering community, an earthquake can have lasting impacts long afterwards due to post traumatic stress disorder (PTSD).

Socioeconomic vulnerabilities of populations at risk were analyzed in the hypothetical yet scientifi cally realistic earthquake sequence that is being used to better understand hazards for the San Francisco Bay region during and after a magnitude-7 earthquake (mainshock) on the Hayward Fault and its aftershocks. In this study, the at-risk populations located in areas of concentrated damage are anticipated to experience longer recovery trajectories, increased long term housing displacement, and transportation impacts due to dependencies on transit dependencies. When neighborhood schools close, families with school age children may move to other areas to keep their children in schools. Persons with access and functions needs are likely to be more dependent on access to functioning medical, social and personal health care services that would be overwhelmed by the event and therefore increasing their vulnerabilities. For the homeless populations, the loss of social community services and damages to shelters could add to protracted relocations. For the young and mobile populations who rent, the major disruption to housing, jobs and transit will also drive relocation. Widespread housing damage and preexisting housing

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market constraints will make it “extremely challenging” for the socially and economically vulnerable populations to find alternative housing near their home communities. Those who utilize interim and irregular housing for months and years after a disaster are more vulnerable to physical, social, and mental disorders, including suicide, substance abuse, and physical and verbal abuse. Aftershocks and post disaster conditions delay population return and increase outmigration.\(^{82}\)

**Erosion**

Risk from erosion relates to earthen and infrastructural losses. The degree of vulnerability to these events and their impacts depends on human behavior and the traditional social factors such as situational awareness, prior knowledge of hazards, social capital and decision-making capabilities, as well as increased vulnerability due to social factors, such as racial and economic disparities.

**Extreme Temps**

People susceptible to respiratory ailments (asthma, lower and upper respiratory disease) disproportionately suffer from the effects of fire, smoke, air pollutions, allergens, heat and PSPS. Those with limited income or without resources are affected disproportionately due to the inability to provide safe shelter, air conditioning, cooling, air purification, medical care, and quality foods, and are also least able to obtain information related to climate risks and adaptation strategies.

**Heat**

Heatstroke, cardiovascular disease, respiratory disease and cerebrovascular disease are related to extreme heat events. Increased number of heat waves creates heat-related physical stress on populations and is exacerbated in the metropolitan areas where greater amounts of heat-absorbing surfaces (e.g., asphalt and concrete) trap heat and emit higher temperatures throughout the night.

The heat also extends the geographic range and the distribution of disease-carrying insects and pests. Health professionals are concerned that California’s warming climate will allow species to acclimate. Such vectors include such pests as ticks that carry Lyme disease, and mosquitos that transmit Zika, dengue fever, West Nile, plague and tularemia. Some others, such as chikungunya, Chagas disease, and Rift Valley fever virus, are threats as well.

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Some communities of color and some low-income, homeless, and immigrant populations are more exposed to heat waves, as these groups often reside in urban areas affected by heat island effects. In addition, these populations are likely to have limited adaptive capacity due to a lack of adequately insulated housing, inability to afford or to use air conditioning, inadequate access to public shelters such as cooling centers, and inadequate access to both routine and emergency health care. These social, economic, and health risk factors give rise to the observed increase in deaths and disease from extreme heat in some immigrant and impoverished communities.

Heat stroke, the most serious heat-related illness, occurs when the body is unable to control its temperature. Body temperature rises rapidly, the sweating mechanism fails, and the body cannot cool down. In extreme causes, heat stroke can cause confusion and unconsciousness, so the victim is unable to seek treatment without assistance.

There are several groups of people who are uniquely vulnerable to the effects of extreme heat, such as infants and children, older adults aged 65 and up, athletes and outdoor workers, low-income households, and individuals with certain chronic medical conditions.

When dealing with an extreme heat event, the most common impacts are those generally felt by the people living in the targeted area. For people in particular, heat can kill when the body is pushed beyond its limits. Most heat disorders occur because the victim has been overexposed to heat. As discussed, the major human risks associated with extreme heat include dehydration, sunburn, fatigue, heat exhaustion, heat stroke, and in severe cases, death.

Some portions of the population are more at risk to the effects of extreme heat. The very young, the elderly, and certain groups with chronic medical conditions (such as asthma or other pulmonary illnesses, heart disease, poor blood circulation, neurological illnesses, and obesity) are generally more vulnerable to the effects of extreme heat, and are more likely to suffer illness or death as a result.

This is especially true if exposure is extended for a period of time and preventative measures are not taken immediately. Distributional implications of impacts, and even less on distributional implications of adaptation actions.”

_Hazardous Materials_

The severity of a hazardous materials release depends upon the type of material released, the amount of the release, and the proximity to populations or environmentally sensitive areas such as wetlands or waterways. The release of materials can lead to injuries or evacuation of nearby residents. Wind direction at the

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time of the release can also have a bearing on the severity (as well as the location and extent) of a hazardous materials release.

The primary threat from the hazardous materials incident hazard is to the structures located along transmission lines and transportation routes or near facilities that use or store hazardous materials. Minor incidents would likely cause no damage and little disruption, assuming they could be contained quickly. Major incidents could have fatal and disastrous consequences. The severity of a hazardous material release relates primarily to its impact on human safety and welfare and on the threat to the environment. Threats to human safety and welfare include:

- Poisoning of water or food sources and/or supply
- Presence of toxic fumes or explosive conditions
- Damage to personal property
- Need for the evacuation of people
- Interference with public or commercial transportation

Environmental risks are not uniformly distributed across groups of people. Age, poverty, and minority status place some groups at a disproportionately high risk for environmental disease. Poor access to health information and health care means less health promotion, less risk avoidance, a less healthy diet, and more adverse conditions that increase susceptibility to exposure. Delayed recognition of exposure, diagnosis, and treatment allows effects to accumulate.

**Landslides**

Although infrastructural losses are of secondary importance to the risk to humans themselves, research investigating the vulnerability of people to landslides is rare. The many reasons for this lack of data are related to the fact that the collapse of occupied buildings makes it a function of structural vulnerability and therefore, indirect. The degree of vulnerability to landslides by an individual considered at high risk, or even the general populations, also depends on human behavior, including many of the traditional social factors that are difficult to measure such as situational awareness, prior knowledge of hazards, and decision-making capabilities.

Landslides can result in primary lifeline failures through the loss of roads or power and communication lines. Transportation routes are often expensive to clean up, and

84 [https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3222496/](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3222496/)


prolonged obstruction can disrupt the movement of people and goods. Risk from landslides relates to earthen and infrastructural losses. The degree of vulnerability to these events and their impacts depends on human behavior and the traditional social factors such as situational awareness, prior knowledge of hazards, social capital and decision-making capabilities, as well as increased vulnerability due to social factors, such as racial and economic disparities.

**Power Outage/Public Safety Power Shutdowns (PSPS)**

Loss of power creates economic hardship to a region experiencing regular PSPS events, such as those experienced throughout the state over the recent years. Many businesses close, including gas stations, grocery stores, and local retail establishments. These impacts may deeply impact students dependent on support jobs, as well impacting family members of campus staff and faculty. PSPS increases risks to the public due to inability to use medical devices, spoilage of food and medicines, and disruption to infrastructure, such as supply of clean water and electricity used to run home medical equipment, such as lift chairs and ventilators.

**Wildfire**

Increased wildfire threat occurs especially in the end of fall, when conditions are driest, but before the winter rains have come; an east-to-west wind gusts exacerbate fire risk. Wildfire threats have the concomitant threat of Public Safety Power Shutoffs (PSPS). And, in the case of an actual wildfire, danger exists both from fire and from the smoke. Recent wildfires have demonstrated that some demographics are disproportionately affected. Native Americans are six times more likely to be affected than white people. Blacks and Hispanic people are 50 percent more vulnerable. These values take into account the likelihood of a community being affected and the greater difficulty of that community to recover. These statistics reflect the lack of access to resources to pay for insurance, to rebuild and recover, to implement fire safety measures, and to access other resources. Price gouging after a fire (such as documented in Sonoma County after the 2017 Tubbs Fire) further exacerbates the disparity. 87 Furthermore, the disabled and the elderly are at particular risk from extreme wildfire conditions, as they are often not as able to effectively evacuate. Of the 85 people who died in the Camp Fire in Butte in 2018, 62 of them were at least 65 years old. 88

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Smoke from wildfires creates a significant public health threat. Especially vulnerable are individuals who have heart or lung issues, such as heart disease, lung disease or asthma. Those most vulnerable include the medically fragile, elderly and children. Air Quality Indexes track the level of the following: particulate matter, surface levels of ozone, carbon monoxide, sulfur dioxide, and nitrogen dioxide. All of these can cause respiratory distress and harm lungs.  

The California Department of Public Health reports the increased public health risks, and risk indicators that include: heat-related ED visits, populations living in wildfire areas, adults with multiple chronic conditions, populations living in poverty, race/ethnicity, outdoor workers, public transit access, air conditioner ownership and tree canopy.

Hazard Mitigation and Emergency Management Planning

The goal of this high-level assessment is to provide a starting point to encourage further exploring campus social risks and vulnerabilities, as well as to inform and to enhance holistic emergency management and hazard mitigation decision making, planning processes and future adaptive risk management strategies. By including the social resilience factors, mitigation investments may move beyond standardized planning and regulations, structure and infrastructure projects, and natural systems protections to embrace a more expanded, customized emergency operations plan and an education and outreach program unique to the campus.

A more robust social resilience inquiry is strongly encouraged to develop an accurate picture, based on methodical and scientific research-based data. Such an effort would be envisioned through both nuanced discussions with a variety of campus stakeholders and the invitation of nontraditional stakeholders to join in a collaborative resilience partnership. Such a forward-leaning effort would be directly in keeping with CSU’s commitment to inclusion and equity in risk reduction.

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Section 17
Cal Poly Pomona

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17.1 University Profile

University History

In 1938, California Polytechnic School, founded as a vocational high school in 1901, acquired the Voorhis School for Boys, a private vocational school founded in 1928, following economic pressures from the Great Depression. The two units operated as one institution, by that time a two-year college. During WWII, most of the student body was called to active military duty, forcing the campus to close in 1943. When it reopened in 1956, the Voorhis unit was moved to a former horse ranch in the neighboring city of Pomona and renamed Cal Poly Kellogg-Voorhis Unit. Five years later, both campuses were added to the California State College system and separated into two independent universities in 1966. Cal Poly Kellogg-Voorhis finally adopted its present-date name California State Polytechnic University, Pomona (Cal Poly Pomona) in 1972.

Today, Cal Poly Pomona includes eight colleges and is classed as a Master's College and University by the Carnegie Institute. It is designated as both a Hispanic-Serving Institution (HSI) and an Asian American and Native American Pacific Islander-Serving Institution (AANAPISI).

University Governance

The campus president is the chief executive officer who oversees the administration of the entire university. The president manages campus operations and fundraising, sets campus priorities, and oversees the hiring and support of staff and faculty. The president also maintains a close working relationship with the CSU’s systemwide office, reporting to the chancellor and participating in the systemwide Executive Council.

The provost is the chief academic officer of the university, overseeing all academic affairs and programs of the university. The provost reports directly to the president.

Management of the university is split between five divisions: Academic Affairs, Administrative Affairs, Student Affairs, Information Technology, and University Advancement.

The Academic Senate is the primary consultative body for educational and other university policies, academic personnel policies, selection of administrative officials, and university administrative regulations and practices. Each of the standing committees, of which there are six, write reports with recommendations, which are then voted on by the senate. If approved, the recommendation is sent to the President, who has the power to accept, modify, or reject.

University Mission

“We cultivate success through a diverse culture of experiential learning, discovery, and innovation.”
In pursuit of this mission, the university has outlined five strategic initiatives. Central to these is providing quality academic programs that promote creativity, enhance student success, and prepare students for the workplace and for civic engagement. Furthermore, Cal Poly Pomona seeks to invest in personnel and strengthen their economic vitality and impact.

**University Location**

Cal Poly Pomona is located in Pomona, a suburban city that is in the eastern portion of the Los Angeles metropolitan area. Its 1,725-acre campus is the second largest in the California State University system and includes a 53-acre ranch in Santa Paula, 25-acre campus at Spadra Ranch, and the Neutra VCL Studio and Residences in Silver Lake. The university is currently negotiating the transfer of a 302-acre development center from the State of California.

The university is proximal to the San Jose Fault, believed to run through campus.

**University Population**

Cal Poly Pomona typically enrolls between 20,000-25,000 students per semester. In fall 2020, the 27,909-student population was overwhelmingly made up of undergraduate degree seekers with an average age of 23. Hispanic students made up 49% of all students, with Asian students making up the second most populous group at 21%. Just over half of all students are first generation.

In addition to the student population, the University is home to approximately 1,500 faculty and staff.

**17.2 Interim Final Rule for Hazard Vulnerability and Risk Assessment**

**Requirement §201.6(c)(2):** The plan shall include a risk assessment that provides the factual basis for activities proposed in the strategy to reduce losses from identified hazards. Local risk assessments must provide sufficient information to enable the jurisdiction to identify and prioritize appropriate mitigation actions to reduce losses from identified hazards.

**Requirement §201.6(c)(2)(i):** [The risk assessment shall include a] description of the type...location and extent of all natural hazards that can affect the jurisdiction. The plan shall include information on previous occurrences of hazard events and on the probability of future hazard events.

**Requirement §201.6(c)(2)(ii):** [The risk assessment shall include a] description of the jurisdiction’s vulnerability to the hazards described in paragraph (c)(2)(i) of this section. This description shall include an overall summary of each hazard and its impact on the community.

**Requirement §201.6(c)(2)(ii):** [The risk assessment] must also address National Flood Insurance Program (NFIP) insured structures that have been repetitively damaged floods.
Requirement §201.6(c)(2)(ii)(A): The plan should describe vulnerability in terms of the types and numbers of existing and future buildings, infrastructure, and critical facilities located in the identified hazard area.

Requirement §201.6(c)(2)(ii)(B): [The plan should describe vulnerability in terms of an] estimate of the potential dollar losses to vulnerable structures identified in paragraph (c)(2)(ii)(A) of this section and a description of the methodology used to prepare the estimate..

Requirement §201.6(c)(2)(ii)(C): [The plan should describe vulnerability in terms of] providing a general description of land uses and development trends within the community so that mitigation options can be considered in future land use decisions.

Requirement §201.6(c)(2)(iii): For multi-jurisdictional plans, the risk assessment must assess each jurisdiction’s risks where they vary from the risks facing the entire planning area.

17.3 Hazard Identification and Risk Assessment

Overview of Cal Poly Pomona History of Hazards

Numerous federal agencies maintain a variety of records regarding losses associated with hazards. Unfortunately, no single source is considered to offer a definitive accounting of all losses. The Federal Emergency Management Agency (FEMA) maintains records on federal expenditures associated with declared major disasters. The US Army Corps of Engineers (USACE) and the Natural Resources Conservation Service (NRCS) collect data on losses during the course of some of their ongoing projects and studies. Additionally, the National Oceanic and Atmospheric Administration’s (NOAA) National Centers for Environmental Information (NCEI) database collects and maintains data about natural hazards in summary format. The data includes occurrences, dates, injuries, deaths, and estimated costs. Many of these databases and other data collection services, including the NCEI, have inherent data limitations when searching for information at a university scale.

The best available data and records were used throughout this assessment.

Hazard Identification

As part of the initial hazard identification process, the Campus Assessment Team considered potential hazards with the most chance to significantly affect the planning area. The hazards include those that have occurred in the past and may occur in the future. A variety of sources were used to develop the list of hazards considered including national, regional, and local sources such as emergency operations plans, FEMA’s How-
To Series, websites, published documents, databases, and maps, as well as discussion among the Campus Assessment Team members.

In the initial phase of the planning process, the Campus Assessment Team considered 14 hazards and the risks they create for the University and its material assets, population, and operations. The hazards initially considered, and the determinations as to the treatment of those hazards, are shown in Table 17-1 (following).

Table 17-1: Hazard Identification Determinations

<table>
<thead>
<tr>
<th>Hazard</th>
<th>Determination (Yes/No)</th>
<th>Reason for Determination</th>
<th>Future Occurrence Probability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Communicable Disease</td>
<td>Yes</td>
<td>Hazard of concern for campus</td>
<td>Highly Likely</td>
</tr>
<tr>
<td>Dam and Levee Failure</td>
<td>No</td>
<td>Not a hazard of concern for campus</td>
<td>N/A</td>
</tr>
<tr>
<td>Drought</td>
<td>Yes</td>
<td>Hazard of concern for campus</td>
<td>Highly Likely</td>
</tr>
<tr>
<td>Earthquake</td>
<td>Yes</td>
<td>Hazard of concern for campus</td>
<td>Possible</td>
</tr>
<tr>
<td>Erosion</td>
<td>Yes</td>
<td>Hazard of concern for campus</td>
<td>Likely</td>
</tr>
<tr>
<td>Extreme Temperature</td>
<td>Yes - Heat; No - Cold</td>
<td>Hazard of concern for campus</td>
<td>Possible (Heat only)</td>
</tr>
<tr>
<td>Flood</td>
<td>No</td>
<td>Not a hazard of concern for campus</td>
<td>N/A</td>
</tr>
<tr>
<td>Hazardous Materials</td>
<td>Yes</td>
<td>Hazard of concern for campus</td>
<td>Possible</td>
</tr>
<tr>
<td>Landslide</td>
<td>Yes</td>
<td>Hazard of concern for campus</td>
<td>Likely</td>
</tr>
<tr>
<td>Power Outage</td>
<td>Yes</td>
<td>Hazard of concern for campus</td>
<td>Likely</td>
</tr>
<tr>
<td>Sea Level Rise</td>
<td>No</td>
<td>Not a hazard of concern for campus</td>
<td>N/A</td>
</tr>
<tr>
<td>Tsunami</td>
<td>No</td>
<td>Not a hazard of concern for campus</td>
<td>N/A</td>
</tr>
<tr>
<td>Volcano</td>
<td>Yes</td>
<td>Hazard of concern for campus</td>
<td>Unlikely</td>
</tr>
<tr>
<td>Wildfire</td>
<td>Yes</td>
<td>Hazard of concern for campus</td>
<td>Possible (Fire); Possible (Smoke)</td>
</tr>
</tbody>
</table>

**Future Occurrence Probability**

In order to determine the probability of future occurrences of each hazard profiled, the following scale was developed:
• Highly Likely- 76%-100% that the hazard would occur annually.
• Likely- 50%-75% that the hazard would occur annually.
• Possible- 11%-49% that the hazard would occur each annually.
• Unlikely- 0%-10% that the hazard would occur each annually.
Communicable Disease

Description of the Hazard

Communicable diseases are illnesses that occur due to infectious agents or their toxic products and are infectious due to their potential of transmission from one person or species to another by a replicating agent. They may be transmitted from a reservoir to a susceptible host either directly as from an infected person or animal or indirectly through the agency of an intermediate plant or animal host, vector, or the inanimate environment. Communicable diseases are clinically evident illness resulting from the presence of pathogenic microbial agents, including pathogenic viruses, pathogenic bacteria, fungi, protozoa, multi-cellular parasites, and aberrant proteins known as prions. The degree of spread of a communicable disease depends on both the ability of an organism to enter, survive and multiply in the host and the comparative ease with which the disease is transmitted to other hosts.

Some ways in which communicable diseases spread are by:

- Travel through the air, such as tuberculosis, measles, or COVID-19;
- Physical contact with an infected person, such as through touch (staphylococcus), sexual intercourse (gonorrhea, HIV), fecal/oral transmission (hepatitis A), or droplets (influenza, TB, COVID-19);
- Contact with a contaminated surface or object (Norwalk virus), food (salmonella, E. coli), blood (HIV, hepatitis B), or water (cholera); and
- Bites from insects or animals capable of transmitting the disease (mosquito: malaria and yellow fever; flea: plague)

Collectively, the twenty-three (23) campuses and Chancellor’s Office of the California State University (CSU) system have identified nine (9) communicable disease hazards that have had significant impacts on their respective student, faculty, and staff populations. Of these communicable diseases, COVID-19 is considered to be the most prominent and widespread agent across all CSU campuses. (See Table 17-2 below.)


Table 17-2: Communicable Diseases at Identified CSU Campuses

<table>
<thead>
<tr>
<th>Collective List of Communicable Diseases Identified by All CSU Campuses</th>
<th>Number of CSU Campuses (Including Chancellor’s Office) Identifying Communicable Disease Having Significant Impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>COVID-19 (SARS-CoV-2)</td>
<td>24</td>
</tr>
<tr>
<td>Meningitis</td>
<td>7</td>
</tr>
<tr>
<td>Measles</td>
<td>6</td>
</tr>
<tr>
<td>Influenza (Including H1N1/ Swine Flu)</td>
<td>6</td>
</tr>
<tr>
<td>Tuberculosis</td>
<td>5</td>
</tr>
<tr>
<td>Norovirus</td>
<td>4</td>
</tr>
<tr>
<td>Mumps</td>
<td>2</td>
</tr>
<tr>
<td>E. Coli</td>
<td>2</td>
</tr>
<tr>
<td>Sexually Transmitted Diseases (STDs)</td>
<td>2</td>
</tr>
</tbody>
</table>

(Source: Interviews with CSU campus staff at CSU campuses and at CSU Chancellor’s Office.)

With the exception of COVID-19, there is variability among CSU campuses regarding which communicable diseases have had the greatest impact on individual campus communities. Table 17-3 shows the communicable disease hazards that have had the greatest impact on each CSU campus.

Table 17-3: Communicable Disease Hazards at CSU Campuses with Greatest Impact

<table>
<thead>
<tr>
<th>CSU Campus</th>
<th>Identified Communicable Disease Hazards with the Greatest Impact on CSU Campus</th>
</tr>
</thead>
<tbody>
<tr>
<td>CSU Bakersfield</td>
<td>COVID-19, Meningitis</td>
</tr>
<tr>
<td>CSU Channel Islands</td>
<td>COVID-19, Measles</td>
</tr>
<tr>
<td>Chico State</td>
<td>COVID-19, Tuberculosis</td>
</tr>
<tr>
<td>CSU Dominguez Hills</td>
<td>COVID-19</td>
</tr>
<tr>
<td>Cal State East Bay</td>
<td>COVID-19, Meningitis</td>
</tr>
<tr>
<td>Fresno State</td>
<td>COVID-19, Meningitis, Tuberculosis</td>
</tr>
<tr>
<td>Cal State Fullerton</td>
<td>COVID-19, Influenza</td>
</tr>
<tr>
<td>Humboldt State</td>
<td>COVID-19, Measles, Norovirus, Influenza, STDs</td>
</tr>
<tr>
<td>Cal State Long Beach</td>
<td>COVID-19</td>
</tr>
</tbody>
</table>
Cal State LA | COVID-19, E. coli, Measles  
---|---  
Cal Maritime | COVID-19  
CSU Monterey Bay | COVID-19  
CSUN (Northridge) | COVID-19, Measles  
**Cal Poly Pomona** | COVID-19, Influenza (Swine Flu - H1N1)  
Sacramento State | COVID-19  
Cal State San Bernardino | COVID-19, Tuberculosis  
San Diego State | COVID-19, Meningitis, Mumps  
San Francisco State | COVID-19  
San José State | COVID-19, H1N1  
Cal Poly San Luis Obispo | COVID-19, Meningitis, Norovirus  
CSU San Marcos | COVID-19  
Sonoma State | COVID-19, H1N1, Norovirus  
Stanislaus State | COVID-19, Tuberculosis  
Office of the Chancellor | COVID-19  
CSU System-Wide | COVID-19, Meningitis, Measles, Tuberculosis, Influenza-Swine Flu-H1N1, Mumps, Norovirus, E. coli, STDs  

(Source: Interviews with CSU campus staff at CSU campuses and at CSU Chancellor’s Office.)

**Descriptions of Identified Communicable Disease Hazards at Cal Poly Pomona**

Cal Poly Pomona has identified two (2) communicable disease hazards that have had the greatest impact on campus – COVID-19 and Influenza (Swine Flu - H1N1). The following are brief descriptions of the communicable disease hazards at Cal Poly Pomona.

**COVID-19 (SARS-CoV-2)**

Coronaviruses are a family of viruses that can cause illnesses such as the common cold, severe acute respiratory syndrome (SARS) and Middle East respiratory syndrome (MERS). In 2019, a new coronavirus was identified as the cause of a disease outbreak that originated in China. This virus is now known as the **severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2)**. The disease it causes is called Coronavirus Disease 2019 (COVID-19). In March 2020, the World Health Organization (WHO) declared the COVID-19 outbreak a pandemic.
Signs and symptoms of coronavirus disease 2019 (i.e., COVID-19) may appear two to 14 days after exposure. Common signs and symptoms can include fever, cough, and tiredness. Early symptoms of COVID-19 may also include a loss of taste or smell.

The virus that causes COVID-19 spreads easily among people, and more continues to be discovered over time about how it spreads. Data has shown that the COVID-19 virus spreads mainly from person to person among those in close contact (within about 6 feet, or 2 meters). The virus is transmitted by respiratory droplets being released when someone with the virus coughs, sneezes, breathes, sings or talks. These droplets can be inhaled or land in the mouth, nose or eyes of a person nearby. In some situations, the COVID-19 virus can spread by a person being exposed to small droplets or aerosols that stay in the air for several minutes or hours (i.e., airborne transmission). It's not yet known how common it is for the virus to spread this way. The COVID-19 virus can also spread if a person touches a surface or object with the virus on it and then touches his or her mouth, nose or eyes; however, this is not considered to be a main way it spreads.

The severity of COVID-19 symptoms can range from very mild to severe. Some people may have only a few symptoms, and some people may have no symptoms at all. However, some people may experience worsened symptoms, such as worsened shortness of breath and pneumonia. People who are older have a higher risk of serious illness from COVID-19, and the risk increases with age. People who have existing medical conditions also may have a higher risk of serious illness from COVID-19. In some cases, the disease can cause severe medical complications and may even lead to death. 5

**Influenza (Including sub-type H1N1/Swine Flu)**

Influenza is a viral infection that attacks the respiratory system (i.e., nose, throat, and lungs). Influenza viruses travel through the air in droplets when someone with the infection coughs, sneezes or talks. Influenza is transmitted either by inhaling virus-laden droplets directly, or by coming into physical contact with an object (e.g., telephone or computer keyboard) and then transferring the virus to the eyes, nose or mouth. People with the virus are likely contagious from about a day before symptoms appear until about five days after symptoms begin.

Common signs and symptoms of the flu include: fever, aching muscles, hills and sweats, headache, dry and persistent cough, shortness of breath, tiredness and weakness, runny or stuffy nose, sore throat, and eye pain. (Vomiting and diarrhea are also influenza signs and symptoms, but these are more common in children than in adults.)

Influenza viruses are constantly changing, with new strains appearing regularly. As a result, antibodies against influenza viruses that have been encountered in the past may

not offer protection from new influenza strains, as the new strains can be very different viruses from previous strains. 6

**H1N1 Flu (Swine Flu)**

The H1N1 flu, commonly known as swine flu, is a type of influenza A virus and is one of several flu viruses strains that can cause the seasonal flu. It is primarily caused by the H1N1 strain of the flu (influenza) virus. Symptoms of the H1N1 flu are the same as those of the seasonal flu.

The H1N1 virus is a combination of viruses from pigs, birds and humans that causes disease in humans. The virus enters your body when you inhale contaminated droplets or transfer live virus from a contaminated surface to your eyes, nose or mouth. It then infects the cells that line your nose, throat and lungs. 7

**Location of the Hazard**

Communicable diseases have the potential to affect the entire Cal Poly Pomona planning area equally. As a result, the communicable disease hazard can be found at Cal Poly Pomona main campus located in Pomona, CA (Los Angeles). The communicable disease hazard can also be found at three (3) off-campus research facilities that Cal Poly Pomona operates: (1) Pine Tree Ranch, a 53-acre citrus and avocado ranch in Santa Paula, CA (Ventura Country); (2) Westwind Ranch, a 1,000-acre farm in the city of Chino, CA (San Bernardino County); and (3) Spadra Ranch, a 125-acre site located approximately one mile from the main campus (Los Angeles County). Furthermore, the communicable disease hazard can be found at the Cal-Poly-Pomona-owned Neutra VCL Studio and Residences in Los Angeles, CA (Los Angeles County). Because of the ubiquitous nature of many communicable diseases, students, faculty, staff at (and visitors to) Cal Poly Pomona are at risk of exposure to the communicable disease hazard.8

**CSU Student Housing Locations and Populations**

Although CSU-campus-owned student housing opportunities have been severely limited due to the COVID-19 pandemic, this situation is temporary. Eventually, students will be allowed back on campus at full capacity, and many of these students will be living in campus-owned housing. When this occurs, over 53,000 students (i.e., just over 11% of the CSU total enrollment) will be at increased risk of exposure to communicable disease hazards, owing to the “close-quarters” living arrangements in student housing. For Cal

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Poly Pomona, approximately 9% of its 27,914 enrolled students (or 2,512 students) reside in student housing. 9-10

**Extent of the Hazard**

Various communicable diseases are categorized by the Center for Disease Control and Prevention (CDC) by levels of containment called Biosafety Levels (or BSLs). The higher the BSL, the greater the level of containment and level of effort necessary to prevent transmission of the disease, and therefore the greater the hazard. Biosafety Levels prescribe procedures and levels of containment for a particular microorganism or material (including research involving recombinant or synthetic nucleic acid molecules) and procedures associated with that containment. BSLs also consider primary barriers (e.g., biosafety cabinets), secondary barriers, facility design, air handling, laboratory security, etc. BSLs are graded from 1 to 4; as the BSL increases so does the relative risk of the agent/procedures as well the stringency of procedures and facility design.

Figure 17-1 describes the different BSLs, and provides examples of communicable diseases that would typically fall in to these classifications, as well as the typical protections that would be necessary to prevent transmission of each of the diseases.


The Extent of Cal Poly Pomona Communicable Disease Hazards Except COVID-19:

Before the COVID-19 pandemic, there were cases of Influenza at Cal Poly Pomona. Influenza – H1N1 would be classified at either the BSL-2 or BSL-3 containment level, depending on the strain.12

The Extent of Cal Poly Pomona COVID-19 Communicable Disease Hazard:

As a microorganism, the SARS-CoV-2 (COVID-19) virus requires a high level of containment. It is therefore classified at BSL-3. 13

History of the Hazard

Over an approximately one-year period, from mid-March, 2020 to March 23, 2021, there were a reported 297 cases of COVID-19 at Cal Poly Pomona. Most communicable disease data are maintained by at the state and at the county levels, and are not generally available at the municipal or campus levels, unless (a) the CSU campus falls under the jurisdiction of a city-level health department, or (b) a geographically specific outbreak occurs on campus or in the local community. The exception to this is the current COVID-


19 pandemic, where both campus and County-level case data have been collected. As a result, it is important to provide COVID-19 case statistics for both CSU campuses and the counties where CSU campus assets are located.

Tables 17-5, 17-6, 17-7, and 17-8 show campus-level and County-level COVID-19 Case data for Cal Poly Pomona. These case data are updated on at least a weekly basis. (Please note that the COVID-19 case numbers here may not reflect the most recent updates.)

Table 17-4: Cumulative Confirmed Cases at Cal Poly Pomona (from March, 2020 through 03/23/2021)\(^{14}\)

<table>
<thead>
<tr>
<th>Classification</th>
<th>On-Campus *</th>
<th>Off-Campus **</th>
</tr>
</thead>
<tbody>
<tr>
<td>Student</td>
<td>32</td>
<td>173</td>
</tr>
<tr>
<td>Employee</td>
<td>67</td>
<td>25</td>
</tr>
<tr>
<td>Total</td>
<td>99</td>
<td>198</td>
</tr>
</tbody>
</table>

*On-Campus Case Definition*: When a student, faculty or staff member reports a positive lab test for COVID-19 to Cal Poly Pomona, and the individual has been on campus during the contagious period.

** Off-Campus Case Definition**: When a student, faculty or staff member reports a positive lab test for COVID-19 to Cal Poly Pomona, but the individual has NOT been on campus during the contagious period. This reporting includes members of the campus community learning and working remotely, and it also follows Los Angeles County Department of Public Health’s definition for “Institutes of Higher Education” settings\(^{15}\).

Table 17-5: Los Angeles County COVID-19 Statistics (as of 03/17/2021):\(^{16}\)

<table>
<thead>
<tr>
<th>COVID-19 Classification</th>
<th>Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cases</td>
<td>1,149,878</td>
</tr>
<tr>
<td>Deaths</td>
<td>21,449</td>
</tr>
</tbody>
</table>

Table 17-6: Ventura County COVID-19 Statistics (as of 03/19/2021):\(^{17}\)

<table>
<thead>
<tr>
<th>COVID-19 Classification</th>
<th>Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>-------------------------</td>
<td>--------</td>
</tr>
</tbody>
</table>


<table>
<thead>
<tr>
<th>Cases</th>
<th>79,028</th>
</tr>
</thead>
<tbody>
<tr>
<td>Deaths</td>
<td>940</td>
</tr>
</tbody>
</table>

Table 17-7: San Bernardino County COVID-19 Statistics (as of 03/22/2021): 18

<table>
<thead>
<tr>
<th>COVID-19 Classification</th>
<th>Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cases</td>
<td>289,846</td>
</tr>
<tr>
<td>Deaths</td>
<td>3,692</td>
</tr>
</tbody>
</table>

Potential Impacts of the Hazard

Communicable disease outbreaks and pandemics potentially have (and will continue to have) direct impact on life, health, and safety across the CSU system (including the Cal Poly Pomona campus). The extent of this impact is contingent on the type of infection or contagion, the severity of the outbreak, and the speed at which it is transmitted. Property and infrastructure integrity may be affected if large portions of the campus population contract communicable diseases at the same time and are therefore unable to perform maintenance, operations, and educational tasks. This would be particularly disruptive if those impacted are first responders or other essential personnel. Long-term outbreaks affecting large numbers of Cal Poly Pomona students could result in cancelled classes, delayed matriculation, or other disruptions to the CSU System’s mission. This has already occurred with the current COVID-19 pandemic and could occur again with more virulent strains of communicable diseases, including COVID-19.

Communicable disease hazards found across the CSU system (including Cal Poly Pomona) vary both by level of containment (BSL) (described previously) and by level of individual/public health risk, or Risk Group (RG) level. While BSLs describe the procedures and required levels of containment in a laboratory setting, Risk Groups (RGs) reflect the potential effects of disease exposure on humans or animals. Like BSLs, RGs range from Level 1 (RG1) to Level 4 (RG4), with Level 1 (RG1) posing minimal risk to healthy individuals and public health and Level 4 (RG4) posing a very serious or extreme risks to individuals and public. BSLs generally correlate with Risk Group (RG) Levels (e.g., a RG2 agent is worked with at BSL-2), but there are exceptions (e.g., production volumes, high-risk procedures, etc.). 19

The World Health Organization’s (WHO) Laboratory Biosafety Manual, 3rd ed., NIH Guidelines, categorizes Risk Groups (RGs) in the following way:

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### Table 17-8: WHO Risk Group Categorization

<table>
<thead>
<tr>
<th>Risk Group (RG)</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>RG1</td>
<td>Rarely associated with disease in healthy adult humans or animals and pose no-to-little public health risk (e.g., Saccharomyces cerevisiae, E. coli K-12 strain derivatives often used for recombinant/molecular biology, many environmental organisms)</td>
</tr>
<tr>
<td>RG2</td>
<td>Associated with mild to moderate disease for which preventative measures or post exposure treatments are often available; public health impact is limited (e.g., Streptococcus pyogenes, Salmonella, hepatitis B virus)</td>
</tr>
<tr>
<td>RG3</td>
<td>Associated with serious to lethal human disease for which preventative vaccines or post-exposure therapies may be scarce. Public health impact is limited-to-moderate (e.g., Mycobacterium tuberculosis, hantaviruses, West Nile virus, SARS)</td>
</tr>
<tr>
<td>RG4</td>
<td>Associated with serious to lethal human disease for which preventative vaccines or post exposure therapies are not usually available. Public health impact is high (e.g., Ebola virus, Marburg virus, smallpox virus, etc.)</td>
</tr>
</tbody>
</table>

Table 17-10 describes the four (4) Risk Group Levels (RGs), and provides examples of communicable diseases that would typically fall in to these classifications, and the typical protections that would be necessary to prevent transmission of the disease. It is important to note that all but two (2) communicable disease hazards identified by CSU campuses fall under either the lower-risk RG1 or RG2 categories. COVID-19 and tuberculosis are the two (2) communicable diseases fall under the higher-risk RG3 category. However, with the advent of the recently-developed COVID-19 vaccine, and with the expectation of an increasingly robust vaccine supply, it is possible that the RG level for COVID-19 could be lowered in the future, thereby reducing both the extent and the potential impact of COVID-19.

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Table 17-9: Risk Group Levels (RGs) with Example Diseases and Recommended Precautions

<table>
<thead>
<tr>
<th>Level</th>
<th>Examples</th>
<th>Typical Protection to Prevent Transmission</th>
</tr>
</thead>
<tbody>
<tr>
<td>RG 1</td>
<td>E. Coli</td>
<td>Precautions are minimal, most likely involving gloves and some sort of facial protection. Usually, contaminated materials are left in open (but separately indicated) waste receptacles. Decontamination procedures for this level are similar in most respects to modern precautions against everyday viruses (i.e.: washing one's hands with anti-bacterial soap, washing all exposed surfaces of the lab with disinfectants, etc.).</td>
</tr>
<tr>
<td>RG 2</td>
<td>Chicken Pox, Hepatitis A, B, C</td>
<td>These bacteria and viruses cause mild disease in humans or are difficult to contract via aerosol. Routine diagnostic work with clinical specimens can be done safely at BSL-2, using BSL-2 practices and procedures.</td>
</tr>
</tbody>
</table>
These bacteria and viruses cause severe to fatal disease in humans, but vaccines or other treatments do exist to combat them. Laboratory personnel have specific training in handling pathogenic and potentially lethal agents and are supervised by competent scientists who are experienced in working with these agents. This is considered a neutral or warm zone.

These viruses and bacteria cause severe to fatal disease in humans, for which vaccines or other treatments are not available. When dealing with biological hazards at this level the use of a Hazmat suit and a self-contained oxygen supply is mandatory. The entrance and exit of a BSL-4 lab will contain multiple showers, a vacuum room, an ultraviolet light room, autonomous detection system, and other safety precautions designed to destroy all traces of the biohazard. Multiple airlocks are employed and are electronically secured to prevent both doors opening at the same time. All air and water service going to and coming from a BSL-4 lab will undergo similar decontamination procedures to eliminate the possibility of an accidental release.

Probability of Future Occurrence of the Hazard

There are significant data limitations regarding non-COVID-19 communicable disease cases, as the information thereof is outdated, anecdotal, and/or inadequate. As a result, it is not feasible to provide quantitative probabilities of future occurrence for non-COVID-19 communicable disease hazards. However, based on the limited data, it is feasible to present qualitative probabilities of future occurrence based on ranges of communicable disease frequency.

Table 17-11 shows a probability scale of future occurrence for the nine (9) communicable disease hazards profiled in this assessment. This scale is divided into four (4) levels of probability:
### Table 17-10: Likelihood of Future Hazard Occurrence

<table>
<thead>
<tr>
<th>Likelihood</th>
<th>Parameters for Determining Likelihood</th>
</tr>
</thead>
<tbody>
<tr>
<td>Highly Likely</td>
<td>76 – 100% probability that hazard will occur annually (high to very high frequency)</td>
</tr>
<tr>
<td>Likely</td>
<td>50 – 75% probability that hazard will occur annually (moderate to high frequency)</td>
</tr>
<tr>
<td>Possible</td>
<td>11 – 49% probability that hazard will occur annually (low to moderate frequency)</td>
</tr>
<tr>
<td>Unlikely</td>
<td>0 – 10% probability that hazard will occur annually (very low to low frequency)</td>
</tr>
</tbody>
</table>

Due to significant data limitations surrounding non-COVID communicable diseases, the probability of future occurrence of CSU-system-wide communicable disease is measured by the proportion of campuses that have identified a particular communicable disease as having an impact on the campus community. In this measure, the more frequent a communicable disease is seen as impactful CSU-wide, the greater the probability of future occurrence. Note: Each communicable disease’s probability of future occurrence ranking CSU-system-wide reflects the ranking at the individual CSU campus level unless noted otherwise.

### Table 17-11: Probability of Future Occurrence of Communicable Disease Hazard for CSU System

<table>
<thead>
<tr>
<th>Collective List of Communicable Diseases Identified by All CSU Campuses</th>
<th>Number of CSU Campuses (Including Chancellor’s Office) Identifying Communicable Disease Having Significant Impact</th>
<th>Proportion of CSU Campuses Identifying Communicable Disease as Having Significant Impact System-Wide</th>
<th>CSU System-Wide Probability Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>COVID-19 (SARS-CoV-2)</td>
<td>24</td>
<td>1.00</td>
<td>Highly Likely</td>
</tr>
<tr>
<td>Meningitis</td>
<td>7</td>
<td>0.29</td>
<td>Possible</td>
</tr>
<tr>
<td>Measles</td>
<td>6</td>
<td>0.25</td>
<td>Possible</td>
</tr>
<tr>
<td>Influenza (Including H1N1/Swine Flu)</td>
<td>6</td>
<td>0.25</td>
<td>Possible</td>
</tr>
<tr>
<td>Tuberculosis</td>
<td>5</td>
<td>0.21</td>
<td>Possible</td>
</tr>
<tr>
<td>Norovirus</td>
<td>4</td>
<td>0.17</td>
<td>Possible</td>
</tr>
<tr>
<td>Mumps</td>
<td>2</td>
<td>0.08</td>
<td>Unlikely</td>
</tr>
<tr>
<td>E. Coli</td>
<td>2</td>
<td>0.08</td>
<td>Unlikely</td>
</tr>
</tbody>
</table>
Vulnerability to the Hazard

Vulnerability to a communicable diseases hazard resides in the population of a given area – both human and animal – not in the infrastructure or physical assets. While CSU assets and infrastructure could be impacted indirectly by the communicable disease hazard, these impacts would be secondary to the impact that the communicable disease hazard would have on students, faculty, staff, and visitors at CSU campuses. CSU campus settings are geographically diverse, with locations ranging from small towns to medium-sized cities to densely populated urban areas. Hundreds of thousands of people work, study, and/or pass through CSU campuses on any given day. (As of Fall 2019, CPSU – Pomona campus had 21,242 students and additional faculty and staff.) Each of these persons is vulnerable to communicable disease, particularly if it is a pathogen that individual has not been immunized against, or for which no immunization exists. Prolonged outbreaks could result in a loss of services, failure of infrastructure (from lack of operators or maintenance), and closure of facilities. This exact scenario has played out in the current COVID-19 pandemic at Cal Poly Pomona.

Estimate of Potential Losses

COVID-19 Pandemic Health Impact on CSU Campuses and Surrounding Communities

The most prescient metric for estimating losses from COVID-19 is loss of life. The nationwide campus-related COVID-19 death rate of 0.02% remains well below the average COVID-19 death rate in the U.S. However, due to data limitations, there is no information on CSU-campus-specific deaths by COVID-19 or by any other communicable diseases. In fact, COVID-19 is the only communicable disease for which case reports have been readily available for CSU campuses.

At some point in the future, CSU campuses will return to full capacity. Without adequate surveillance regarding campus access and student and employee interaction, CSU campuses (including Cal Poly Pomona) are at risk of developing an extreme incidence of COVID-19, and may become “super-spreaders” for adjacent communities.

22 The California State University. Enrollment. Retrieved 05.03.2021 from: https://www2.calstate.edu/csu-system/about-the-csu/facts-about-the-csu/enrollment/Pages/default.aspx

23 The California State University. Employee Head Count by Campus. Retrieved 05.03.2021 from: https://www2.calstate.edu/csu-system/faculty-staff/employee-profile/csu-workforce/Pages/employee-headcount-by-campus.aspx

emergence of more virulent COVID-19 variants would only add to the potential for high negative impacts on life safety, operations, and service delivery across the CSU system. (Other communicable diseases would also re-emerge, but with low to moderate negative impacts on life safety, operations, and service delivery.)

**Economic Impact of COVID-19 Pandemic on CSU Financial Health**

During the first few months of the COVID-19 pandemic in 2020, the CSU system suffered tremendous negative fiscal impacts. From March through July of 2020 alone, over $146 million worth of revenue losses were sustained across the CSU system due to refunds to students for parking, housing and dining service fees during Spring Semester, 2020. (See Figure 17-2 below for the economic impact to the Cal Poly Pomona campus.) Several CSU campuses saw refund losses surpass $10 million. (See Figure 17-2.)

Figure 17-2: CSU COVID-19 Cost Tracking Showing Revenue Refund Losses and Increased Costs

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**Mitigative Relief from Federal Assistance**

The $1.5 billion in total federal assistance sent to the CSU system will help relieve the losses of revenues from services like dorms, parking and dining services during a year of mainly empty campuses. (See Table 17-13.) However, because of staggering COVID-related revenue losses, the CSU system is planning for three (3) years of fiscal duress.

---

Table 17-12: Total Federal Assistance to CSU for COVID-19 Related Losses, 2020 – 2021

<table>
<thead>
<tr>
<th>Institution</th>
<th>December 2020 Stimulus</th>
<th>CARES Act</th>
<th>APLU Projection of HEERF Total ARP Act Funding Allocation</th>
<th>Total Estimated Federal COVID Relief Funding</th>
</tr>
</thead>
<tbody>
<tr>
<td>California Polytechnic State University</td>
<td>$20,752,799</td>
<td>$14,725,000</td>
<td>$37,000,928</td>
<td>$72,478,727</td>
</tr>
<tr>
<td>California State Polytechnic University, Pomona</td>
<td>$48,614,353</td>
<td>$31,102,000</td>
<td>$86,044,649</td>
<td>$165,761,002</td>
</tr>
<tr>
<td>California State University Channel Islands</td>
<td>$14,288,099</td>
<td>$8,512,000</td>
<td>$24,915,170</td>
<td>$47,715,269</td>
</tr>
<tr>
<td>California State University Maritime Academy</td>
<td>$1,381,700</td>
<td>$1,204,000</td>
<td>$2,472,622</td>
<td>$5,058,322</td>
</tr>
<tr>
<td>California State University - Sacramento</td>
<td>$59,891,260</td>
<td>$35,643,000</td>
<td>$104,900,133</td>
<td>$200,434,393</td>
</tr>
<tr>
<td>California State University, Bakersfield</td>
<td>$22,855,632</td>
<td>$12,483,000</td>
<td>$40,285,565</td>
<td>$75,624,197</td>
</tr>
<tr>
<td>California State University, Chico</td>
<td>$31,603,856</td>
<td>$20,019,000</td>
<td>$55,754,538</td>
<td>$107,377,394</td>
</tr>
</tbody>
</table>


<table>
<thead>
<tr>
<th>University Name</th>
<th>Capital Outlay</th>
<th>Engineering Outlay</th>
<th>Total Outlay</th>
<th>Bonded Outlay</th>
</tr>
</thead>
<tbody>
<tr>
<td>California State University, Dominguez Hills</td>
<td>$31,843,563</td>
<td>$18,312,000</td>
<td>$55,915,410</td>
<td>$106,070,973</td>
</tr>
<tr>
<td>California State University, East Bay</td>
<td>$24,243,652</td>
<td>$14,394,000</td>
<td>$42,929,208</td>
<td>$81,566,860</td>
</tr>
<tr>
<td>California State University, Fresno</td>
<td>$52,725,317</td>
<td>$32,557,000</td>
<td>$92,926,594</td>
<td>$178,208,911</td>
</tr>
<tr>
<td>California State University, Fullerton</td>
<td>$67,736,949</td>
<td>$41,088,000</td>
<td>$120,859,884</td>
<td>$229,684,833</td>
</tr>
<tr>
<td>California State University, Long Beach</td>
<td>$67,421,424</td>
<td>$41,202,000</td>
<td>$119,508,329</td>
<td>$228,131,753</td>
</tr>
<tr>
<td>California State University, Los Angeles</td>
<td>$61,905,561</td>
<td>$40,067,000</td>
<td>$108,543,672</td>
<td>$210,516,233</td>
</tr>
<tr>
<td>California State University, Monterey Bay</td>
<td>$13,455,716</td>
<td>$8,705,000</td>
<td>$23,922,768</td>
<td>$46,083,484</td>
</tr>
<tr>
<td>California State University, Northridge</td>
<td>$74,004,088</td>
<td>$47,458,000</td>
<td>$131,021,450</td>
<td>$252,483,538</td>
</tr>
<tr>
<td>California State University, San Bernardino</td>
<td>$42,438,131</td>
<td>$27,924,000</td>
<td>$74,982,459</td>
<td>$145,344,590</td>
</tr>
<tr>
<td>California State University, San Marcos</td>
<td>$26,602,684</td>
<td>$15,542,000</td>
<td>$46,496,808</td>
<td>$88,641,492</td>
</tr>
<tr>
<td>California State University, Stanislaus</td>
<td>$22,007,207</td>
<td>$12,928,000</td>
<td>$38,636,391</td>
<td>$73,571,598</td>
</tr>
<tr>
<td>Humboldt State University</td>
<td>$16,130,016</td>
<td>$11,146,000</td>
<td>$28,831,619</td>
<td>$56,107,635</td>
</tr>
<tr>
<td>San Diego State University</td>
<td>$45,914,127</td>
<td>$30,394,000</td>
<td>$80,592,385</td>
<td>$156,900,512</td>
</tr>
<tr>
<td>San Francisco State University</td>
<td>$47,404,409</td>
<td>$30,000,000</td>
<td>$83,075,470</td>
<td>$160,479,879</td>
</tr>
<tr>
<td>San Jose State University</td>
<td>$46,631,939</td>
<td>$30,977,000</td>
<td>$82,976,130</td>
<td>$160,585,069</td>
</tr>
</tbody>
</table>
Vulnerability Assessment Conclusions

Before the COVID-19 pandemic, populations at all CSU campuses and CSU-affiliated facilities were substantial. Collectively, as of Fall 2019, CPSU – Pomona had 21,242 students and additional faculty and staff. All were at risk from the communicable disease events, with 534,304 people being directly vulnerable. The COVID-19 pandemic has caused campus population numbers to plummet to a small fraction of full capacity. At some point in the future, campus population numbers will return to their pre-pandemic levels, and students, faculty, and staff will again be vulnerable to the communicable disease hazard. *If just 10% of the total CSU population were to become ill with a highly infective communicable disease like influenza or another strain of SARS, this would mean that approximately 53,430 people would be sick at the same time.* This scenario would likely overwhelm available on-campus medical services could even overwhelm portions of the larger community’s medical resources – especially if there were large numbers of infected people with immune system compromises or other underlying health problems.

See Table 17-14 below for the “10% outbreak scenario” projections both for each CSU campus and for the entire CSU system.

**Table 17-13: Scenario of Communicable Disease Hazard Affecting 10% of the CSU Population**

<table>
<thead>
<tr>
<th>CSU Campus</th>
<th>Approximate Enrollment Population (Fall 2019)</th>
<th>Approximate Total FT/PT Faculty/Staff Population (Fall 2019)</th>
<th>Total Combined Approximate Student and Faculty/Staff Population</th>
<th>10% Outbreak Scenario (Students and Faculty/Staff Combined)</th>
</tr>
</thead>
<tbody>
<tr>
<td>CSU Bakersfield</td>
<td>11,199</td>
<td>1,277</td>
<td>12,476</td>
<td>1,248</td>
</tr>
<tr>
<td>CSU Channel Islands</td>
<td>7,093</td>
<td>994</td>
<td>8,087</td>
<td>809</td>
</tr>
<tr>
<td>Chico State</td>
<td>17,019</td>
<td>1,969</td>
<td>18,988</td>
<td>1,899</td>
</tr>
</tbody>
</table>


<table>
<thead>
<tr>
<th>CSU Campus</th>
<th>Enrollment</th>
<th>Housing</th>
<th>Total Enrollment</th>
<th>Cases</th>
</tr>
</thead>
<tbody>
<tr>
<td>CSU Dominguez Hills</td>
<td>17,027</td>
<td>1,761</td>
<td>18,788</td>
<td>1,879</td>
</tr>
<tr>
<td>Cal State East Bay</td>
<td>14,705</td>
<td>1,764</td>
<td>16,469</td>
<td>1,647</td>
</tr>
<tr>
<td>Fresno State</td>
<td>24,139</td>
<td>2,534</td>
<td>26,673</td>
<td>2,667</td>
</tr>
<tr>
<td>Cal State Fullerton</td>
<td>39,868</td>
<td>3,736</td>
<td>43,604</td>
<td>4,360</td>
</tr>
<tr>
<td>Humboldt State</td>
<td>6,983</td>
<td>1,171</td>
<td>8,154</td>
<td>815</td>
</tr>
<tr>
<td>Cal State Long Beach</td>
<td>38,074</td>
<td>4,004</td>
<td>42,078</td>
<td>4,208</td>
</tr>
<tr>
<td>Cal State LA</td>
<td>26,361</td>
<td>2,821</td>
<td>29,182</td>
<td>2,918</td>
</tr>
<tr>
<td>Cal Maritime</td>
<td>911</td>
<td>329</td>
<td>1,240</td>
<td>124</td>
</tr>
<tr>
<td>CSU Monterey Bay</td>
<td>7,123</td>
<td>1,059</td>
<td>8,182</td>
<td>818</td>
</tr>
<tr>
<td>CSUN (Northridge)</td>
<td>38,391</td>
<td>3,832</td>
<td>42,223</td>
<td>4,222</td>
</tr>
<tr>
<td><strong>Cal Poly Pomona</strong></td>
<td><strong>27,914</strong></td>
<td><strong>2,650</strong></td>
<td><strong>30,564</strong></td>
<td><strong>3,056</strong></td>
</tr>
<tr>
<td>Sacramento State</td>
<td>31,156</td>
<td>3,228</td>
<td>34,384</td>
<td>3,438</td>
</tr>
<tr>
<td>Cal State San Bernardino</td>
<td>20,311</td>
<td>2,118</td>
<td>22,429</td>
<td>2,243</td>
</tr>
<tr>
<td>San Diego State</td>
<td>35,081</td>
<td>3,702</td>
<td>38,783</td>
<td>3,878</td>
</tr>
<tr>
<td>San Francisco State</td>
<td>28,880</td>
<td>3,401</td>
<td>32,281</td>
<td>3,228</td>
</tr>
<tr>
<td>San José State</td>
<td>33,282</td>
<td>3,568</td>
<td>36,850</td>
<td>3,685</td>
</tr>
<tr>
<td>Cal Poly San Luis Obispo</td>
<td>21,242</td>
<td>2,871</td>
<td>24,113</td>
<td>2,411</td>
</tr>
<tr>
<td>CSU San Marcos</td>
<td>14,519</td>
<td>1,687</td>
<td>16,206</td>
<td>1,621</td>
</tr>
<tr>
<td>Sonoma State</td>
<td>8,649</td>
<td>1,338</td>
<td>9,987</td>
<td>999</td>
</tr>
<tr>
<td>Stanislaus State</td>
<td>10,614</td>
<td>1,276</td>
<td>11,890</td>
<td>1,189</td>
</tr>
<tr>
<td>Office of the Chancellor</td>
<td>0</td>
<td>673</td>
<td>673</td>
<td>67</td>
</tr>
<tr>
<td><strong>CSU System-Wide</strong></td>
<td><strong>480,541</strong></td>
<td><strong>53,763</strong></td>
<td><strong>534,304</strong></td>
<td><strong>53,430</strong></td>
</tr>
</tbody>
</table>

*Note: Enrollment figures do not include non-specific CSU campus International Programs (455 students) or CALStateTEACH Program (933 students).*

While the case numbers of COVID-19 have been significantly lower (about 1% of the total CSU population) than those in the 10% scenario, the degree of virulence and resultant morbidity and mortality caused by COVID-19 have led to widespread campus shutdowns, educational disruption, and economic harm to the CSU system (including Cal Poly Pomona). In short, the real-time COVID-19 communicable disease outbreak scenario has proven far more devastating than the 10% simulated scenario.
There is a wealth of technical information available for communicable disease. However, there is also limited non-COVID-19 communicable disease data available regarding risk or vulnerability of specific populations throughout the CSU. Much of the data that does exist is protected by privacy policies, and therefore cannot be obtained for more specific populations. As a result, performing a detailed quantitative assessment for this hazard is difficult.

**Identified Data Limitations**

Data that could be collected prior to the next update in order to improve this methodology includes:

- Data regarding infection rates at the campus level and for specific populations;
- Data regarding communicable disease case numbers and outcomes, by CSU campus;
- Data regarding projected population changes;
- Data regarding absenteeism; and
- Data regarding increased operating costs as a result of absenteeism (i.e., temporary shifting of duties resulting in business interruption).
**Drought**

**Description of the Hazard**

Drought is defined as a condition where moisture levels fall significantly below normal for an extended period of time over a large area that adversely affects plants, animal life, and humans. Drought is a gradual phenomenon. Although droughts are sometimes characterized as emergencies, they differ from typical emergency events. Most natural disasters, such as floods or forest fires, occur relatively rapidly and afford little time for preparing for disaster response. Droughts occur slowly, over a multi-year period, and it is often not obvious or easy to quantify when a drought begins and ends.

Throughout California, one dry year does not normally constitute a drought. California’s extensive system of water supply infrastructure (reservoirs, groundwater basins, and conveyance assets) mitigates the effect of short-term dry periods for most water users. Defining when a drought begins is a function of drought impacts to water users. Drought in one location may not constitute a drought for all water users, as some users in relative proximity may have a different water supply. For example, individual water suppliers may use a combination of sources such as rainfall/runoff, water in storage, or expected supply from a water wholesaler to define their water supply conditions.

Drought can be characterized as one or more of the four following types:

- **Meteorological drought** is defined on the basis of the degree of dryness (in comparison to some “normal” or average amount) and the duration of the dry period. A meteorological drought must be considered as region-specific since the atmospheric conditions that result in deficiencies of precipitation are highly variable from region to region.

- **Hydrological drought** is associated with the effects of periods of precipitation (including snowfall) shortfalls on surface or subsurface water supply (e.g., streamflow, reservoir and lake levels, ground water). The frequency and severity of hydrological drought is often defined on a watershed or river basin scale. Although all droughts originate with a deficiency of precipitation, hydrologists are more concerned with how this deficiency plays out through the hydrologic system. Hydrological droughts are usually out of phase with or lag the occurrence of meteorological and agricultural droughts. It takes longer for precipitation deficiencies to show up in components of the hydrological system such as soil moisture, streamflow, and ground water and reservoir levels. As a result, these impacts are out of phase with impacts in other economic sectors.

- **Agricultural drought** focus is on soil moisture deficiencies, differences between actual and potential evaporation, reduced ground water or reservoir levels, and so forth. Plant water demand depends on prevailing weather conditions, biological characteristics of the specific plant, its stage of growth, and the physical and biological properties of the soil.
- **Socioeconomic drought** refers to when physical water shortage begins to affect health, well-being, and quality of life of people, or when the drought starts to affect the supply and demand of an economic product that relies on water.

The drought issue in California is further compounded by water rights. The central challenge is how to prioritize water usage among a broad variety of contexts. It is for this reason that water is a commodity possessed and utilized under a variety of legal doctrines. As such, many competing sets of interests create a dynamic prioritization process between, for example, farming and federally protected fish habitats and water supply for municipal/public use (including usage for Cal Poly Pomona) versus water usage for wildfire abatement or natural resource protection.

**Location of the Hazard**

Drought conditions have been identified in Los Angeles County and the city of Pomona where Cal Poly Pomona is located. Drought is not a location-specific hazard and affects the entire planning area equally. Drought location is not isolated to each campus footprint but occurs as a geographic sub-set of drought conditions occurring at larger scales. From 2000-2020, drought conditions existed continuously somewhere in the state, with 80-100% of the state impacted for 12 of the last 20 years. 31

**Extent of the Hazard**

Given the historical occurrence of severe drought impacts throughout Los Angeles County which surrounds the planning area and the potential future impact exacerbated by climate change, the CSU Planning Committee recognizes that drought will continue to pose a high degree of risk statewide, potentially impacting crops, livestock, water resources, the natural environment at large, buildings and infrastructure (from land subsidence), and local economies.

In addition, although drought affects the entire CSU system-wide planning area, the potential impacts may be variable and specific to each campus/jurisdiction, depending on contextual factors such as the degree of assets and activities, historically impacted by drought within each jurisdiction. CPSU Pomona maintains access to 4 water wells and reclaimed water for irrigation, and the extent of drought on campus is low.

In addition, land subsidence has occurred statewide and will continue in areas where the groundwater basin has been subject to overdraft and long-term recharge is inadequate to maintain the water table elevation, leaving underground voids. Subsidence levels have been measured up to 30-feet in California with subsidence bowls covering hundreds of square miles. As such, drought-related subsidence may result in serious structural damage to buildings, roads, irrigation ditches, underground utilities, and pipelines. These effects have not occurred on campus, but remain issues of concern over the long term.

For Cal Poly Pomona, the extent of the hazard is Low (corresponding to D0-D1 on the extent scale below). However, the campus planning committee recognizes that the potential for more severe conditions exists over the long term and is tied to regional water resource vulnerabilities.

The U.S. Drought Monitor developed tables of impacts reported during past droughts in California in order to depict the extent of drought risk for each level of drought on the U.S. These possible extent conditions for California complement the general impacts column of the U.S. Drought Monitor Classification Scheme.

Table 5-14: Impacts of Drought Levels as Determined by US Drought Monitor

<table>
<thead>
<tr>
<th>Category</th>
<th>Impact</th>
</tr>
</thead>
</table>
| D0       | Soil is dry; irrigation delivery begins early  
Dryland crop germination is stunted  
Active fire season begins  
Winter resort visitation is low; snowpack is minimal |
| D1       | Dryland pasture growth is stunted; producers give supplemental feed to cattle  
Landscaping and gardens need irrigation earlier; wildlife patterns begin to change  
Stock ponds and creeks are lower than usual  
Grazing land is inadequate  
Producers increase water efficiency methods and drought-resistant crops  
Fire season is longer, with high burn intensity, dry fuels, and large fire spatial extent; more fire crews are on staff |
| D2       | Wine country tourism increases; lake- and river-based tourism declines; boat ramps close  
Trees are stressed; plants increase reproductive mechanisms; wildlife diseases increase  
Water temperature increases; programs to divert water to protect fish begin  
River flows decrease; reservoir levels are low and banks are exposed |
| D3       | Livestock need expensive supplemental feed, cattle and horses are sold; little pasture remains, producers find it difficult to maintain organic meat requirements  
Fruit trees bud early; producers begin irrigating in the winter |

<table>
<thead>
<tr>
<th>Federal water is not adequate to meet irrigation contracts; extracting supplemental groundwater is expensive</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dairy operations close</td>
</tr>
<tr>
<td>Marijuana growers illegally tap water out of rivers</td>
</tr>
<tr>
<td>Fire season lasts year-round; fires occur in typically wet parts of state; burn bans are implemented</td>
</tr>
<tr>
<td>Ski and rafting business is low, mountain communities suffer</td>
</tr>
<tr>
<td>Orchard removal and well drilling company business increase; panning for gold increases</td>
</tr>
<tr>
<td>Low river levels impede fish migration and cause lower survival rates</td>
</tr>
<tr>
<td>Wildlife encroach on developed areas; little native food and water is available for bears, which hibernate less</td>
</tr>
<tr>
<td>Water sanitation is a concern, reservoir levels drop significantly, surface water is nearly dry, flows are very low; water theft occurs</td>
</tr>
<tr>
<td>Wells and aquifer levels decrease; homeowners drill new wells</td>
</tr>
<tr>
<td>Water conservation rebate programs increase; water use restrictions are implemented; water transfers increase</td>
</tr>
<tr>
<td>Water is inadequate for agriculture, wildlife, and urban needs; reservoirs are extremely low; hydropower is restricted</td>
</tr>
<tr>
<td>Fields are left fallow; orchards are removed; vegetable yields are low; honey harvest is small</td>
</tr>
<tr>
<td>Fire season is very costly; number of fires and area burned are extensive</td>
</tr>
<tr>
<td>Many recreational activities are affected</td>
</tr>
<tr>
<td>Fish rescue and relocation begins; pine beetle infestation occurs; forest mortality is high; wetlands dry up; survival of native plants and animals is low; fewer wildflowers bloom; wildlife death is widespread; algae blooms appear</td>
</tr>
<tr>
<td>Policy change; agriculture unemployment is high, food aid is needed</td>
</tr>
<tr>
<td>Poor air quality affects health; greenhouse gas emissions increase as hydropower production decreases; West Nile Virus outbreaks rise</td>
</tr>
<tr>
<td>Water shortages are widespread; surface water is depleted; federal irrigation water deliveries are extremely low; junior water rights are curtailed; water prices are extremely high; wells are dry, more and deeper wells are drilled; water quality is poor;</td>
</tr>
</tbody>
</table>
History of the Hazard

Historically, drought has been so prevalent in California that its presence is almost continuous. According to the US Drought Monitor, Time Series Los Angeles County (which encompasses the city of Pomona and the campus) has experienced five periods of drought covering 14 years between 2000 – 2021, including a severe drought from 2012 – 2019.

Figure 17-3: Periods of Drought in Los Angeles County, CA, 2001 – 2021

According to the National Drought Mitigation Center, over 3,500 reports and publications covering 370 drought-related events took place across the state (many of which were statewide events) between 2000-2020. In addition, the National Center for Environmental Information (NCEI) reports more than 500 events statewide during this same time period. These events produced a comprehensive range of impacts to water supply, regulations and allocations to businesses and municipalities, budgets and resources for firefighting, water law and policy, and physical impacts to built and natural environments. As such, data records of previous occurrences can be viewed as separate time and event demarcations for a hazard almost continuously in effect across the state with cascading impact potential.

According to the Department of Water Resources, droughts exceeding three years are relatively common in Southern California, but relatively rare in Northern California - the region is the geographic source of much of the state’s developed water supply. The 1929-34 drought established the criteria commonly used in designing storage capacity and yield of large Northern California reservoirs.


34 NCEI. Storm Events. Retrieved 5.2.2021 from: https://www.ncdc.noaa.gov/stormevents

According to the US Drought Monitor’s time series data, from 2000-2021 (with the exception of a 2–3-month period in 2000 and 2011), some degree of drought conditions has been continuously in effect somewhere in California. In fact, 80% - 100% of the state has been subjected to drought conditions for 12 of the last 20 years, with the most severe drought being the 100% state-wide event from 2012-2017.

Figure 17-4: Periods of Drought in State of California, 2001 – 2021

![California Percent Area](image)

Given the extent of the drought risk in California, the following drought event was selected as an exemplar due to its broad and significant impacts on the state and on Los Angeles County which surrounds the Cal Poly Pomona campus planning area:

2012 – 2017 – Drought produced severe impacts to water wells throughout the state of California, with a high number of wells running dry. Land subsidence due to increased groundwater pumping also occurred in numerous areas of the state such as the San Joaquin and Central Valleys. Crop damage was widespread as well. Water allotments were drastically reduced in many towns and water agencies, with extremely high costs for procuring water. In addition, job loss occurred with many families requiring food supply assistance, and water supply assistance provided to home-owners with dry wells. According to a report released by UC Davis Center for Watershed Sciences, the 2012-2017 period of the California drought cost the state’s agriculture industry about $1 billion in lost revenue, with a total statewide economic cost of the drought calculated to be $2.2 billion. The report says, ‘it is responsible for the greatest water loss ever seen in California agriculture - about one third less than normal”. The report calls the groundwater situation in California "a slow-moving train wreck.” Spring snowpack at Donner Summit reached record low levels in 2014, exceeded in 2015 by a remarkable April 1 snow-water-equivalent value of only 5% of average. Decreased precipitation since contributed to near-record low levels in the Shasta Reservoir. The ongoing drought has

contributed to declines in crop values across the state. For example, crops including cotton, corn silage and barley (the field crop category) fell by 42 percent. 37

Potential Impacts of the Hazard

Drought impacts are wide-reaching and may be economic, environmental, and/or societal. This assessment of its impact recognizes that although historic drought impacts have not been reported for the planning area, potential impacts are a sub-set of larger and inter-connected local and regional droughts, and that the (related) historic impacts provide a sound basis for understanding potential (future) impacts.

The most significant potential impact associated with drought across the Cal Poly Pomona campus planning area is a potential reduction in water availability for the municipal area tied to the campus. Other impacts include crop loss and damage to trees and other natural resources (See Tree Mortality below). The footprint of Cal Poly Pomona to some extent includes these vulnerable resources based on the campus landscape (trees) and the presence (and footprint size) of any agricultural research crops and/or field stations.

As a secondary impact of drought, wildfire is directly attributable to dry atmospheric conditions. Wildfires almost always coincide with drought in California, though not limited to such. 38 However, the wildfire hazard is analyzed separately in this plan. (See wildfire section later in this document).

In reviewing the occurrences of drought for Los Angeles County (surrounding the Cal Poly Pomona), the US Drought Monitor and the National Drought Mitigation Center report that tens of millions of trees died during the (2012-2017) state-wide drought disaster. Though data sources do not provide data for tree mortality specific to Cal Poly Pomona, the broad geographic extent of the impact makes it likely that tree mortality occurred to some degree on the campuses. Due to the lasting and ongoing effects of drought on the landscape, trees will continue to be impacted within the municipalities, counties and regions wherein lies the CSU campus system as long as drought conditions continue.

Given the absence of data, in order for the CSU Committee to assess the impact of tree mortality, it is useful to view it as a risk sub-set to the probability, location, extent, severity and duration of the drought hazard within each campus-located municipality, county and region. Regarding potential impacts, standing dead trees could fall, posing a risk to people, buildings, power lines, roads and other infrastructure. In addition, drought-impacted trees become susceptible to diseases and insect infestations (bark beetle) further adding to the risk of tree mortality and related potential impacts. No data is

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currently available for tree mortality on campus; however, the CSU Planning Team will pursue data on this issue in the future.

As a potential tertiary impact, prolonged and repeated drought conditions over time can produce land subsidence and the risk of damage to building foundations and infrastructure on campus resulting from ground instability and collapse. Land subsidence is defined as the vertical sinking of the land over manmade or natural underground voids. Subsidence is often the direct result of groundwater over-extraction in response to drought conditions, as well as oil and gas extraction. Weight can accelerate the process of subsidence resulting from surface development and infrastructure such as roads and buildings, vibrations from construction blasting and heavy truck or train traffic. For example, the State Water Project’s 444-mile-long California Aqueduct has required repairs such as the raising of canal linings, bridges, and water control structures on the Aqueduct — in the Central Valley a five-mile reach of the Eastside Bypass was impacted by subsidence, and the Department of Water Resources estimated that it may cost in the range of $250 million to acquire flowage easements and levee improvements to restore the design capacity of the subsided area. 39

At present, drought related damage to campus buildings and infrastructure at Cal Poly Pomona has not been reported, but the potential for such impacts is possible. With regard to overall potential impact, water supply/availability for Cal Poly Pomona is ultimately tied to broader inter-dependent, and more intensive modes of water use at local and regional scales such as agriculture and ranching, wildfire protection, larger metropolitan/municipal usage, manufacturing and commerce, tourism, recreation, and wildlife preservation. During drought periods, the State of California’s regulated water allocations are modified and often reduced, which can result in reduced water availability for all usage contexts, including Cal Poly Pomona. A reduction of electric power generation and water quality deterioration are also potential impact factors.

Table 17-15: Summary of Drought Impacts on Water Resources40

<table>
<thead>
<tr>
<th>Resource</th>
<th>Type of Impact</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sea Level</td>
<td>Direct</td>
<td>Sea level is rising and will likely impact coastal areas</td>
</tr>
<tr>
<td>Soil Moisture</td>
<td>Direct</td>
<td>Prolonged dry seasons can lead to decreases in soil moisture; drier vegetation</td>
</tr>
</tbody>
</table>


<table>
<thead>
<tr>
<th><strong>Vegetation</strong></th>
<th><strong>Indirect</strong></th>
<th>Longer and more intense fire season with increased extent of area burned</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Stream Conditions</strong></td>
<td><strong>Direct</strong></td>
<td>Increases in water temperature; potential effects on fish</td>
</tr>
<tr>
<td><strong>Snowpack</strong></td>
<td><strong>Indirect</strong></td>
<td>Increases in temperature will lead to decreases in snowpack</td>
</tr>
<tr>
<td><strong>Runoff</strong></td>
<td><strong>Direct</strong></td>
<td>Warmer temperatures are likely to lead to a shift in peak runoff from spring to winter and a likely decrease in summer base flow</td>
</tr>
<tr>
<td><strong>Hydropower</strong></td>
<td><strong>Indirect</strong></td>
<td>Decreased summer flows resulting from earlier snowmelt and a shift in peak runoff could affect hydropower generation during summer months</td>
</tr>
<tr>
<td><strong>Precipitation</strong></td>
<td><strong>Direct</strong></td>
<td>Warmer winter temperatures will result in a greater percentage of precipitation falling as rain rather than as snow</td>
</tr>
<tr>
<td><strong>Groundwater</strong></td>
<td><strong>Indirect</strong></td>
<td>Reduction in snowpack and extended periods of drought are likely to increase dependency on groundwater</td>
</tr>
</tbody>
</table>

**Probability of Future Occurrence of the Hazard**

**Highly Likely** — The US Drought Monitor’s time series data (2000-2020) indicates that some degree of drought has nearly a 100% probability of occurrence somewhere in the state in any given year. Given that Cal Poly Pomona lies within a drought impacted region, it is prudent to extend this likelihood of occurrence to the planning area. 41

**Vulnerability to the Hazard**

In California, rising temperatures are projected to increase the average lowest elevation at which snow falls, reducing water storage in the snowpack, particularly at those lower mountain elevations which are now on the margins of reliable snowpack accumulation. Higher spring temperatures will also result in earlier melting of the snowpack. The shift in snow melt to earlier in the season is critical for California’s water supply because flood control rules require that water be allowed to flow downstream and that water cannot be stored in reservoirs for use in the dry season. As such, state-level drought risk factors that have led to drought’s state-wide severity and extent, and potential impacts also create drought vulnerabilities at the level of the Cal Poly Pomona campus.

Moreover, climate change will likely adversely impact the vulnerability of watersheds and ecosystems in their ability to deliver important ecosystem services. These changes may limit the natural capacity of healthy forests to capture water and regulate stream flows. Sierra Nevada mountain winters and springs are warming, and on average, precipitation as snowfall relative to rain is decreasing. A warming climate with reduced snowpack will result in earlier snowmelt and will subsequently reduce downstream water availability during summer and early fall.

As such, the state and the Cal Poly Pomona planning area stakeholders potentially have less capacity to address future drought risks due to projected temperature increases and shortages in water; ground-water withdrawals have been occurring at a deficit rate of 1 – 2 million acre-feet per year, where the impacts of drought include decreased availability of water for agriculture and environmental uses. In forested and other vegetated areas, prolonged drought decreases the moisture content of forest fuels and increases the risk of high severity wildfires.

It should be pointed out that California is the single most productive agricultural state and its agricultural industry relies heavily on reservoir water supplied by snowmelt and rainfall runoff. Yearly variations in snowpack depths have implications for water availability as snowmelt from the winter snowpack feeds a network of reservoirs. Spring snowpack at Donner Summit reached record low levels in 2014, exceeded in 2015 by a remarkable April 1 snow-water-equivalent value of only 5% of average. Decreased precipitation since 2011 has contributed to near-record low levels in the Shasta Reservoir.

**Vulnerability of Populations**

Drought vulnerabilities for California’s population include agricultural sector job loss, secondary economic losses to local businesses and public recreational resources, increased cost to local and state government for large-scale water acquisition and delivery, and water rationing and water wells running dry for individuals and families. As drought is often accompanied by prolonged periods of extreme heat, negative health impacts such as dehydration can also occur, where children and elderly are most susceptible. Air quality often declines in times of drought which can affect those with respiratory ailments. These same vulnerability measures apply to the students, faculty and staff of the Cal Poly Pomona campus.

**Property Vulnerability**

Drought vulnerabilities include crop loss, injury and death of livestock and pets, and damage to infrastructure, homes and other buildings resulting from the secondary drought impact of land subsidence. The related drought impacts of tree mortality and

land subsidence pose risks to vulnerable critical infrastructure and property. These same vulnerability measures apply to the properties of the Cal Poly Pomona campus.

**Natural Environment Vulnerability**

Drought vulnerabilities for the natural environment on campus are primarily flora and landscaping. Statewide, vulnerabilities are widespread throughout public and private lands within the state, including tree mortality, impacts to all flora and fauna, and destabilization (subsidence) of land along streams and rivers, and within watersheds.

The core issue shaping drought vulnerabilities throughout California is water supply and demand. Several factors play into the issue including groundwater basins, surface water run-off, public and agricultural demand, and surface water storage water sheds. A USGS led analysis was first conducted in 2010 through the Forest and Rangeland Assessment and ongoing through the USGS Forest and Rangeland Ecosystem Science Center to identify threats and assets where water supply would benefit from environmental management designed to protect or enhance water resources, the key effort which, in part, both defines and mitigates the severity of drought risk and vulnerabilities.

With regard to overall threat and asset findings shaping the potential severity of drought, the watersheds in the Sierra region contribute most greatly to the state’s water supply, but are under threat from climate change, wildfire and development. In addition, groundwater basins in the San Joaquin Valley and Sacramento Valley bioregions are an abundant resource that is heavily threatened by over pumping. 43

**Critical Facilities Vulnerabilities**

Drought vulnerabilities for Cal Poly Pomona’s critical facilities include water shortfalls for facility operations and critical functions, and potential structural destabilization and damage resulting from land subsidence.

**Estimate of Potential Losses**

An estimate of potential losses from drought has not been calculated for the campus or the CSU system as a whole. However, drought related losses to the City of Pomona and the surrounding region such as crop loss and cost increases for water resources have re-occurred over time. Please consult city and county level government, and/or state agricultural agencies for data on the financial impacts from drought.

**Vulnerability Conclusions**

43 USGS. Forest and Rangeland Ecosystem Science Center. Retrieved 5.4.2021 from: https://www.usgs.gov/centers/fresc
The CSU Planning Committee understands that the high degree of vulnerability posed by drought will be exacerbated by greater climate variation in the future and therefore greater variation and uncertainty regarding the availability of water supplies which are already under tremendous stress. In response to such vulnerability, state legislation passed in 2014 requires local governments to regulate pumping and recharge to better manage groundwater supplies, and groundwater-dependent regions are required to halt overdraft and bring basins into sustainable levels of pumping and recharge by the early 2040s. That said, the Committee will continue to work with local, regional and state partners and stakeholders to explore solutions for mitigating the drought hazard on its campuses by accessing the best available data and resources on climate change and its relationship to drought.

Identified Data Limitations

Data is limited concerning campus-related agricultural assets as well as data on campus tree mortality.

*Earthquake*

Description of the Hazard

An earthquake is a sudden motion or shaking caused by the release of pressure accumulated along the edge of tectonic plates covering the earth. These huge plates are constantly moving and move ever so slowly under, over, or by passing one another. This movement is gradual however the plates may lock together accumulating enormous amounts of energy. When this energy builds, stress develops, and the adjoining plates will eventually break free and result in ground shaking – an earthquake.

Large earthquakes may result in fissuring, ground settlement, and/or vertical or horizontal displacement. Earthquakes occur without warning and can result in extensive damages and human casualties. Damages associated to earthquake generated ground shaking is normally confined to a narrow area along fault trend from the earthquake epicenter. However, seismic waves may generate ground shaking resulting in damages in areas outside of the fault trend.

**Fault Rupture** – The rupture of faults is the differential movement of the two sides of the earth’s plates at the point of the fault. Horizontal or vertical displacement may be significant and occur over great distances. The movement and energy that occurs along a fault is released in waves resulting in ground shaking. The intensity of ground shaking varies based on the magnitude of the earthquake, the proximity to the earthquake epicenter, the composition of the ground sediment or rock the waves travel through, and the depth of the earthquake.

**Liquefaction** – In addition to the primary fault rupture that occurs right along a fault during an earthquake, the ground many miles away can also fail during intense shaking. As seismic waves travel through saturated granular soil; the soil begins to liquefy and act
as a fluid. Soil strength and stability is lost causing the effects of ground shaking to intensify and for ground deformation to occur. These water saturated soils when shaken quickly lose the ability to support buildings, bridges, utilities, and other structures. Areas susceptible to liquefaction include places where sandy sediments have been deposited by rivers along their course or by wave action along beaches. The greater the magnitude of an earthquake and longer duration of strong ground shaking will result in an enhanced potential for liquefaction to occur. Settlement can cause damage when the amount settlement varies significantly across the length of a structure. Lateral spreading occurs when liquefaction occurs on gently sloping ground and the liquefied material at depth allows the area to slide, often toward a vertical discontinuity or “free face” such as a creek or stream channel. Liquefaction can occur in susceptible soils below bodies of water, and settlement and lateral spreading can damage structures built on or adjacent to these areas. Transportation bridges across water bodies, wharves, piers and other structures at ports and harbors, and underwater utility lines can be severely damaged by this hidden hazard.

**Subsidence** - Changes in the local environment that cause subsidence or sinkholes are called triggering mechanisms. Water is the primary factor that affects the local environment and causes subsidence. Water level decline, changes in groundwater flow, increased loading, and deterioration (such as abandoned mines) are all triggering mechanisms. Water level decline may occur naturally, or it may be the result of human action. Factors that lead to water decline are pumping (from wells), localized drainage (for construction activities), dewatering, or drought. Changes in groundwater flow can result from an increase in the velocity of groundwater movement, and increase in the frequency of water table fluctuations, and changes in discharge (either increase or decrease). Increased loading can cause pressure in the soil, leading to the failure of underground cavities and space, such as caves. Vibrations from earthquakes, heavy machinery, and blasting may result in structural collapse, followed by surface resettlement.

**Location of the Hazard**

The State of California is particularly vulnerable to earthquake activity due to California’s location residing between two large tectonic plates. Cal Poly Pomona is located in the San Gabriel Valley of eastern Los Angeles County. In general, fault systems surround and traverse through Los Angeles and Orange Counties including the area of Cal Poly Pomona. Throughout the basin the ground is saturated with sediment eroded from the mountains and foothills via multiple stream and river channels and resulting in liquefaction zones scattered across the region.

The Pacific Plate and the North American Plate come together at the San Andreas Fault 20-25 miles northeast of the Cal Poly Pomona campus. In addition to the San Andreas Fault, Los Angeles County is home to or near additional fault systems with the potential to generate strong ground shaking. The Elysian Park Fault extends across the southern boundary of the campus in an east to west direction. The Hollywood-Raymond Fault is another east to west fault 3 ½ miles north of the campus connecting Arcadia and Beverly Hills. The Puente Hills Fault extends from the southern base of the Puente Hills to
downtown Los Angeles approximately 5 miles southwest of the campus. The Newport-Inglewood Fault traverses south to north paralleling the Orange County coastline extending 12 miles southwest of the Cal Poly Pomona campus. The Verdugo Fault extends from South Pasadena northwest to San Fernando 5 miles to the north of the campus. There are numerous additional faults in the area on all sides of the campus.

Figure 17-5: Fault Lines in Proximity to Cal Poly Pomona

The Cal Poly Pomona campus is located within areas designated to be liquefaction zones. All campus facilities are located within the liquefaction zone or areas where liquefaction zones overlap with areas prone to landslides. Additionally, substantial areas of the community surrounding the campus reside within the liquefaction zones including access routes into and out of the campus. This includes Interstate 10, State Route 57, State Route 60, Valley Blvd., and the Union Pacific Railroad. The liquefaction zone generally follows the path of the San Jose and Diamond Bar Creeks.
Extent of the Hazard

The extent or severity of earthquake damage is expressed in terms of magnitude and intensity. The amount of energy released during an earthquake is normally conveyed as a magnitude measured from a seismogram. Magnitude is expressed in numbers and decimals representing the physical size of the earthquake. The strength and effect of the shaking on the surface of the earth is classified as the intensity. Intensity is further defined from the effects the earthquake has on people, structures, and the natural environment. The intensity of an earthquake in terms of measuring magnitude and evaluating its effects is generally expressed using the Modified Mercalli (MM) Intensity Scale. Duration is the length of time the earthquake’s energy is released.

The Richter magnitude scale was developed in 1935 by Charles F. Richter of the California Institute of Technology as a mathematical device to compare the size of earthquakes. The

Richter Scale is the best-known scale for measuring the magnitude of earthquakes. The magnitude value is proportional to the logarithm of the amplitude of the strongest wave during an earthquake. A recording of 7, for example, indicates a disturbance with ground motion 10 times as large as a recording of 6. The energy released by an earthquake increases by a factor of 31 for every unit increase in the Richter scale.

Table 17-16: Earthquake Intensity and Frequency Comparisons

<table>
<thead>
<tr>
<th>Magnitude</th>
<th>Mercalli Intensity</th>
<th>Potential Damage</th>
<th>Global Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 2.0</td>
<td>I</td>
<td>None</td>
<td>Continually</td>
</tr>
<tr>
<td>2.0 - 2.9</td>
<td>I to II</td>
<td>None</td>
<td>&gt; IM per year</td>
</tr>
<tr>
<td>3.0 - 3.9</td>
<td>II to IV</td>
<td>Light</td>
<td>&gt; 100,000 per year</td>
</tr>
<tr>
<td>4.0 - 4.9</td>
<td>IV to VII</td>
<td>Light</td>
<td>10K to 15 K per year</td>
</tr>
<tr>
<td>5.0 - 5.9</td>
<td>VI to VII</td>
<td>Moderate</td>
<td>1K to 1,500 per year</td>
</tr>
<tr>
<td>6.0 - 6.9</td>
<td>VII to X</td>
<td>Heavy</td>
<td>100 to 150 per year</td>
</tr>
<tr>
<td>7.0 - 7.9</td>
<td>VII &lt;</td>
<td>Very Heavy</td>
<td>10 - 20 per year</td>
</tr>
<tr>
<td>8.0 - 8.9</td>
<td>VII &lt;</td>
<td>Very Heavy</td>
<td>1 per year</td>
</tr>
<tr>
<td>&gt; 9.0</td>
<td>VII &lt;</td>
<td></td>
<td>1 per 10-50 years</td>
</tr>
</tbody>
</table>

The Modified Mercalli Intensity Scale provides descriptive values of earthquake intensity that may provide greater meaning to the broader population as the description of intensity refers to the effects actually experienced. This scale uses an arbitrary ranking based on observed earthquake effects. The scale is composed of increasing levels of intensity ranging from shaking that is not recognizable to intense shaking resulting in catastrophic damages and casualties. The Modified Mercalli Intensity Scale is demonstrated below:
<table>
<thead>
<tr>
<th>Intensity</th>
<th>Shaking</th>
<th>Description / Damage</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Not felt</td>
<td>Not felt except by a very few under especially favorable conditions.</td>
</tr>
<tr>
<td>II</td>
<td>Weak</td>
<td>Felt only by a few persons at rest, especially on upper floors of buildings.</td>
</tr>
<tr>
<td>III</td>
<td>Weak</td>
<td>Felt quite noticeably by persons indoors, especially on upper floors of buildings. Many people do not recognize it as an earthquake. Standing motor cars may rock slightly. Vibrations similar to the passing of a truck. Duration estimated.</td>
</tr>
<tr>
<td>IV</td>
<td>Light</td>
<td>Felt indoors by many, outdoors by few during the day. At night, some awakened. Dishes, windows, doors disturbed; walls make cracking sound. Sensation like heavy truck striking building. Standing motor cars rocked noticeably.</td>
</tr>
<tr>
<td>V</td>
<td>Moderate</td>
<td>Felt by nearly everyone; many awakened. Some dishes, windows broken. Unstable objects overturned. Pendulum clocks may stop.</td>
</tr>
<tr>
<td>VI</td>
<td>Strong</td>
<td>Felt by all, many frightened. Some heavy furniture moved; a few instances of fallen plaster. Damage slight.</td>
</tr>
<tr>
<td>VII</td>
<td>Very strong</td>
<td>Damage negligible in buildings of good design and construction; slight to moderate in well-built ordinary structures; considerable damage in poorly built or badly designed structures; some chimneys broken.</td>
</tr>
<tr>
<td>VIII</td>
<td>Severe</td>
<td>Damage slight in specially designed structures; considerable damage in ordinary substantial buildings with partial collapse. Damage great in poorly built structures. Fall of chimneys, factory stacks, columns, monuments, walls. Heavy furniture overturned.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Intensity</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>IX</td>
<td>Violent</td>
</tr>
<tr>
<td></td>
<td>Damage considerable in specially designed structures; well-designed frame structures thrown out of plumb. Damage great in substantial buildings, with partial collapse. Buildings shifted off foundations.</td>
</tr>
<tr>
<td>X</td>
<td>Extreme</td>
</tr>
<tr>
<td></td>
<td>Some well-built wooden structures destroyed; most masonry and frame structures destroyed with foundations. Rails bent.</td>
</tr>
</tbody>
</table>

The graph below illustrates the increasing intensity of energy that is released and as the measured magnitude increases. While each whole number increase in magnitude represents a tenfold increase in the measured amplitude, it represents an increasing rate of 32 times more energy released in the same increase in magnitude. As the magnitude of an earthquake is measured higher, the intensity of the earthquake worsens progressively from one category to the next.

Figure 17-7: Earthquake Magnitude and Equivalent Energy Release

The Cal Poly Pomona campus is located within areas designated to be liquefaction zones. All campus facilities are located within the liquefaction zone or areas where liquefaction zones overlap with areas prone to landslides. Fourteen fault systems traverse the areas surrounding the campus. In addition, numerous severe and even catastrophic events have taken place in the region. Based on these factors, the planning committee ranks the extent of the hazard for the campus as **High.**

**History of the Hazard**

The State of California has a long history of chronic and destructive earthquakes throughout the state. On average, earthquakes strong enough to result in structural damages occur three to four times a year in California, while earthquakes Magnitude 6.0 to 6.9 occur once every two to three years. Los Angeles County also has a long history of earthquake activity. The entire area of the Los Angeles Basin is at risk to seismic activity and has a history of significant earthquakes resulting in damages.

<table>
<thead>
<tr>
<th>Date</th>
<th>Location</th>
<th>Magnitude</th>
<th>Damages</th>
</tr>
</thead>
<tbody>
<tr>
<td>12/8/1812</td>
<td>San Juan Capistrano</td>
<td>7.5</td>
<td>120 fatalities, $40 million</td>
</tr>
<tr>
<td>3/10/1933</td>
<td>Long Beach</td>
<td>6.4</td>
<td>120 fatalities, $40 million</td>
</tr>
<tr>
<td>2/9/1971</td>
<td>San Fernando</td>
<td>6.6</td>
<td>58-65 fatalities, $553 million</td>
</tr>
<tr>
<td>10/1/1987</td>
<td>Whittier</td>
<td>5.9</td>
<td>8 fatalities, $358 million</td>
</tr>
<tr>
<td>2/28/1990</td>
<td>Upland</td>
<td>5.7</td>
<td>30 injuries, $12.7 million</td>
</tr>
<tr>
<td>6/28/1991</td>
<td>Sierra Madre</td>
<td>5.6</td>
<td>1 fatality, $40 million</td>
</tr>
<tr>
<td>6/28/1992</td>
<td>Landers</td>
<td>7.3</td>
<td>3 fatalities, $92 million</td>
</tr>
<tr>
<td>1/17/1994</td>
<td>Northridge</td>
<td>6.7</td>
<td>57 fatalities, $40 billion</td>
</tr>
<tr>
<td>7/29/2008</td>
<td>Chino Hills</td>
<td>5.5</td>
<td>Minor</td>
</tr>
<tr>
<td>3/28/2014</td>
<td>La Habra</td>
<td>5.1</td>
<td>$10 million</td>
</tr>
</tbody>
</table>

The January 9, 1994 Northridge Earthquake became the costliest seismic event in California history. The earthquake caused extensive damage to structures, the transportation infrastructure, utility systems, water storage, communications, and critical facilities. This level of damage due to the fault that ruptured was directly underneath a densely populated urban area. The Northridge Earthquake was found to raise the nearby mountains by as much as 70 centimeters. The earthquake was provided a federal disaster declaration (DR-1008).

The October 1, 1987 Whittier Narrows Earthquake shook a large part of southern California. The earthquake caused $358 million in damages, especially in the Alhambra, Pasadena, and Whittier areas. The earthquake resulted in extensive infrastructure...
damages, multiple injuries, and 8 fatalities. The earthquake was provided a federal disaster declaration (DR-799).

The February 9, 1971 Magnitude 6.5 San Fernando Earthquake struck the San Fernando Valley in Los Angeles just after 6am. The intense shaking caused the collapse of freeway overpasses, hospitals, and other infrastructure. It damaged thousands of homes and businesses, a reservoir, and critical infrastructure. 65 people were killed and 2,000 more were injured. The shaking was felt for 300 miles including in Las Vegas, Nevada. The earthquake was provided a federal disaster declaration (DR-299).

The March 10, 1933 Long Beach Earthquake registered at a Magnitude 6.4 occurred along the Newport-Inglewood Fault. The earthquake resulted in over $50 million in damages, 500 injuries, and 120 fatalities. Unreinforced masonry structures were the source of most of the casualties. 70 schools were destroyed and 120 were damaged. This earthquake promoted statewide standards in building design and construction for schools and other structures to better withstand seismic events.

Potential Impacts of the Hazard

The shaking of the ground from earthquakes can result in building collapse, bridge failure, utility disruptions and other structural collapse. Large earthquakes can additionally cause natural gas lines to break resulting in structure fires. The proximity to the unstable soils on the campus and surrounding the campus presents a potential for liquefaction creating greater ground instability during seismic events. A major earthquake in the Pomona area would likely result in region-wide social disruptions in addition to structural damages. The region-wide structural damages may disrupt lifelines and supply chain routes limiting the campus from effective evacuation routes and receiving necessary supplies or equipment.

Most injuries resulting from earthquakes are from collapsing walls, flying glass, or other objects moved by ground shaking. The lack of warning allows individuals minimal time to react and find areas of safety. A moderate earthquake occurring near Pomona could cause injuries or fatalities to members of the campus community or support networks the campus relies on. These earthquake effects might be aggravated by collateral incidents such as fire, flooding, hazardous material spills, dam/levee compromises, and other cascading events. A catastrophic earthquake near Pomona could result in extensive casualties, expansive structural damages, panic, widespread utility outages, communication failures, and secondary emergencies such as fire. A catastrophic earthquake would certainly affect the broader Los Angeles County region limiting immediate assistance that the campus may normally expect.

Local impacts to the Cal Poly Pomona campus caused by an earthquake could include:

- Damage and secondary fires to industrial buildings to the southeast of campus
- Potential hazardous material releases on and off campus
- Potential liquefaction-based effects to areas of the surrounding neighborhoods to the west
- Potential for liquefaction-based landslides on campus
- Infrastructure damage to freeway system
- Structural damage to bridges
- Damages to rail lines and rail cars ¾ mile to south of campus
- Potential isolation of campus from community
- Potential isolation among on-campus residents
- Structural damage to flood control and drainage systems
- Structural damage to campus academic and support buildings
- Structural damage to residence halls resulting in displaced student populations
- Structural damage to nearby residences and apartment complexes
- Community members arriving on campus for refuge from damaged homes
- Potential landslide or damages to Spadra Landfill across street from campus
- Damages or releases from water storage tanks on hill near Kellogg House
- Damaged university communications, computer systems, and networks
- Damage to facilities securing on-campus animals
- Considerable stress and fear among community
- Closure or reduction of service to campus operations
- Reduction of campus revenue
- Needs for assistance or shared resources from neighboring Mt San Antonio College

Probability of Future Occurrence of the Hazard

The Working Group on California Earthquake Probabilities (WGCEP), a collaboration between the United States Geological Survey (USGS), the Southern California Earthquake Center (SCEC), and the California Geological Survey (CGS) develops Uniform California Earthquake Forecasts (UCERFs) using the best currently available science and technology. The UCERF version 3 provides a three-dimensional view of the likelihood a region in California will experience a Magnitude 6.7 or greater earthquake in the next 30 years. The likelihood for the Los Angeles County fault systems surrounding Pomona is included in the following table.
Based on the earthquake shaking potential in the Los Angeles Basin, the proximity to the above listed fault systems, the probability of seismic ground shaking generating damage is considered Possible.

### Vulnerability to the Hazard

A considerable challenge regarding earthquakes is they generally occur without warning. The fault systems surrounding the region all cross major transportation routes potentially reducing the availability of access and the supply chain. The geographic location of Cal Poly Pomona places the campus in a suburban community near residential, commercial, and industrial areas that is moderately populated. Earthquake effects experienced in the neighboring local community will likely spill over onto the campus.

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48 2019 County of Los Angeles All-Hazards Mitigation Plan, 2019

The known fault systems generating the threat to Pomona generally surround the city and some cross into the city including near the Cal Poly Pomona campus. The closest being the San Jose Fault extending along the northern edge of the campus. The proximity and potential for large earthquake development from these surrounding systems expose significant vulnerabilities. The potential for earthquake damaged structures being left uninhabitable including campus residence halls will result in numerous displaced individuals and households. A lack of earthquake insurance will cause extreme financial burdens on those affected.

Elements of the vulnerability to a major earthquake on the Cal Poly Pomona campus will vary depending on when the earthquake were to strike. The primary basis of vulnerability is based on the population affected and the built environment exposed. In general, newer construction will be more earthquake resistant than older buildings as building codes and construction technology have improved. A locally centered earthquake, even from moderate events, would have the potential for more damaging results when associated with the moderate liquefaction zones of the city. This would particularly be seen with greater damages to unreinforced masonry buildings.

The risk to the campus population will be lessened during periods when classes are not in session or during periods of breaks. Conversely, during the days and hours that classes are in session and staff are at their workplaces, the human vulnerability increases. Generally, people are safer when at home in wood frame structures as earthquakes tend to generate less structural damage to wood construction than in commercial or industrial facilities. The greater number of people on campus at the time of an earthquake will result in more people being exposed to effects from damaged campus facilities or equipment and require greater evacuation assistance. However, in region-wide events this vulnerability may simply shift to the homes and workplaces of members of the campus community and their families.

The aftermath of a major earthquake will likely result in widespread search and rescue operations for trapped and injured individuals. The demand on emergency services will be great, potentially requiring the campus community to be prepared for these scenarios and initiate response actions as needed. There will be needs for emergency medical care, shelter, water, and food for individuals who have been displaced by the earthquake. In earthquakes causing significant damages, there may be a necessity to provide assistance with identification and support to local agencies in mass fatality management.

There may be a need to evacuate members of the campus community from the campus to other locations that are deemed to be safer locations. The Interstate 10 and State Route 57 Interchange is a multi-level interchange residing on an area deemed a liquefaction zone. The potential exists for collapse and a compromise to evacuation, access, and supply routes. Other prime freeway interchanges including the State Routes 57 and 60 interchange and the State Routes 60 and 71 interchanges reside on liquefaction zones.

Certain campus populations will experience greater challenges to a post-earthquake environment. Vulnerable populations including those that rely on specific services,
require electrical power, homeless students, experience disabilities, non-English speakers, those whose age make evacuating difficult, and others will be most affected. These individuals will likely need to navigate through earthquake generated debris, extreme stresses of a disaster, an inability to communicate to or gain access to support networks, and find difficulty in accessing equipment or supplies to aid in a specific need.

Estimate of Potential Losses

Estimates of potential losses will be influenced by a variety of factors. The intensity of the earthquake will determine what scale of damages affecting campus infrastructure, equipment, and other impacted features. Losses will be generated by the physical damages, the loss of revenue, loss of academic research, loss of building contents, and community wide economic reductions.

Based on estimate replacement costs of facilities and structures on campus, the maximum total replacement costs due to earthquake are $355,971,530.

Table 17-20: HAZUS Peak Ground Acceleration Zone (PGA) Estimated Losses

<table>
<thead>
<tr>
<th>PGA Zone Designation</th>
<th>Intensity</th>
<th>No of Buildings</th>
<th>Maximum Replacement Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Extreme</td>
<td>X+</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Violent</td>
<td>IX</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Severe</td>
<td>VIII</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Very Strong</td>
<td>VII</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Strong</td>
<td>VI</td>
<td>222</td>
<td>$355,971,530</td>
</tr>
<tr>
<td>Moderate</td>
<td>V</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Light</td>
<td>IV</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Weak</td>
<td>II-III</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Not Felt</td>
<td>I</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>NA</td>
<td>NA</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>No Building Value Data Provided*</td>
<td>NA</td>
<td>175</td>
<td>Unknown</td>
</tr>
</tbody>
</table>

*Buildings with no value defined are also included in the respective Zones they are found in.

Vulnerability Assessment Conclusions

It is difficult to predict the severity of casualties, property, and cascading impacts generated by future seismic events affecting the greater Los Angeles region and the Cal Poly Pomona campus. Each of the earthquake generated effects will vary widely based on the intensity of the earthquake, location of the epicenter, proximity to people and development, time of day and year, the soil composition under the impacted structures, building construction, among others. In any case, the potential for a major earthquake exists affecting the campus and causing extensive challenges to the Cal Poly Pomona campus and community.
In the event that a major earthquake was to strike along the many fault systems surrounding Pomona, the effects could be significant to the campus community and campus operations. The widespread impacts generated by a major earthquake would extend the effects of casualties, damages, and other impacts to the broader Los Angeles County region creating large-scale regionwide needs for critical assistance and a heavy demand on limited emergency resources. The threat and impacts presented to the campus will be shared with the campus community from their homes and places of work. The campus will likely be required to address critical needs independently during early phases of the disaster.

Vulnerabilities will be seen in the physical infrastructure on the campus and the human population of the campus community. Campus infrastructure is vulnerable to severe shaking particularly in areas where the ground is loose or susceptible to liquefaction. Specifically older buildings, masonry constructed buildings, and other structures susceptible to shaking related damage are the most vulnerable. Communication systems, computer networks, and other electronic systems may be vulnerable when overwhelmed by increased demand during emergencies or by shaking related damages. The people of the campus community are vulnerable to effects of intense shaking in the form of injuries from falling debris, exposure to secondary floods or fires, loss of employment, extreme disaster induced stress, and loss of access to critical services or social contacts.

The campus population are additionally vulnerable to the effects of major ground shaking that are far reaching. The psychological and social impacts a major earthquake will give rise to will potentially harm individuals and cause tremendous fear. The willingness to return indoors may be hampered especially as after-shocks continue. These effects are magnified for populations having specific vulnerabilities or access limitations. Populations having various limitations or specific needs may be vulnerable to reduced or eliminated access to essential services that have been rendered incapable to respond.

**Identified Data Limitations**

Data limitations include missing campus structural replacement costs, and lack of a complete inventory of building construction types to include status of earthquake retrofitting. HAZUS generated analysis is focused on the broader community level versus fine-tuning the analysis to the micro-level for facilities such as a university campus.

**Erosion**

**Description of the Hazard**

The US Geological Survey (USGS) defines erosion as “the process whereby materials of the earth’s crust are loosened, dissolved, or worn away and simultaneously moved from
one place to another”. Erosion may occur in areas of streams and rivers, along bluffs, around immovable objects (such as buildings or bridge abutments), or as a cascading result of other natural hazards, such as earthquakes or wildfires. When erosion occurs along bodies of water, the removal of material causes the shore to move further landward.

Forces such as sea level rise and changes in sediment supply impact erosion gradually and can be difficult to recognize. In contrast, the impacts of short-term events, such as storms and flooding, can be severe and are immediately recognizable.

Location of the Hazard

Erosion is a relatively non-spatial hazard that can occur in any location with conducive soil structure and a source of movement such as water or wind. An area’s potential for erosion is determined by several factors, including rainfall, topography, soil characteristics, and vegetative cover. Streambank and bluff erosion can occur near any riverine area. For the purpose of this campus-level analysis, the erosion hazard poses a consistent risk across all those areas of the campus with erosion-prone characteristics. The northern portion of campus is considered to be exposed to erosion hazards. Additional locations may be identified in the future.

Extent of the Hazard

There is no published scale of severity or extent for this geologic hazard. If conditions are favorable, erosion is likely to occur. Though no occurrences have taken place, the northern portion of campus is considered to be exposed to erosion hazards, and campus leadership monitors such conditions. As such, the planning committee ranks the extent of the hazard as **Low to Moderate**.

History of the Hazard

There are no recorded incidents of erosion on the Cal Poly Pomona campus, although the northern portion of campus is considered exposed to erosion hazards.

Potential Impacts of the Hazard

Erosion causes instability in soil. During high-intensity rain events, for example, eroded areas will continue to erode, resulting in additional loss of soil and ground stability in the area. This removal of sediment can result in damage to infrastructure, public health, and safety. On campus, areas of erosion can create pedestrian and transportation hazards, and structures may become unsafe if erosion is not controlled.

In agricultural areas, the erosion of soil degrades the quality of the soil, which can lead to reduced crop yields. At the Don B. Huntley College of Agriculture, soil erosion can create significant concerns for agriculture and research. Eroded test plots can negatively impact experiments and tests, resulting in a loss of knowledge and data.

**Probability of Future Occurrence of the Hazard**

Erosion is an on-going and dynamic process that occurs regularly. As climate change induces more frequent and intense weather events, such as wildfires and flooding, erosion may generally become more widespread or severe. These events can cause erosion or exacerbate areas already experiencing erosion. As a result, and in consideration of the potential extent of erosion, the probability of at least a limited degree of erosion taking place somewhere on the campus is **high** over the long term.

**Vulnerability to the Hazard**

Topography, soil structure, land use, and precipitation are all factors of erosion. Cal Poly Pomona infrastructure, buildings, and agriculture located on steep slopes, in areas with little vegetation, or in areas with conducive soil types are more vulnerable to erosion. In the wider Pomona community, erosion vulnerabilities include agricultural sector job loss, degradation of riverine ecosystems, and loss of water quality.

**Estimate of Potential Losses**

The historic and potential impacts of erosion on property statewide include reduced agricultural productivity, lower surface water quality, and damaged drainage networks. Current modeling is not precise enough to allow for an assessment of potential losses to buildings and infrastructure on campus.

**Vulnerability Assessment Conclusions**

While the ability to predict future erosion on the Cal Poly Pomona campus is limited, the core issues shaping erosion vulnerability on campus are flora and landscaping. If left unchecked, erosion can cause significant damage to campus infrastructure and the surrounding environment.

**Identified Data Limitations**

The complex interactions between soil erosion factors make predictive modeling, determination of hazard areas, and quantification of loss difficult. Localized data on this hazard is also limited, resulting in more generalized findings.

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**Extreme Temperatures (Includes Extreme Cold and Extreme Heat)**

**Description of the Hazard (Extreme Heat)**

What is considered an excessively hot temperature varies according to the normal climate for that region. However, when temperatures are extremely high, people are at higher risk for heat-related illnesses, such as dehydration, heat exhaustion, heat stroke, and in severe cases, death.52

Hazards from extreme heat are made worse when high temperatures are accompanied by high levels of humidity, which is defined as the amount of moisture in the air.53 As the temperature climbs, the air is able to hold more moisture. High humidity prevents the human body from cooling down naturally, which leads people to perceive that the temperatures “feel” hotter. The combination of temperature and humidity is known as the heat index.54

Heat stroke, the most serious heat-related illness, occurs when the body is unable to control its temperature. Body temperature rises rapidly, the sweating mechanism fails, and the body cannot cool down.55 In extreme cases, heat stroke can cause confusion and unconsciousness, so the victim is unable to seek treatment without assistance.

There are several groups of people who are uniquely vulnerable to the effects of extreme heat, such as infants and children, older adults aged 65 and up, athletes and outdoor workers, low-income households, and individuals with certain chronic medical conditions.56

**Location of the Hazard**

Extreme heat events are a non-spatial hazard, and may occur at the Cal Poly Pomona campus.

**Extent of the Hazard**

Extreme heat has a wide range of extent and severity markers and characteristics. In the City of Pomona, monthly average maximum temperatures in June through October range


54 Ibid.


approximately from the low 80s to the low 90s. According to data from the National Climatic Data Center (NCDC), the highest daily temperature recorded in the City of Pomona was 113°F on July 22, 2006. Given 2 additional extreme heat events resulting in the deaths of eight people and extended power outages, the planning committee ranks the extent of the hazard as **Moderate to High**.

The National Weather Service issues a Heat Advisory when the heat index value is expected to reach 100° – 104°F within the next 12 to 24 hours. Excessive Heat Warnings are issued when there is an anticipated heat index of 105°F or greater that will last for two (2) or more hours. Excessive Heat Warnings are issued by the county when any location in the county is expected to reach those criteria. In anticipation of an Excessive Heat Warning, an Excessive Heat Watch may be issued 1 to 2 days in advance, when the Heat Warning criteria is 50 – 79% likely to occur.

Figure 17-8 (following) depicts the National Weather Service’s methodology for determining the heat index, using the % humidity and the actual temperature.

As the heat index rises, so does the potential danger to people and animals. Table 17- (following) shows the health hazards associated with extreme heat.

**Table 17-21: Health Risks Associated with Heat Index**

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<table>
<thead>
<tr>
<th>Category</th>
<th>Heat Index</th>
<th>Health Hazards</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Extreme Danger</strong></td>
<td>130° F or higher</td>
<td>Heat stroke / sunstroke is likely with continued exposure.</td>
</tr>
<tr>
<td><strong>Danger</strong></td>
<td>105° – 129° F</td>
<td>Sunstroke, heat cramps, and/or heat exhaustion is likely with prolonged exposure and/or physical activity.</td>
</tr>
<tr>
<td><strong>Extreme Caution</strong></td>
<td>90° – 104° F</td>
<td>Sunstroke, heat cramps, and/or heat exhaustion is possible with prolonged exposure and/or physical activity.</td>
</tr>
<tr>
<td><strong>Caution</strong></td>
<td>80° – 89° F</td>
<td>Fatigue is possible with prolonged exposure and/or physical activity.</td>
</tr>
</tbody>
</table>

History of the Hazard

Based on data gathered from the National Centers for Environmental Information (NCEI) Storm Events Database, along with the 113 degree event in Pomona in 2006, there have been five excessive heat events in Los Angeles County (home to Cal Poly Pomona) since 1950, but all taking place from 2007 to the present. These events were consolidated within two periods in 2007 and 2008.

**August 30, 2007; September 1, 2007; September 3, 2007:** A combination of high temperatures and high humidity produced an extreme heat event across Los Angeles County and much of Southern California. Heat index values ranged from 105° to 112° F. *Eight deaths were attributable to this excessive heat event.*

**June 20, 2008; June 21, 2008:** Afternoon high temperatures during this extreme heat event climbed as high as 114° F. The heat resulted in several power outages due to excessive electrical use.

Potential Impacts of the Hazard

Cal Poly Pomona may experience impacts from extreme heat due to cancelled classes or postponed outdoor events in order to protect students, faculty, and staff from the weather.

In addition to the threat extreme heat poses to humans, high temperatures also pose a threat to utility production, which in turn threaten facilities and operations that rely on utilities. As temperatures rise, more people stay indoors, increasing the demand for air conditioning, fans, and other electronics. This puts a strain on the electrical grid, which can cause temporary outages. These outages can impact operations throughout campus, resulting in interruptions and delays in service. Outages may also negatively impact research efforts on campus, as the inability to maintain a steady, constant temperature may impact research specimens and experimental results.

Probability of Future Occurrence of the Hazard
There have been no extreme heat events in the City of Pomona or Los Angeles County in over a decade. Therefore, using the scale provided, it is only **Possible** that the hazard will occur annually. It is also important to note that Los Angeles County considers extreme heat as a hazard, but only as one small part of a larger discussion regarding the effects of climate change.59

**Vulnerability to the Hazard**

When dealing with an extreme heat event, the most common impacts are those generally felt by the people living in the targeted area. For people in particular, heat can kill when the body is pushed beyond its limits. Most heat disorders occur because the victim has been overexposed to heat. As discussed, the major human risks associated with extreme heat include dehydration, sunburn, fatigue, heat exhaustion, heat stroke, and in severe cases, death.

Some portions of the population are more at risk to the effects of extreme heat. The very young, the elderly, and certain groups with chronic medical conditions (such as asthma or other pulmonary illnesses, heart disease, poor blood circulation, neurological illnesses, and obesity) are generally more vulnerable to the effects of extreme heat, and are more likely to suffer illness or death as a result.60 This is especially true if exposure is extended for a period of time and preventative measures are not taken immediately.

Cal Poly Pomona is aware of the potential for extreme heat events. All buildings are air-conditioned and during excessive heat events, the campus will have an ambulance or mobile medical team on alert for students, faculty, or staff who may experience heat-related illness.

The risk of power shut-offs affecting air conditioning is not a concern for the campus. Cal Poly Pomona is identified by Southern California Edison as a university and is therefore last on the utility’s list to be affected during planned black-outs or brown-outs.

Therefore, while this is a hazard that the campus may occasionally experience, the campus has measures in place to handle the risks and vulnerabilities.

59 2019 County of Los Angeles All-Hazards Mitigation Plan. 4.1 Climate Change. Print. Retrieved 01.27.21 from: https://lacounty.gov/emergency/county-of-los-angeles-all-hazards-mitigation-plan/

Estimate of Potential Losses

Based on the previous historical occurrences, annualized losses are considered to be negligible. In an extreme heat event, loss of human life or health impacts are a greater concern than is property damage.

Vulnerability Assessment Conclusions

While the ability to predict future heat events at the Cal Poly Pomona campus is limited, the effects of climate change may provide some information. According to the Environmental Protection Agency (EPA), Southern California has warmed about three degrees on average over the last century, with less rainfall. This may lead to stronger heat events, drought, and an increased risk of wildfires.61

Identified Data Limitations

Numerous public and private actors conduct research, acquire data and disseminate meteorological information and forecasting to the general public, including the CSU university system. Currently, it is assumed that, apart from regular access to climate change models on changes to temperature extremes over time, the CSU community maintains sufficient access to the data needed to plan for, respond to, and mitigate the effects of extreme heat and cold.

**Hazardous Materials**

**Description of the Hazard**

A hazardous material is defined in California’s State Hazardous Materials Incident Contingency Plan (1991) as “a substance or combination of substances which, because of quantity, concentration, physical, chemical, or infectious characteristics may: cause, or significantly contribute to an increase in deaths or serious illnesses; and/or pose a substantial present or potential hazard to humans or the environment.”

Hazardous materials are one or more of the following: flammable, corrosive or an irritant, oxidizing, explosive, toxic (poisonous or infectious), thermally unstable or reactive, or radioactive. Hazardous materials are ubiquitous in modern society and may be found at all stages of production, consumption, and disposal.

Federal and state laws permit the intentional release of some hazardous materials into the environment such that the risk to human health and the environment is thought to be acceptable. However, sometimes releases are unintentional, resulting from leaks, accidents, or natural hazards. This section focuses on such accidental releases and fall into the following key categories:

**Fixed Hazardous Materials Incident:** A fixed hazardous materials incident is the accidental release of chemical substances or mixtures during production or handling at a fixed facility.

**Transportation Hazardous Materials Incident:** A transportation hazardous materials incident is the accidental release of chemical substances or mixtures during highway, waterway or air transport. Populations, built and natural environments are potentially impacted.

**Pipeline Incident:** A pipeline transportation incident occurs when a break in a pipeline creates the potential for an explosion or leak of a dangerous substance (oil, gas, etc.) possibly requiring evacuation. An underground pipeline incident can be caused by environmental disruption, accidental damage, or sabotage. Incidents can range from a small, slow leak to a large rupture where an explosion is possible. Inspection and maintenance of the pipeline system along with marked gas line locations and an early warning and response procedure can lessen the risk to those near the pipelines.

Hazardous materials can also be classified according to worker safety and health.

Information provided by California Division of Safety and Health includes guidelines related to:


• **Safety hazards**: fire and fire byproducts, electricity, flammable gases, unstable structures, demolition, sharp or flying objects, excavations)

• **Health hazards**: carbon monoxide ash, soot and dust; asbestos; hazardous liquids; other hazardous substances; heat illness)

**Natural-Technological Incidents (Natechs)**: During the past two decades, increasing attention has been given to hazardous materials releases resulting from Natechs or a natural disaster event that triggers a technological hazard event. Natechs are of particular concern for the following reasons:

- They can produce a simultaneous effect on many industrial facilities
- Can overwhelm response capacity
- Containment systems may fail
- May produce cascading disasters
- Response may be hindered by a disaster’s impact on the physical environment

**Location of the Hazard**

Hazardous materials and infrastructure such as fuel tanks, rail lines, chemicals, hazardous waste sites and gas pipelines to varying degrees are located within the CSU system and/or within its surrounding communities. Please refer to Annex ? for the map identifying the types and locations of hazardous materials and infrastructure on or near the Cal Poly Pomona campus. The planning committee indicates that radioactive materials are located in a building leased to the American Red Cross and chemicals are located in the chemistry lab on campus. At larger scales (beyond the campus planning area) hazardous materials are located throughout the city of Pomona and Los Angeles County, and reflect different types, configurations and scales dispersed across these geographic areas.

**Extent of the Hazard**

There is no comprehensive statewide vulnerability assessment available at this time. As such, the true extent of the hazardous materials risk in California and its communities is not known, meaning no overarching conclusions have been reached which have been able to integrate all qualitative and quantitative risk factors to produce a comprehensive measure of the extent of the hazard.

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However, for the Cal Poly Pomona planning committee, although no hazmat events have taken place on campus, hazardous materials include chemicals in the science building, and radioactive material in a leased building on campus, as well as a rail line running through campus. Based on these factors along with the types and levels of hazardous materials in the larger community, it is prudent to rank the extent of the hazard for the Cal Poly Pomona campus as Moderate to High, and to consider worst case scenarios as the main driver of policy in order to fully mitigate all possible hazardous materials event outcomes.

For example, according to the 2018 CA State Hazard Mitigation Plan, 400 hazardous materials problems are tied to 32 past earthquakes, including over 150 problems from the Loma Prieta Earthquake alone. 67 That said, the plan indicates that it is likely that many such hazardous materials releases have received little attention in the past because public authorities, the media, and the public have overlooked them in the rush to address and recover from immediate disaster threats, and that responsible parties may have an incentive to understate the extent of releases or not to report them at all.

History of the Hazard

According to the CA Governor’s Office of Emergency Services’ Hazardous Materials Spill Report, the state experiences from 10 to 30 spill events daily. As of April 20th, 2021 already 2096 spill events had occurred. Such events have occurred in all the cities and/or counties where CSU campuses are located. 68

According to the 2018 CA State Hazard Mitigation Plan, with regard to natural-technological hazard events (Natechs), 400 hazardous materials events are tied to 32 past earthquakes, including over 150 Natech events from the Loma Prieta Earthquake alone.

No hazmat incidents have taken place on the Cal Poly Pomona campus.

Potential Impacts of the Hazard

A large hazardous materials release could affect an entire community or city under certain conditions related to direction of air flow (air-based chemical release) and population density or the contamination of a community’s main water supply. Either type of release could necessitate large scale evacuation. By contrast, in the rural unincorporated areas where population densities are low, even in the event of a large release, the number of homes that may need to be evacuated would be significantly lower than in an urban environment. The occurrence of a hazmat incident can also result


in the shut-down of transportation corridors which can last for hours at a time while the impacted area is stabilized.

The release of some toxic gases may cause immediate death, disablement, or sickness if absorbed through the skin, injected, ingested, or inhaled. Contaminated water resources become unsafe and unusable, depending on the amount of contaminant. Some chemicals cause painful and damaging burns if they come in direct contact with skin. Prolonged and concentrated exposure to such chemicals can produce severe long-term impacts to respiratory, endocrine and nervous systems, heart and brain health.

The potential impacts of chemicals and toxic gases discussed here also apply to the students, staff and environment on the Cal Poly Pomona campus.

With regard to the natural environment overall, contamination of air, ground, or water may result in harm to fish, wildlife, livestock, and crops. The release of hazardous materials into the environment may cause debilitation, disease, or birth defects over a long period of time. Loss of livestock and crops may lead to economic hardships within the community.

Recent California examples include the 2016 Aliso Canyon methane gas leak69, which caused evacuation of nearby residents, many of whom experienced temporary health problems such as difficulty breathing and eye irritation; and the 2016 Fruitland metal recycle plant fire in Maywood, which released heavy metals such as lead, magnesium, copper, aluminum, antimony, calcium, iron, sulfur, tin, potassium, and zinc which pose severe risks to public health.70 Health effects from exposure to these metals included short-term symptoms such as irritation to the eyes, nose, throat, and lungs.

Potential Impacts of the Hazard (Natechs)

Natural disasters, including earthquake, flood, and fire also pose risks to public health and the environment. For example, following the Northridge Earthquake, California State University (CSU) Northridge laboratories and chemical storage rooms experienced multiple chemical spills. Such incidents, triggered by a natural disaster, pose a significant risk to students, faculty, staff, and first responders. At a minimum, all CSU campuses with a science lab (including Cal Poly Pomona) is at risk of potential impact from a natural-technological (combined impact) event.

In a severe flood event, floodwaters are often contaminated with hazardous materials posing a threat to public and animal health, groundwater, and other parts of the environment. These hazardous materials may be released from damaged or flooded underground tank sites (e.g., gas stations or chemical storage facilities), propane tanks, ______


manure or human waste handling facilities, fertilizer and pesticide storage, agricultural sites, and household hazardous waste.

In a fire event, (such as the October 2017 Northern California firestorms which destroyed approximately 6,000 residences) entire neighborhoods can be burned to the ground. Hazardous material release creates public health concerns which can delay the initial steps of fire recovery, including reopening burned areas to residents and initiating debris removal activities. The post-fire “toxic sweep” poses a risk of coming into contact with toxic substances due to the presence of synthetic and hazardous materials.

Probability of Future Occurrence of the Hazard

The probability of occurrence for a hazmat event on the Cal Poly Pomona campus can be viewed in two different ways: the history of occurrence serves as a sound predictor of future probability assuming current risk and vulnerability factors remain somewhat constant. For the purposes of the current estimate, no current data clearly indicates otherwise. As such, the probability of occurrence is Low because the Cal Poly Pomona campus has not experienced hazmat events. That said, hazmat occurrences are largely based on human error, and any changes in risk and vulnerability factors such as a decreased vigilance in materials oversight and handling practices or changes in the amount of chemicals or exposure will likely increase the probability on campus.

Vulnerability to the Hazard

Hazardous materials pose a risk to the Cal Poly Pomona campus. As identified by the campus planning committee and on the hazmat map, the following vulnerabilities are present on campus: chemicals are present in the science lab, radioactive material is located in the building leased to the ARC, a rail line runs near the north side of campus and a gas pipeline near the south side. Gases, chemicals or radioactive materials, if spilled or released, could severely impact human health and campus operations.

Although it is quite difficult to produce a quantitative measure of vulnerability because (unlike natural hazards) the probability of occurrence is dependent on human error, which itself is variable based upon a fluctuating set of interrelated factors, some of which lack prediction or control, given the complexity of how all natural and built environments and hazmat risks factors interrelate at the local or campus level, it is prudent to assume for planning purposes that the campus’ vulnerability is a sub-set of the larger community’s vulnerability. As such, the Cal Poly Pomona leadership maintains vigilance to mitigate the campus’ vulnerabilities identified above at a minimum.

Estimate of Potential Losses

As discussed previously, it is difficult if not impossible to produce an accurate quantitative measure of vulnerability because of the variable nature of a hazardous materials spill. For example, the release of a toxic airborne chemical in a populated area has severe impact potential, whereas the impact potential of a small chemical spill in a remote or rural area is most likely limited to remediation of soil. And, in both cases, the probability of occurrence is dependent on human error, which itself is variable based
upon a fluctuating set of interrelated factors, some of which lack prediction or control. In all cases, different types and amounts of hazardous materials interact with fluctuating combinations of human error to produce different event outcomes with variable impact costs.

Vulnerability Assessment Conclusions

It is well understood that with regards to hazmat vulnerability, each campus and its surrounding community (including Cal Poly Pomona) operates through a complex and dynamic interaction between industrial and commercial inputs and outputs and the natural and built environment. Such activity produces hazardous materials that move through the environment along both convergent and divergent routes and across all levels of land-use from site to campus to city and county and beyond. It is also clear from a review of the Los Angeles County hazard mitigation plan and Cal OES’ records of hazardous material spills, that such events occur with great frequency and varying degrees of severity across jurisdictions statewide. As such, in assessing the vulnerability of the Cal Poly Pomona campus, campus-level risks and vulnerabilities are not discreet or isolated but can become exacerbated or augmented through connections to broader community-level hazmat risks and vulnerabilities.

Finally, in order to draw conclusions on vulnerability, it should be noted that any identified vulnerabilities at the campus level and/or community level are circumscribed and potentially reduced by targeted policy and program interventions. Numerous policies and programs have been established in recent years in response to California’s widespread and complex and integrated hazardous materials risks - California established the Unified Program which consolidates and integrates the administrative requirements, permits, inspections, and enforcement activities of the following environmental and emergency response programs: the Aboveground Petroleum Storage Act (APSA) Program, Area Plans for Hazardous Materials Emergencies, the California Accidental Release Prevention (CalARP) Program, the Hazardous Materials Release Response Plans and Inventories (Business Plans), Hazardous Material Management Plan (HMMP) and Hazardous Material Inventory Statement (HMIS) requirements (California Fire Code), the Hazardous Waste Generator and Onsite Hazardous Waste Treatment (tiered permitting) Programs, and the Underground Storage Tank Program.

Identified Data Limitations

The Cal Poly Pomona planning committee has provided information on campus-level hazmat materials and risks. Data limitations pertain to a comprehensive understanding of human activity and error related to materials control over the long term.
Landslide

Description of the Hazard

A landslide is a down-slope movement of soil, rock, or other debris, and can also be referred to as a mass movement or slope failure. These geological hazards can range in size from a few feet to over a mile in length and width and, when heavy and rapidly moving, can cause serious damage and loss of life.

Landslides are classified based on the type of material and type of movement involved. They can range from slow-moving earth flows to fast-moving debris flows, though many large slope failures involve more than one type of movement. The primary natural triggers of slope failures are water, seismic activity, and volcanic activity. Slope saturation by water can occur from intense rainfall, snowmelt, changes in ground-water levels, and surface-water level changes along coastlines. In winter months, El Nino storms or other high rainfall events may saturate soils and trigger slope failure.

Deep-Seated Landslides

Deep-seated landslides, ranging in depth from ten to several hundred feet, occur as a result of geologic and hydraulic changes, such as earthquakes or increased levels of groundwater. These landslides can move slowly or quickly and can cause extensive property damage, but rarely result in loss of life.

Debris Flows Related to Shallow Landslides

Shallow landslides may mobilize into rapidly moving debris flows and typically occur after sudden saturation of the ground. These types of debris flows are typically more dangerous because they move rapidly, causing both property damage and loss of life.

Debris flows may also occur as a result of post-fire conditions, where wildfires have left barren ground exposed to heavy rainfall. Intense rainfall, generally greater than .5 inch per hour, has the potential to trigger a post-fire debris flow. These landslides may impact lives and properties within its deposition zone, and can result in downstream flooding. These post-fire debris flows often occur during the fall and winter following major summer fires.

Location of the Hazard

The susceptibility of an area to landslides depends on several variables, including magnitude of slope gradients, water content, ground cover, presence of erosion, and slope material and structure. However, landslides are most prevalent in terrain with weak


material and steep slopes, and the highest risk is found in areas with high rainfall or high earthquake potential. Slope failures are also most likely to occur in areas where they have occurred in the past. In California, the most landslide-prone areas are found along the coast and in the northern Franciscan Formation.

General landslide vulnerability can be estimated from the distribution of weak rocks and steep slopes as seen in Figure 17-9. Based on the Figure below, the campus is surrounded by high susceptibility landslide zones.

Figure 17-9: Deep-seated Landslide Susceptibility Surrounding Cal Poly Pomona

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**Extent of the Hazard**

The San Gabriel mountains, both steep and erosive, contain steeply walled canyons above areas with high population density. When heavy rain occurs, there is significant potential for floods and landslides throughout the County. Most of the City of Pomona is

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located on flat topography, however the hillsides in the western portion are considered susceptible to landslides. The indirect impacts of landslides in the region may cover a larger geographical extent than that of direct impacts. Based on the campus’ location surrounded by high susceptibility zones, and the extensive history of occurrence in Pomona, the planning committee ranks the extent of the hazard as Moderate to High.

History of the Hazard

FEMA has declared thirteen major disasters involving landslides, mudslides, debris flows, or mud flows in Los Angeles County since 1978. NOAA has recorded five debris flow events in the County since 2004, most of which occurred in the areas directly surrounding metropolitan Los Angeles. The 2018 Southern California Mudflows damaged 40 to 45 homes in Sun Valley and caused a vehicle to strike a natural gas pipeline, which began to leak.

The City of Pomona experienced a small landslide in 2006 that destroyed 4 homes and caused 6 million dollars in damage. In March 2003, a landslide occurred in Ganesha park, causing a temporary closure of Paige Drive. A history of landslides on the campus has not been reported.

Potential Impacts of the Hazard

Cal Poly Pomona may be impacted by the disruption of services as a result of landslides in the region. Landslides can result in physical damage to buildings and property and have the potential to significantly effect infrastructure. As a landslide moves, it distresses structural foundations by settlement, cracking, and tilting. Fast-moving flows can remove entire structures in one instance, while other types of flows can cause damage gradually.

Transportation and utility infrastructure are particularly vulnerable to landslides, since the failure of any component can disrupt service over a large area. The loss of power and communication and disruption of transportation can have cascading effects throughout an area, including impaired disposal of sewage, contamination of water supplies, and the release of flammable fuels. Transportation routes are also often expensive to clean up, and prolonged obstruction can disrupt the movement of people and goods for long periods of time.

Probability of Future Occurrence of the Hazard

Slope failures are also often triggered by other natural hazards such as heavy rainfall and earthquakes, so landslide frequency is often related to the frequency of these other hazards. As climate change impacts the frequency and intensity of triggers such as rain events, fires, and coastal erosion, landslides may generally occur more often. According to the NCEI Storm Events Database, the City of Los Angeles has been impacted by

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earthquakes, wildland fires, and severe storms at least every other year since 1960. Given the historic frequency of these contributary sources to landslides and of recorded landslides themselves, the probability of future occurrence is high. Based on these factors, the probability of annual future occurrence on the campus is Possible.

Vulnerability to the Hazard

The vulnerability of the built environment to landslides depends on exposure and is more likely to incur damage as a result of proximity, rather than inferior structural design. The structures most vulnerable to landslides are buildings and utility/transportation lifelines, which can be impacted by either impact or ground deformation. Utilities and transportation infrastructure are particularly vulnerable, due to their geographic extent and susceptibility to physical distress. Any population proximal to a landslide when it occurs is vulnerable to its impacts. Based on the campus’ location, from the mapping it appears that the campus exhibits all vulnerabilities (above) to some degree. The Cal Poly Pomona campus leadership may consider a broader assessment of asset vulnerability in the future.

Estimate of Potential Losses

There are no current models for estimating potential losses from a landslide directly impacting the campus.

Although the economic impact of landslide damage can exceed that of the direct repair costs, there are currently no applicable methods for estimating indirect costs related to Cal Poly Pomona.

Vulnerability Assessment Conclusions

Community exposure to landslides varies depending on their physical locations – whether in flat plains or on steep hillsides – and on their dependence on critical infrastructure located in landslide hazard zones.

Landslides could impact the campus in a variety of ways, primarily related to indirect impacts to transportation and utilities. Utility outages can impact health, particularly for vulnerable populations, and can cause interruptions in operations. Interruptions may impact student and employee’s ability to travel to campus and the delivery of classes and events.

Identified Data Limitations

The ability to predict future landslides at the Cal Poly Pomona campus is limited. However, the USGS estimates that climate change-induced shifts in weather will increase the frequency of post-wildfire landslides, which are expected to occur almost every year in California.
Power Outage

Description of the Hazard

Pomona, California is a city located in between the Inland Empire and San Gabriel Valley in Los Angeles County. The City of Pomona lies east of the City of Los Angeles in the Pomona Valley, and is the home of Cal Poly Pomona. The city spans nearly 23 square miles.

Most aspects of modern life, and almost all aspects of urban life, rely on the availability of reliable utilities, such as electricity, water, and natural gas. An interruption in the supply or distribution of these commodities can leave populated areas like Pomona without basic services, such as electricity or sanitation. These interruptions can be cascading effects from other hazard events, such as windstorms, floods, wildfires and earthquakes, or they can be caused by intentional disruptions of transmission lines.

A power outage event can interrupt day-to-day operations of the Cal Poly Pomona campus, like in-person classes, impede or limit digital, telephonic or radio communications, create traffic jams around the busy avenues and boulevards surrounding the campus, close the student health center, and close restaurants around campus and outside the campus. Additionally, thousands of Cal Poly Pomona student residents in on-campus housing would also be affected by a power outage on campus and in the area. A severe power outage in Pomona would also directly affect the campus and the community.

Electric power disruptions and outages fall into two categories: intentional and unintentional.

The four types of intentional disruptions are:

- Planned: Some disruptions are intentional and can be scheduled based on maintenance or upgrading needs.
- Unscheduled: Some intentional disruptions must be done "on the spot" in response to an emergency.
- Demand-Side Management: Some customers (i.e., on the demand side) have entered into an agreement with their utility provider to curtail their demand for electricity during periods of peak system loads.
- Load Shedding: When the power system is under extreme stress due to heavy demand and/or failure of critical components, it is sometimes necessary to intentionally interrupt the service to selected customers to prevent the entire system from collapsing. These intentional interruptions result in rolling blackouts.

Unintentional or unplanned disruptions are outages that come with essentially no advance notice or warning. This type of disruption is the most problematic. The following are categories of unplanned disruptions:
- Accident by the utility, utility contractor, or others.
- Malfunction or equipment failure.
- Equipment overload (utility company or customer).
- Reduced capability (equipment that cannot operate within its design criteria).
- Tree contact other than from storms.
- Vandalism or intentional damage.
- Weather, including lightning, wind, earthquake, flood, and broken tree limbs taking down power lines.
- Wildfire that damages transmission lines.

**Location of the Hazard**

Although power outages can take place within a certain area, as a hazard, it has the potential to occur and affect the entire planning area equally.

**Extent of the Hazard**

In order to anticipate outage conditions and reduce impacts, campus facility managers and others keep track of conditions and data provided by the media, municipal utilities and the California Independent System Operator (CAISO). CAISO is tasked with managing the power distribution grid that supplies most of California, except in areas served by municipal utilities, and is thus the entity that coordinates statewide flow of electrical supply. CAISO uses a series of stage alerts to the media based on system conditions. The alerts are:

- Stage 1 - reserve margin falls below 7 percent.
- Stage 2 - reserve margin falls below 5 percent.
- Stage 3 - reserve margin falls below 1.5 percent.

Rotating blackouts become a possibility when Stage 3 is reached.

A power outage could affect the entire area of the campus, including the Cal Poly Pomona athletic fields, classrooms resident halls, administrative offices, virtual, telephonic and radio communications, leading to loss of lighting in campus parking structures, and creating a cascading hazard for commuters as they depart from or arrive to campus in the evening. Additionally, the university is located within proximity of highly utilized thoroughfares for the transportation of goods to throughout California.

Given the prevalence of rolling blackouts and other power outages in California, the campus maintains safety precautions, situational awareness, access to emergency power generators and other protocols for managing campus power outages. That said, only one recorded outage has taken place on campus. As such, the planning committee ranks the extent of the power outage hazard as **Minimal**.

**History of the Hazard**
Cal Poly Pomona did not report experiencing additional power outages in recent years, but the following power loss incident was identified on the Cal Poly Pomona website. On April 30, 2019: The University experienced power failure in multiple buildings on campus and the university was able to work with the area’s electric utility provider to return to a normal state of operations and regular classes.

**Potential Impacts of the Hazard**

Instructors, campus residents, staff, and administration rely on electricity for basic survival and operations. During a widespread power failure, it may take days to restore operations. Electrical power may be the only cooling source for many individuals around the campus and its community, and long-term outages can potentially put people’s health and life at risk. Disruptions in the supply of heating fuel may put people and property at risk during extremely cold weather if it relies on electric generation or heating mechanisms instead of gas. Additionally, many medical devices, communications devices, and security rely on power to maintain their functions.

**Climate Change and Energy Shortage**

Climate change is expected to bring more frequent and intense natural disasters. These changes have created a variability at a rate that makes historical data a poor predictor of future climate. For example, the warmest years on record in California occurred in 2014, 2015, and 2016. The 2016-2017 year broke the record as the wettest ever recorded in the northern Sierra Nevada Mountains.

Changes in temperatures, precipitation patterns, extreme events, and sea-level rise have the potential to decrease the efficiency of thermal power plants and substations, decrease the capacity of transmission lines, render hydropower less reliable, spur an increase in electricity demand, and put energy infrastructure at risk of flooding.

With climate warming, higher costs from increased demand for cooling in the summer are expected to outweigh the decreases in heating costs in the cooler seasons. Hotter temperatures in California will mean more energy (typically measured in “cooling-degree days”) needed to cool homes and businesses both during heat waves and on a daily basis, during the daytime peak of the diurnal temperature cycle. During future heat waves, historically cooler coastal cities (e.g., San Francisco and Los Angeles) are projected to experience greater relative increases in temperature, such that areas that never before relied on air conditioning will experience new cooling demands.

Secondary impacts of energy shortages are most often felt by vulnerable populations. For example, those who rely on electric power for life-saving medical equipment, such as respirators, are extremely vulnerable to power outages. Also, during periods of extreme heat emergencies, the elderly and the very young are more vulnerable to the loss of cooling systems requiring power sources.

**Probability of Future Occurrence of the Hazard**

The probability of California experiencing a power outage can be difficult to quantify but is a hazard that occurs annually during the same seasonal periods of temperature
variance throughout the calendar year. The City of Pomona and Los Angeles County experience such outages. As such, the probability ranking for the Pomona area is **Likely**. Since the Cal Poly Pomona campus has also recorded power outage events, it is prudent to assign this same ranking for the campus.

Climate models suggest summer global temperatures are likely to increase while changes between temperature extremes would be more pronounced. As such, it is expected that power outages will occur more frequently in the future.

**Vulnerability to the Hazard**

Based on the data available, and in consideration of the increasing effects of climate change, the campus remains vulnerable to power outages in terms of impacts to people, power infrastructure and campus operations. Nonetheless, as discussed campus leadership works to reduce vulnerabilities through consistent use of safety and operational protocols and emergency power sources to ensure it is able to mitigate an interruption to electrical power.

**Estimate of Potential Losses**

The data provided by Cal Poly Pomona’s State does not report any value for potential losses due to power outage. However, the university has begun implementing mitigation efforts by working with Southern California Edison to improve and modernize antiquated systems. A $30 million dollar investment to the electric utility infrastructure has been upgraded. A new electrical substation has also been leased adjacent to the campus to mitigate against power outages.

**Vulnerability Assessment Conclusions**

Elevators, entry ways, air filtration systems and lighting provide the campus community with the necessary infrastructure and systems to function and navigate through the campus and to maintain a safe campus environment and visibility during nighttime hours. The primary concern for campus leadership is that a loss of power can lead to potential hazards to students, faculty, and staff at SJSU. Vulnerable populations (especially students with physical disabilities) may be the most heavily affected by loss of power, as they rely on elevators, entry ways with automatic doors, and locks and lights; a power outage would impede a disabled student’s ability to travel and utilize the campus and its structures safely.

The use of communication devices, billing, records, and electrical tools may also become unusable due to a loss of electricity. Many records and billing items may have to revert to “by-hand” procedures and paper copies may have to be kept continuing operations. Additionally, classrooms may not be usable if lighting equipment is not functioning impacting a semester or quarter’s progress for the academic year.

**Identified Data Limitations**
Cal Poly Pomona did not report any monetary or life losses due to a power outage. Also, the campus did not report any incidents involving a power outage directly affecting the campus community and operations.

**Volcano (Associated Air Quality)**

**Description of the Hazard**

The US Geological Service defines volcanoes as “openings or vents where lava, tephra (small rocks), and steam erupt on to the Earth’s surface. Through a series of cracks within and beneath the volcano, the vent connects to one or more linked storage areas of molten or partially molten rock (magma). This connection to fresh magma allows the volcano to erupt over and over again in the same location.”

A volcanic eruption occurs when magma, lighter than surrounding rock, is driven upwards by its buoyancy and by pressure from the dissolved gases contained within it. Gases are released from magma as it reaches the surface and pressure decreases. Magma can be erupted in several ways and violent eruptions typically cause tiny pieces of tephra (ash) to be carried away by the wind. This ash is hard, does not dissolve in water, is extremely abrasive and mildly corrosive, and conducts electricity when wet. The gases released in an eruption include carbon dioxide, sulfur dioxide, hydrogen sulfide, and hydrogen halides. Depending on their concentration, these are potentially hazardous to people, animals, agriculture, and property.

**Location of the Hazard**

There are eight volcanic areas located throughout California. Seven of these - Medicine Lake Volcano, Mount Shasta, Lassen Volcanic Center, Clear Lake Volcanic Field, Long Valley Volcanic Region, Coso Volcanic Field, and Salton Buttes – are considered active volcanoes. No portion of Cal Poly Pomona or Los Angeles County is within a volcano hazard zone.

**Extent of the Hazard**

Volcanic hazards are most severe within a few miles of the volcano vent and the severity generally decreases with distance. Ash impact zones can range from tens to hundreds of miles from the vent source. The US Geological Survey has estimated zones surrounding active volcanoes wherein 2 inches or more of ashfall following an eruption is possible. While Cal Poly Pomona does not fall within an estimated ashfall zone, lighter dustings of

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ash outside of those areas may directly or indirectly impact the campus. As such, the planning committee ranks the extent of the hazard for the campus as Low.

History of the Hazard

No historical eruption events in California have affected the campus. Over the last 1,000 years, there have been at least 12 eruptions in California. The most recent volcanic eruption in California occurred at Lassen Peak about 100 years ago, when a major explosion delivered windborne ash over 275 miles away.

Potential Impacts of the Hazard

The specific impacts vary widely and depend on which type of volcano erupts, the style of explosion, the volume of lava, the eruption duration, and the local water conditions. As Cal Poly Pomona is not proximal to an active volcano, only the potential impacts of ashfall and gases have been detailed. While both these hazards can be widespread, their most severe impacts are generally seen closer to the volcanic source.

Although ashfall is typically a nonlethal volcanic hazard, it is the most widespread and disruptive. Falling ash can damage crops, electronics, and machinery. It can also impact human health by irritating the respiratory tract, eyes, and skin. The particles may enter drinking water and structures and may cause structure failure if it is thick and heavy enough. Even a fine layer of ash can disrupt utilities. A portion of California’s major electric transmission lines, aerial telecommunication lifelines, transportation corridors, and water storage and conveyance lie within the state’s volcano hazard zones. Impacts to any of these can impact operations at Cal Poly Pomona.

The potential impacts of gases released during volcanic eruptions are as follows:

- Carbon dioxide typically becomes diluted very quickly and is not life threatening. However, it can become trapped in higher concentrations in low-lying areas and has the potential to be fatal.
- Sulfur dioxide can cause acid rain and air pollution downwind of a volcano.
- Hydrogen sulfide can cause irritation of the upper respiratory tract. At high concentrations it can cause unconsciousness and death.
- Hydrogen halides can coat ash particles and, once deposited, poison drinking water, agricultural crops, and grazing land.

Probability of Future Occurrence of the Hazard

The US Geological Survey, based on the record of volcanic activity in California, estimates that the probability of another small- to moderate-sized eruption in the next thirty years is about 16 percent. As such, the annual probability of future occurrence for the campus is ranked by the committee as Unlikely.

Vulnerability to the Hazard
Populations living near volcanoes are the most vulnerable to eruptions and lava flows. However, volcanic ash can travel and affect populations miles away. The location and thickness of ash in any given area is a function of the severity of the eruption and wind speed and direction. For Cal Poly Pomona, there is low vulnerability to the immediate impacts of volcanic eruptions due to the limited area affected and remote potential of an eruption. In the event of a widespread ashfall event, the elderly, infants, and populations with existing respiratory disease will be at higher risk.

Estimate of Potential Losses

Impacts to critical infrastructure, agriculture, and property from ashfall have the potential to cause widespread disruption, damage, and economic loss throughout the state. In the event of a widespread ashfall event, impacts will be immediate.

Current modeling is not precise enough to allow for an assessment of potential losses from ashfall to structures or infrastructure on or surrounding the campus.

Vulnerability Assessment Conclusions

Cal Poly Pomona is unlikely to experience the direct impacts of a volcanic event. While the campus may be indirectly impacted by ashfall elsewhere in the state, direct ashfall impacts are generally unlikely but possible in a widespread event. However, the likelihood of any volcanic eruption in the state impacting the campus is very low.

Identified Data Limitations

Not all active volcanoes in California have been zoned for hazards by the US Geological Survey. This, together with the infrequent occurrence of volcanic explosions and number of factors determining type and extent of impacts, make the quantification of potential loss difficult.

Wildfire

Description of the Hazard

While wildfires are a natural part of California’s ecosystem, wildfires in California represent a hazard that presents one of the greatest probabilities of destruction along with a demonstrated history of catastrophic fire events in recent years. The destructive fire seasons of 2017 to 2020 illustrated the destructive forces fire presents to communities across the state. Wildfires may result in the structural loss, infrastructure loss, dangerous air quality, environmental damages, economic impacts, injuries, and loss of life. In many communities throughout California, wildfire presents greatest risk to human life and property.

Wildfires have been defined as any free burning vegetation fire that initiates from an unplanned ignition, whether natural or human caused demanding fire suppression
actions to contain. These fires are prone to become uncontrolled, spreading through vegetative fuels rapidly exposing people and structures to harm. Wildfires present a significant risk to communities across the state, as evidenced by increasing trends of structural losses from wildland fires. This risk is elevated in areas where development and community growth has intersected, also known as the wildland-urban interface (WUI). In the interface setting, development itself can provide additional fuel for large fires. Recent fires have also demonstrated the ability of fire to consume populated areas in extreme conditions.

California’s Mediterranean climate in combination with its geography and vast population create a combination of factors that promotes an optimal environment for large fire growth and consequences. As there is great diversity of geographic characteristics across the state, the risks and potential consequences of wildfire must be assessed locally. The physical location, weather patterns, local fuel types and volume, extent of the WUI, topography, and additional factors will factor differently from part of the state to another. The behavior of wildfires in California is significantly influenced by three distinct geographic factors. These factors will help shape the size, direction of spread, rate of combustion, fire intensity, and ability to pre-heat fuels. The physical factors contributing to wildfire behavior include:

- **Topography** – The rate in which wildfires spread increases with greater slopes in topography. The greater the slope will result in more pre-heating of fuel above the advancing fire. The direction that a slope faces will also influence fire behavior as south facing slopes receive greater solar radiation and thus drier vegetation that is more susceptible to combustion. Ridgetops often denote the end of fire spread as fire has greater difficulty spreading downhill.

- **Weather** – Weather factors substantially in influencing the behavior of wildfires. Wind, temperature, humidity, lightning, and lack of precipitation all contribute to a fire’s ability or inability to spread and intensify. California routinely experiences conditions in which these factors are in alignment to contribute to extreme fire behavior during the summer and fall seasons. High winds, low humidity, and high temperatures provide an environment promoting extreme fire activity.

- **Fuels** – Certain types of vegetation are increasingly prone to igniting and promote more intense burning. Areas with greater “fuel loading” (amount of fuel present in terms of weight of fuel per unit of area) increases the amount of fuel to fuel a fire. Greater volumes of dead or dry vegetation compared to live plants is a critical factor. Vegetation during drought conditions will experience decrease in moisture content increasing the conditions for combustion. Fuels close proximity to one another allows for rapid spread through contact or radiant exposures.

77 State of California Hazard Mitigation Plan, September 2018
A risk assessment for wildfires should be implemented within a geospatial context focusing on the specific location features and incorporates the three components of the wildfire risk triangle – likelihood, intensity, and susceptibility.

Location of the Hazard

Substantial portions of the State of California are exceptionally vulnerable to wildfire activity or reside in a wildland-urban interface (WUI) area due to the vast open spaces, rangelands, forests, and other lands with high susceptibility to fire occurring throughout the state. Cal Poly Pomona is located along the base of the eastern edge of the San Jose Hills. Areas considered to be within Fire Hazard Severity Zones defined by the Fire and Resource Assessment Program (FRAP) within the California Department of Forestry and Fire Protection (CalFire) occur to the west and north of the campus. Additionally, these fire hazard zones exist in other areas throughout Los Angeles County. These areas surrounding the valley are topographically diverse, contain heavier vegetative fuels, and often have residential development interspersed. The land in the San Gabriel Valley where the Cal Poly Pomona campus is located, is largely developed with residential and commercial land uses surrounded by low rising hills with moderate to heavy vegetation.

The area immediately to the south and east of the campus is predominately commercial and residential. The areas to the west and north include open hillsides some combined with residential land uses included. Fire Hazard Severity Zones are found throughout the campus and throughout the hillsides surrounding the campus to include Very High Fire Hazard Severity Zones (VHFHSZ).
Los Angeles County has multiple areas considered as fire hazard zones that present direct threats of burning potential in areas that are in proximity to those hazard areas. Additionally, these large areas of land that are considered to be hazardous for the potential for fire will also produce the threat of diminished or hazardous air quality due to the smoke and particulates produced in the burning process. The air quality for residents of the County and the Cal Poly Pomona campus community can be greatly affected by large fires burning in these areas.

Fire Hazards Zones surrounding Los Angeles County and the San Gabriel Valley demonstrate the broader community threat that wildfires present to the population. Fire hazard severity zones are found surrounding the populated areas of the county. This presents the potential for fire related damages and smoke inundation to occur in many areas that members of the campus community reside, are employed in, or where they recreate. Transportation routes are equally impacted causing potential added challenges.

for the campus community to get to areas if safety, get resources, or gain access to the campus.

Figure 17-11: Fire Hazard Severity Zones, Eastern Los Angeles County and Inland Empire

Extent of the Hazard

While the threat to fire directly affecting the campus is considerable, the direct effect of fire-generated smoke is also likely to occur. Fires are likely to occur in areas close enough to the campus that generate substantial amounts of smoke that could envelop the campus in the right atmospheric conditions. Fires that are large enough to generate volumes of smoke to cover great distances have the potential to affect the air quality of the San Gabriel Valley area including the campus. This will especially be the case in weather conditions creating strong offshore winds. The potential for this impact has been demonstrated during the summers of 2018, 2019, and 2020 as fires burned across the state and spread smoke over vast distances. Fires burning outside of the San Gabriel Valley and Inland Empire region have the potential to distribute smoke onto the Cal Poly Pomona campus.
The area immediately surrounding the Cal Poly Pomona campus is in direct proximity to fire hazard zones designated as a High Fire Hazard Severity Zones and Very High Fire Hazard Severity Zones. As a result, along with the history of occurrences in the surrounding area, the planning committee ranks the extent of the wildfire hazard for the campus as **High**.

The National Fire Danger Rating System (NFDRS) is the current system in use for rating and classifying the potential danger of fire. The NFDRS tracks the effects of previous weather events on both dead and live fuel loads and adjusts accordingly based on future or predicted weather conditions. These complex relationships and equations are computed, and the outputs are expressed in terms that users can quickly and easily understand. The current NFDRS is used by all federal and most state agencies to assess fire danger conditions.

The following table depicts the NFDRS, from the US Forest Service’s Wildland Fire Assessment System.

Table 17-22: National Fire Danger Rating System\(^7^9\)

<table>
<thead>
<tr>
<th>Rating</th>
<th>Basic Description</th>
<th>Detailed Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>CLASS 1: Low Danger (L)</td>
<td>Fires not easily started</td>
<td>Fuels do not ignite readily from small firebrands. Fires in open or cured grassland may burn freely a few hours after rain, but wood fires spread slowly by creeping or smoldering and burn in irregular fingers. There is little danger of spotting.</td>
</tr>
<tr>
<td>COLOR CODE:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Green</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CLASS 2: Moderate Danger (M)</td>
<td>Fires start easily and spread at a moderate rate</td>
<td>Fires can start from most accidental causes. Fires in open cured grassland will burn briskly and spread rapidly on windy days. Woods fires spread slowly to moderately fast. The average fire is of moderate intensity, although heavy concentrations of fuel – especially draped fuel -- may burn hot. Short-distance spotting may occur but is not persistent. Fires are not likely to become serious and control is relatively easy.</td>
</tr>
<tr>
<td>COLOR CODE:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Blue</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CLASS 3: High Danger (H)</td>
<td>Fires start easily and spread at a rapid rate</td>
<td>All fine dead fuels ignite readily, and fires start easily from most causes. Unattended brush and campfires are likely to escape. Fires spread rapidly and short-distance spotting is common. High intensity burning may develop on slopes</td>
</tr>
<tr>
<td>COLOR CODE:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yellow</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

or in concentrations of fine fuel. Fires may become serious and their control difficult, unless they are hit hard and fast while small.

<table>
<thead>
<tr>
<th>CLASS 4: Very High Danger (VH)</th>
<th>Fires start very easily and spread at a very fast rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>COLOR CODE: Orange</td>
<td>Fires start easily from all causes and immediately after ignition, spread rapidly and increase quickly in intensity. Spot fires are a constant danger. Fires burning in light fuels may quickly develop high-intensity characteristics - such as long-distance spotting - and fire whirlwinds when they burn into heavier fuels. Direct attack at the head of such fires is rarely possible after they have been burning more than a few minutes.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>CLASS 5: Extreme (E)</th>
<th>Fire situation is explosive and can result in extensive property damage</th>
</tr>
</thead>
<tbody>
<tr>
<td>COLOR CODE: Red</td>
<td>Fires under extreme conditions start quickly, spread furiously, and burn intensely. All fires are potentially serious. Development into high intensity burning will usually be faster and occur from smaller fires than in the Very High Danger class (4). Direct attack is rarely possible and may be dangerous, except immediately after ignition. Fires that develop headway in heavy slash or in conifer stands may be unmanageable while the extreme burning condition lasts. Under these conditions, the only effective and safe control action is on the flanks, until the weather changes or the fuel supply lessens.</td>
</tr>
</tbody>
</table>

Due to the impacts of wildfires on public health, agencies across the nation have adopted the use of the Air Quality Index (AQI) to communicate and provide a consistent approach to air quality measurements and categorization. The AQI primarily focuses on the health effects caused by pollutants in the air such as smoke. The goal of the AQI is to provide advisories to assist the public in determining when to reduce exposures to inhalation of air pollution as pollution levels rise.

Figure 17-12: Air Quality Index for Ozone and Particulate Pollution

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History of the Hazard

The State of California has a long history of chronic and destructive wildfires throughout the state. On average, 8,300 wildfires have caused burnt 928,245 acres across the state over the 20-year period between 2000 and 2020.81 Los Angeles County also has a long history of wildfire activity primarily in the foothills and mountains of the San Gabriel Mountains, the Chino Hills, and the San Jose Hills. Wildfires occurring in Los Angeles County and the Inland Empire have resulted in hundreds of thousands of acres burned and millions of dollars in damages.

The area immediately surrounding the Cal Poly Pomona campus is in direct proximity to fire hazard zones designated as a High Fire Hazard Severity Zones and Very High Fire Hazard Severity Zones. The campus does have a history of minor wildfire activity occurring within proximity to the campus. However, the San Gabriel Valley and Inland Empire are surrounded by areas that are considered to be of high fire threat that would produce vast quantities of smoke and particulates into the air. The Cal Poly Pomona campus has experienced multiple days of poor air quality due to fires burning in southern California mountains. The 2017, 2018, and 2020 fire seasons in particular illustrated the increase in wildfire generated smoke saturating the air of communities throughout the state including the San Gabriel Valley. Cal Poly Pomona personnel reported the ongoing development of policies and procedures to address the response to poor air quality days.

Table 17-23: - Historic Large-Scale Fires Near Cal Poly Pomona82

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81 California Department of Forestry and Fire Protection, Stats and Events, https://www.fire.ca.gov/stats-events/

82 City of Pomona Natural Hazards Mitigation Plan, November 2012
Potential Impacts of the Hazard

The location of the Cal Poly Pomona campus on a hillside near areas designated as High Fire Hazard Severity Zones places a threat that flame, ember, and smoke exposure from wildfire to the campus. There is potential for fire to occur from the west or north of the campus. The surrounding hillsides and valleys are composed of light to moderate fuels. The threat from fire and the impacts fire would have on the university is due to the campus being located adjacent to open hillsides and field susceptible to fire spread.

Potential impacts to the campus community resulting from wildfires include:

- Injuries or loss of life
- Campus property destruction or damage
- Residential property destruction or damage
- Commercial property destruction or damage
- Loss of property contents
- Infrastructure damage
- Threat or damage to on campus child care facilities
- The Kellogg House is surrounded by dense vegetation
- Structures on the northwest side of campus on South University Drive including Chilled Water Plant, Health Services, Science Laboratories, College of Agriculture, College of Science, Building One, Manor House, Palmitas Residence Hall, La Cienega Center, Los Olivos Commons, Cedritos Residence Hall, Encinitas Residence Hall, Montecito Residence Hall, Aliso Residence Hall, Alamitos Residence Hall, and the Recreation Maintenance Building.
- Substantial on-campus student resident population reside within fire hazard zone requiring evacuation in fire events
- Kellogg West Main Lodge and the Kellogg Conference Center are surrounded by dense vegetation.
- Damaged or destroyed lifelines/supply routes
- Damaged or destroyed utilities, on campus power generation
- Damaged or destroyed critical facilities supporting campus emergency support needs
- Loss of community economic base
- Employment losses
- Loss to ground supporting vegetation on hillsides resulting in erosion or landslides in future precipitation events
- Agricultural (crops and livestock) damages or destruction
- Environmental damage
- Societal and community impacts
- Damage to organizations and facilities providing support services to vulnerable populations
- Greater evacuation challenges for those most vulnerable
- Psychological impacts of impacted populations
- Disruptions to education delivery to community

Potential impacts resulting from wildfire generated smoke include:
- Dangerous levels of air pollution
- Human Health Effects
  - Similar health impacts to pets
- Air conditioning systems overwhelmed
- Greater demands on air filtration systems
- Greater demands on healthcare systems
- Reduced outdoor work productivity
- Closures of academic sessions

Additionally, there remains a number of secondary impacts from wildfires that could affect the campus community. Utilities feeding areas of Los Angeles County including the campus may be damaged resulting in power outages. Fire related damage in the watersheds will likely cause future landslides, degradation to plants supporting hillsides, and impact the hydroelectric power capabilities. Fires may present threats to areas of recreation, scenic value, and wildlife that are a part of the culture of the campus community. Finally, the campus may experience effects of evacuated individuals arriving on campus from other areas as a location of refuge.

**Probability of Future Occurrence of the Hazard**

Based on the wildfire threat potential in the area surrounding the Cal Poly Pomona campus and hillsides along the north and west side of the campus, including the immediate proximity to Local Fire Hazard Severity Zones listed as “Very High”, the
density of residential and commercial development, and the historic occurrences of fires, the probability of annual wildfire related damage is considered Possible.

Based on the wildfire threat potential in the area surrounding Southern California including the hills and mountains throughout the region, the volume of areas in elevated Fire Hazard Severity Zones throughout the southern portions of the state, and the historic occurrences of smoke, the probability of annual wildfire generated smoke impacts to air quality is considered Possible.

**Vulnerability to the Hazard**

The Cal Poly Pomona campus is subject to direct impact from wildfire due to the campus location within a wildland-urban interface zone. The campus is identified to reside near a designated local High Fire Hazard Severity Zone. The campus is surrounded on two sides by hillsides and open lands containing combustible vegetation combined with residential development. Additionally, vulnerabilities to the effects of wildfire would lie within the campus community who may reside or work in locations that are exposed to the Fire Hazard Severity Zones in other parts of the surrounding region. Wildfires occurring in other areas of the region may result in the displacement of large numbers of people. These effects may spill onto the campus in the form of evacuees or facility support to emergency resources.

Fire directly threatening the campus would likely take the form of vegetation fires along the hillsides and extending onto the campus or localized fires involving single structures or small areas. Smaller vegetation fires are possible surrounding the campus in the urban forest or fields surrounding the city. These incidents would likely have significant impact on the campus. The campus community living or working in areas along the northern portions of the campus where dense vegetation exists along the fire hazard zones outside of campus are particularly vulnerable to effects of fire.

The primary basis of vulnerability is based on the population affected and the built environment exposed. In general, newer construction will be more fire resistant than older buildings as building and fire codes and construction technology have improved. Density of buildings and proximity of fuels to buildings or equipment at risk of combustion would additionally influence the fire’s ability to spread to structures. Structures with vegetation and other combustibles near the structure increases the ability of fire to spread to buildings.

Access to the west using West Temple Avenue servicing access to Walnut and Grand Ave accessing Covina could become cutoff during fire incidents. Interstate 10 and State Route 57 traverse fire hazard zones and may also be impacted by fire making those routes impassible. Access for supplies, equipment, and emergency services in addition to evacuation away from the campus would likely be forced to use alternative routes into Pomona.

The greater concerns regarding vulnerabilities to wildfire are related to the smoke that fires in the area would produce. The recent summer seasons have clearly demonstrated
the reality of large wildfires producing enough smoke to fill the San Gabriel Valley and Inland Empire even from substantial distances away. These recent fires have displayed how the effects of this smoke impact the general population and especially vulnerable populations. Cal Poly Pomona students, faculty, and staff both on campus and off campus face these same vulnerabilities related to smoke filled air. Student athletes participating in outdoor sports and engaging in aerobic activities are increasingly vulnerable to the effects of wildfire.

The vulnerability to members of the campus community in which wildfire generated smoke on the Cal Poly Pomona campus will vary depending on when the air quality was to reach unhealthy levels. The risk to the campus population will be lessened during periods when classes are not in session or during periods of breaks. Conversely, during the days and hours that classes are in session and staff are at their workplaces, the human vulnerability increases. However, in region-wide events this vulnerability may be shared with the homes and workplaces of members of the campus community and their families.

Vulnerable populations will likely face disproportionate health safety issues from smoke filled air, experience increased stresses, may require the need to remain away from the campus enclosed at home, and may find difficulty in accessing equipment or supplies to aid in a specific need.

**Estimate of Potential Losses**

Estimates of potential losses will be influenced by a variety of factors. Costs would also be likely to include mitigation or repairs of HVAC systems, sealing of doors and windows, and other methods of keeping smoke from entering buildings. Secondary costs would include lost academic days during campus closures, lost staff on campus productivity, and health and medical interventions for affected members of the campus community.

Based on estimate replacement costs of facilities and structures on campus, the maximum total replacement costs due to wildfire are $355,971,530. However due to the lack of a complete inventory of building and facility costs, the total replacement estimate is likely much higher.

Table 17-24: Wildfire Hazard Potential (WHP) Zone Estimated Losses

<table>
<thead>
<tr>
<th>WHP Zone</th>
<th>No of Buildings</th>
<th>Maximum Replacement Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Extreme</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Very High</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>High</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Moderate</td>
<td>8</td>
<td>$4,011,022</td>
</tr>
<tr>
<td>Low</td>
<td>16</td>
<td>$16,607,969</td>
</tr>
<tr>
<td>Very Low</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Non-Burnable</td>
<td>231</td>
<td>$335,352,539</td>
</tr>
</tbody>
</table>
Vulnerability Assessment Conclusions

The occurrence of wildfires has been a frequent event in Los Angeles County, including wildfire incidents that have threatened or caused damages near the Cal Poly Pomona campus. The location of the Cal Poly Pomona campus surrounded by open hillsides with light to moderate vegetative fuels along the entire northern edges presents a threat of fire to the campus community and campus assets. The foothills and mountains surrounding Los Angeles County host environments that are ideal for the development of wildfire activity. The consequences of fires in these areas would present primary and secondary consequences to the Cal Poly Pomona campus and expose vulnerabilities on the campus and to the campus community.

The topography of the valley surrounded by mountains allows for smoke filled air to linger in the valleys of Los Angeles County area with the potential for unhealthy air quality depending on wind conditions. Fires in the watersheds of the San Gabriel, San Bernardino, and Santa Ana Mountains and the Transverse Ranges and tributaries may damage vegetation stabilizing hillsides and result in increased sediments to be discharged into the river system and reservoirs reducing their capacity and effectiveness.

Communities located within or near the Wildland Urban Interface may be subject to damaging fires. These same communities may be home to members of the campus community. The potential for large-scale wildfires in the region further generates the added potential for a number of cascading effects such as disruptions to the local economy, utility failures, disruptions to providing for the needs of the community, and development of public health hazards. The potential for large-scale wildfires and resulting damage of homes and businesses has exponentially powerful impacts on particular populations among the campus community including those with access or functional needs, international students, the homeless, and students residing in the residence halls.
Identified Data Limitations

Data limitations include missing campus structural replacement costs, and lack of both a complete inventory of building construction types and mitigation efforts to lessen the impact due to fire activity. HAZUS generated analysis is focused on the broader community level versus fine-tuning the analysis to the micro-level for facilities such as a university campus.

**Severe Weather (Wind, Tornado, Hail, and Lightning)**

Description of the Hazard

Severe weather can be described as a variety of weather or climate events that are beyond or near the ends of the range of observed weather patterns and behavior. These events can include high or extreme winds, storms, lightning, hail, tornadoes, heat waves, unusually cold temperatures, extreme rainfall, and flooding.\(^\text{83}\) According to the Intergovernmental Panel on Climate Change (IPCC), to be classified as severe (or extreme), the occurrence of each value of a climate or weather variable (e.g., wind, hail, lightning, tornado, etc.) must be “above (or below) a threshold value near the upper (or lower) ends of the range of observed values of the variable.”\(^\text{84}\)

Severe weather in California can be generated by local, regional, and/or global weather and climate influences. From the individual thunderstorm to the Santa Ana wind event to the strong El Niño, damaging weather elements that are produced by and accompany severe weather and climate phenomena (e.g., damaging winds, hail, lightning, and tornadoes) occur throughout California and the California State University (CSU) system.

**Global Scale Influences on Severe Weather in California: El Niño, La Niña, and ENSO**

The El Niño-Southern Oscillation (ENSO) is a recurring climate pattern involving changes in the temperature of waters in the central and eastern tropical Pacific Ocean. On periods ranging from about three (3) to seven (7) years, the surface waters across a large swath of the tropical Pacific Ocean warm or cool by anywhere from 1°C to 3°C, compared to normal. This oscillating warming and cooling pattern, referred to as the ENSO cycle,  

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directly affects rainfall distribution in the tropics and can have a strong influence on weather across the United States and other parts of the world.

El Niño and La Niña are extreme phases of the ENSO cycle, with a third phase occurring between them called the Neutral phase. The El Niño phase is characterized by unusually warm ocean temperatures and weaker-than-normal east winds in the Equatorial Pacific, while the La Niña phase is characterized by unusually cold ocean temperatures and stronger-than-normal east winds in the Equatorial Pacific. Both extreme ENSO phases lead to significant differences from the average ocean temperatures, winds, surface pressure, and rainfall across parts of the tropical Pacific. The Neutral phase indicates that conditions are near their long-term average.

The extreme ENSO phases affect the frequency and intensity of weather events across the world, including in California. On average, areas across California experience exceptionally stormy winters with increased precipitation under El Niño conditions, but experience less stormy and drier winters under La Niña conditions. This variability in storminess and precipitation brought on by El Niño and La Niña events affects the both the frequency and intensity of severe weather conditions experienced by all CSU campuses, including Cal Poly Pomona.

Regional Climate Influences on Severe Weather across California

Most of the weather in California is influenced by the wet-winter/ dry-summer Mediterranean climate pattern. In the summer months, Pacific storm tracks are deflected north due to the position of the Pacific High (i.e., a large-scale atmospheric circulation over the Northeast Pacific Ocean), preventing Pacific storms from reaching California. As a result, most summer storms are generated due to the incursion of moist air from the Gulf of Mexico or the Gulf of California, and occur as scattered, locally heavy showers in the desert and mountain regions of the state. In the winter months, the Pacific High decreases in intensity and moves south, permitting powerful Pacific storms to move into and across the state; these storms can produce extreme winds, heavy rains (including “atmospheric river” events), and widespread coastal and inland flooding. (Please see the Flood Hazard profile in this document for information on Floods.)
events accompanied by precipitation in California are far more frequent in the winter months than they are in the summer months.90

While the Mediterranean climate pattern influences the seasonal frequency, intensity, geographic spread, and type of some severe weather events CSU campuses experience (including Cal Poly Pomona), other severe weather phenomena may occur in California at any time of the year. For example, near the coast and over the Central Valley, there appears to be no defined seasonality to thunderstorms, and these storms are usually light and infrequent. Thunderstorms are more intense and more frequent in the intermediate and higher elevations of the Sierra Nevada, and occur with greater frequency during the summer months.91

Types of Storms in California

The 2018 California State Hazard Mitigation Plan (SHMP) defines a storm as a violent atmospheric disturbance occurring over land and/or water that is distinguished by its strength, characteristics, and the scale of the resulting damage.92 The SHMP also lists the following types of storms that produce hazardous conditions and potential damage throughout the state of California.93 These storms affect (in varying degrees) all CSU campuses, including Cal Poly Pomona.

- **Thunderstorm**: A rain-bearing cloud that also produces lightning. Thunderstorms can produce some of nature’s most destructive and deadly weather including tornadoes, hail, strong winds, lightning and flooding.94 Thunderstorms are caused by an atmospheric imbalance from warm unstable air rising rapidly into the atmosphere. Lightning, which occurs during all thunderstorms, can strike anywhere.95 Thunderstorms can produce some of nature’s most destructive and deadly weather including tornadoes, hail, strong winds, lightning and flooding.96 Severe thunderstorms are more intense, violent, and dangerous thunderstorms. The National Oceanic and Atmospheric Administration (NOAA) defines a severe

90 Retrieved on 07.17.2021 from https://wrcc.dri.edu/Climate/narrative_ca.php
91 Retrieved on 07.17.2021 from https://wrcc.dri.edu/Climate/narrative_ca.php
thunderstorm as any storm that produces one or more of the following elements: Damaging winds or speeds of 58 mph (50 knots) or greater, hail 1 inch in diameter or larger, and/or a tornado.97 98

- **Hailstorm**: a type of storm that precipitates round chunks of ice. Hailstorms usually occur during regular thunderstorms.

- **Wind storm**: marked by high wind with little or no precipitation.

- **Winter storm**: A storm that can produce a combination of freezing rain, sleet, heavy snow, and/or strong winds.

- **Coastal storm**: large wind-driven waves and/or storm surge that strike the coastal zone.

- **Ice storm**: Ice storms are one of the most dangerous forms of winter storms. When surface temperatures are below freezing, but a thick layer of above-freezing air remains aloft, rain can fall into the freezing layer and freeze upon impact into a glaze of ice. In general, 8 millimeters (0.31 inch) of accumulation is all that is required, especially in combination with breezy conditions, to start downing power lines as well as tree limbs. Ice storms also make unheated road surfaces too slick to drive on. Ice storms can vary in time range from hours to days and can cripple small towns and large urban centers alike.

- **Snowstorm**: A heavy fall of snow accumulating at a rate of more than 5 centimeters (2 inches) per hour that lasts several hours. Snowstorms, especially ones with a high liquid equivalent and breezy conditions, can down tree limbs, cut off power, and paralyze travel over a large region.99

**Severe Weather Hazard Elements: Wind Hazards, Hail, and Lightning**

This hazard profile concentrates on the following types of severe weather hazards: **wind hazards** (including tornadoes), **hail**, and **lightning**. These hazards are produced by a variety of weather phenomena, including thunderstorms, coastal storms, winter storms, and topographically-enhanced downslope winds. While storm and downslope wind hazards are responsible for severe weather events across the CSU system, only the wind, tornado, hail, and lightning elements generated by these hazards are covered in this profile. (Storm-related hazards such as flooding and extreme temperatures are covered in other sections of this document.)

97 Retrieved on 07.15.2021 from https://www.noaa.gov/explainers/severe-storms

98 Retrieved on 07.15.2021 from https://www.weather.gov/safety/thunderstorm

Wind Hazards

Wind is the horizontal movement of air past any given point. Wind begins with differences in air pressures; pressure that is higher at one point than another sets up a force, pushing the high towards the low pressure.\textsuperscript{100} Wind gusts are defined as “rapid fluctuations in the wind speed with a variation of 10 knots or more between peaks and lulls.” \textsuperscript{101}

Wind hazards in California take several forms: High Wind, Strong Winds, Thunderstorm Winds, Mountain-Valley (Downslope) Winds, and Tornadoes. These hazards are encountered across California, and have the potential to cause harm to or loss of life and/or property throughout California and the CSU system (including Cal Poly Pomona).

High Winds, Strong Winds, and Thunderstorm Winds

The National Weather Service reports three (3) types of wind events that occur areas over land: High Winds, Strong Winds, and Thunderstorm Winds. Collectively, these reports are used to determine the frequency with which wind hazard events have affected areas across the U.S., including California.

High Winds

High winds are defined as sustained non-convective winds of 35 knots (40 mph) or greater lasting for 1 hour or longer, or gusts of 50 knots (58 mph) or greater for any duration (or otherwise locally/regionally defined). In some mountainous areas, the above numerical values are 43 knots (50 mph) and 65 knots (75 mph), respectively.\textsuperscript{102}

Strong Winds

Strong winds are defined as non-convective winds gusting less than 50 knots (58 mph), or sustained winds less than 35 knots (40 mph), resulting in a fatality, injury, or damage.\textsuperscript{103}

Thunderstorm Winds

Thunderstorm winds are winds that arise from thunderstorm convection (occurring within 30 minutes of lightning being observed or detected), with speeds of at least 50 knots (58 mph). They can also be winds of any speed (non-severe thunderstorm winds below 50 knots (58 mph)) producing a fatality, injury, or damage.\textsuperscript{104}

\textsuperscript{101} Retrieved on 07.15.2021 from https://forecast.weather.gov/glossary.php?word=wind%20gust
\textsuperscript{102} Retrieved on 07.17.2021 from https://www.nws.noaa.gov/directives/sym/pd01016005curr.pdf
\textsuperscript{103} Retrieved on 07.17.2021 from https://www.nws.noaa.gov/directives/sym/pd01016005curr.pdf
Please note: **Straight-line wind** is a term used to define any thunderstorm wind that is not associated with rotation. It is used mainly to differentiate from the rotational winds found in tornado-producing storms. However, it is not a term used in the NCEI Storm Events Database, and therefore cannot be used to determine severe weather history of or potential impacts to CSU campuses.

**Tornadoes**

A tornado is an extreme severe weather wind hazard. A tornado is a rapidly rotating column of air extending from a thunderstorm to the surface of the Earth. This column extends between cloud and the Earth’s surface. The damage from tornadoes comes from the strong winds they contain and the flying debris they create. It is generally believed that rotational wind speeds can be as high as 300 mph in the most violent tornadoes. On a local scale, tornadoes are the most violent and most destructive of all atmospheric phenomena.

**Mountain-Valley (Downslope) Wind Systems: Santa Ana, Diablo, and Sundowner Winds.**

**Santa Ana Winds.** A type of wind hazard that is peculiar to Southern California is called a *Santa Ana Wind*. Santa Ana winds are strong, topographically-enhanced, extremely dry downslope winds that originate inland and affect coastal southern California and northern Baja California (Mexico). They occur when air from a region of high pressure over the dry, desert region of the southwestern U.S. flows westward towards low pressure located off the California coast. This creates dry winds that flow east to west through the mountain passages in Southern California. These winds have a strong seasonal component; they are most common during the cooler months of the year, occurring from September through May. Santa Ana winds typically feel warm (or even hot) because as the cool desert air moves down the side of the mountain, it is compressed, which causes the temperature of the air to rise. If strong enough, Santa Ana winds can cause major property damage, and may present difficulties for airborne and seagoing transportation. They also may increase wildfire risk because of the dryness of the winds and the speed at which they can spread a flame across the landscape. (Note: The Wildfire hazard is profiled elsewhere in this document.)

106 Retrieved on 07.15.2021 from https://www.earthnetworks.com/tornado/
108 Retrieved on 07.15.2021 from https://www.weather.gov/bgm/severedefinitions
Figure below illustrates the mechanisms involved in the generation of Santa Ana winds across Southern California.

Figure 13: What Drives a Santa Ana Wind?\textsuperscript{111}

**Diablo Winds.** The Diablo wind is another type of topographically-enhanced downslope wind phenomenon that occurs in the North-Central areas of California. Diablo winds are offshore wind events that flow northeasterly over Northern California’s Coast Ranges, often creating high wind speeds downwind of major canyons and over ridges, and extreme fire danger for the San Francisco Bay Area. Diablo winds are driven by a surface pressure gradient that forms in response to an inverted pressure trough that develops over California.\textsuperscript{112}

**Sundowner Winds.** Sundowner winds are significant and potentially damaging downslope wind and warming events that periodically occur along a short segment of the

\textsuperscript{111} Retrieved on 07.14.2021 from https://twitter.com/nwslosangeles/status/933049473034579968

\textsuperscript{112} Retrieved on 07.13.2021 from https://www.fireweather.org/diablo-winds
southern California coast in the vicinity of Santa Barbara, CA. The unique topography of this coastal region promotes the development of Sundowner wind events: over a length of about 100 km, the coastline is oriented approximately west–east, with the adjoining narrow coastal plain bounded by a steeply rising (to elevations greater than 1200 m) and coast-parallel mountain range. Called Sundowner winds because they often begin in the late afternoon or early evening, their onset is typically associated with a rapid rise in temperature and decrease in relative humidity, and the winds tend to blow from the north from the Santa Ynez Mountains to the coast of Santa Barbara County, California. During the more intense Sundowner wind events, wind speeds can be of gale force 39-54 miles per hour) or higher, and can even reach hurricane force (≥ 74 miles per hour) in the most extreme cases. Temperatures over the coastal plain, and even at the coast itself, can rise significantly above 37.8°C (100°F). Seasonally, Sundowner winds peak in March, April, and May, with a minimum during summer and a secondary peak in winter that often corresponds with Santa Ana winds. In addition to causing a dramatic change from the more typical marine-influenced local weather conditions, Sundowner wind episodes have produced significant wind-related property and agricultural damage, as well as conditions of extreme fire danger.113 114 115

**Hail**

Hail is a form of precipitation consisting of solid ice that forms inside thunderstorm updrafts.116 It is roughly round in shape and at least 0.2’ in diameter. Hail develops in the upper atmosphere as ice crystals that are bounced about by high velocity updraft winds; the ice crystals accumulate frozen droplets and fall after developing enough weight. The size of hailstones varies and is a direct consequence of the severity and size of the storm that produces them – the higher the temperatures at the Earth’s surface, the greater the strength of the updrafts and the amount of time hailstones are suspended, and therefore the greater the size of the hailstone.117

**Lightning**

Lightning is an electrical discharge produced by a thunderstorm. Lightning rapidly heats the air in its immediate vicinity to about 50,000°F - about five times the temperature of the


surface of the sun. This compresses the surrounding air and creates a supersonic shock wave, which decays to an acoustic wave that is heard as thunder.\textsuperscript{118}

The discharge may occur within or between clouds, between the cloud and air, between a cloud and the ground, or between the ground and a cloud.\textsuperscript{119} Lightning that is produced from thunderstorms in which precipitation evaporates before reaching the ground is called “dry lightning.”

Location of the Hazard
Severe weather is a non-spatial hazard, and can occur anywhere in the CSU system, including either at the Cal Poly Pomona main campus or at satellite campus facilities owned by the school. No one area of the campus – or of the surrounding community – is subject to experiencing severe weather more than any other area.

There is geographic variability among the different types of mountain and valley wind events (as a sub-category of the severe weather hazard). Santa Ana winds occur in Southern California, Diablo winds occur in North-Central California, and Sundowner winds occur almost exclusively in Santa Barbara County, California.

Extent of the Hazard
Severe weather hazards are non-spatial hazards that potentially affect all Cal Poly Pomona campus areas equally. However, the smallest geographic unit of measurement for almost all official severe weather event data is at the county level. Because the severe weather data used do not exist at the campus level, it is assumed that the same (or similar) severe weather risks to Cal Poly Pomona reflect those of the surrounding community and County. As a result, all assets and people at Cal Poly Pomona are at risk from the effects of severe weather and can expect to experience at least some (or the complete range of) endemic severe weather hazards. In consideration of the campus’ design, layout, and operations, the severe weather history and degree of severity in the Pomona (Los Angeles County), Santa Paula (Ventura County), and Chino (San Bernardino County) areas, and the history and degree of severity of each severe weather sub-type identified by the extent scales (below), the campus planning committee ranks the overall extent of the Severe Weather hazard as \textbf{MODERATE}. See each sub-hazard below for the planning committee’s sub-type extent ranking.

\textit{Wind Hazard: Non-Rotational}
The Beaufort Scale is an empirical measure that relates wind speed to observed conditions at sea or on land. Its full name is the Beaufort wind force scale. First developed in 1805, it is still used today to estimate wind strengths.

Table 17-25: Beaufort Wind Force Scale

<table>
<thead>
<tr>
<th>Force</th>
<th>Speed (mph)</th>
<th>Speed (knots)</th>
<th>Description</th>
<th>Specifications for use at sea</th>
<th>Specifications for use on land</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0-1</td>
<td>0-1</td>
<td>Calm</td>
<td>Sea like a mirror.</td>
<td>Calm; smoke rises vertically.</td>
</tr>
<tr>
<td>1</td>
<td>1-3</td>
<td>1-3</td>
<td>Light Air</td>
<td>Ripples with the appearance of scales are formed, but without foam crests.</td>
<td>Direction of wind shown by smoke drift, but not by wind vanes.</td>
</tr>
<tr>
<td>2</td>
<td>4-7</td>
<td>4-6</td>
<td>Light Breeze</td>
<td>Small wavelets, still short, but more pronounced. Crests have a glassy appearance and do not break.</td>
<td>Wind felt on face; leaves rustle; ordinary vanes moved by wind.</td>
</tr>
<tr>
<td>3</td>
<td>8-12</td>
<td>7-10</td>
<td>Gentle Breeze</td>
<td>Large wavelets. Crests begin to break. Foam of glassy appearance. Perhaps scattered white horses.</td>
<td>Leaves and small twigs in constant motion; wind extends light flag.</td>
</tr>
<tr>
<td>4</td>
<td>13-18</td>
<td>11-16</td>
<td>Moderate Breeze</td>
<td>Small waves, becoming larger; fairly frequent white horses.</td>
<td>Raises dust and loose paper; small branches are moved.</td>
</tr>
<tr>
<td>5</td>
<td>19-24</td>
<td>17-21</td>
<td>Fresh Breeze</td>
<td>Moderate waves, taking a more pronounced long form; many white horses are formed.</td>
<td>Small trees in leaf begin to sway; crested wavelets form on inland waters.</td>
</tr>
<tr>
<td>No.</td>
<td>Beaufort Scale</td>
<td>Wind Force</td>
<td>Description</td>
<td></td>
<td></td>
</tr>
<tr>
<td>-----</td>
<td>---------------</td>
<td>------------</td>
<td>-------------</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>25-31</td>
<td>22-27</td>
<td><strong>Strong Breeze</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Large waves begin to form; the white foam crests are more extensive everywhere.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Large branches in motion; whistling heard in telegraph wires; umbrellas used with difficulty.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>32-38</td>
<td>28-33</td>
<td><strong>Near Gale</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Sea heaps up and white foam from breaking waves begins to be blown in streaks along the direction of the wind.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Whole trees in motion; inconvenience felt when walking against the wind.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>39-46</td>
<td>34-40</td>
<td><strong>Gale</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Moderately high waves of greater length; edges of crests begin to break into spindrift. The foam is blown in well-marked streaks along the direction of the wind.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Breaks twigs off trees; generally impedes progress.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>47-54</td>
<td>41-47</td>
<td><strong>Severe Gale</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>High waves. Dense streaks of foam along the direction of the wind. Crests of waves begin to topple, tumble and roll over. Spray may affect visibility.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Slight structural damage occurs (chimney-pots and slates removed)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>55-63</td>
<td>48-55</td>
<td><strong>Storm</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Very high waves with long overhanging crests. The resulting foam, in great patches, is blown in dense white streaks along the direction of the wind. On the whole the surface of the sea takes on a white appearance. The tumbling of the sea becomes heavy and shock-like. Visibility affected.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Seldom experienced inland; trees uprooted; considerable structural damage occurs.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>64-72</td>
<td>56-63</td>
<td><strong>Violent Storm</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Exceptionally high waves (small and medium-size ships might be for a time lost to view behind the waves). The sea is completely covered with long white patches of foam lying along the direction of the wind. Everywhere the edges of the wave crests are blown into froth. Visibility affected.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Very rarely experienced; accompanied by widespread damage.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
The air is filled with foam and spray. Sea completely white with driving spray; visibility very seriously affected.

Based on those extent ranking factors identified (above), the planning committee ranks the extent of non-rotational wind hazards as **MODERATE**.

**Extent: Tornado**

Tornadoes have their own severity/extent scale. Until 2007, tornadoes were measured and described according to the Fujita Scale.\(^{123}\)

In February 2007, use of the Fujita Scale was discontinued. In its place, the Enhanced Fujita (EF) Scale is used. The Enhanced Fujita scale considers how most structures are designed and is thought to be a much more accurate representation of the surface wind speeds in the most violent tornadoes. Like the original Fujita scale, the Enhanced Fujita scale is a set of wind estimates (not measurements) based on damage.

It is important to note the **date** that a tornado occurred. Tornadoes that occurred prior to February, 2007 are classified using the original Fujita scale and will not be converted to the Enhanced Fujita Scale.

Table below illustrates the Fujita Scale in use prior to February 2007.

Table 17-26: Fujita Tornado Scale (Pre-February 2007)\(^{124}\)

<table>
<thead>
<tr>
<th>F-Scale Number</th>
<th>Intensity Phrase</th>
<th>Wind Speed</th>
<th>Type of Damage</th>
</tr>
</thead>
<tbody>
<tr>
<td>F0</td>
<td>Gale tornado</td>
<td>40-72 mph</td>
<td>Some damage to chimneys; breaks branches off trees; pushes over shallow-rooted trees; damages sign boards.</td>
</tr>
<tr>
<td>F1</td>
<td>Moderate tornado</td>
<td>73-112 mph</td>
<td>The lower limit is the beginning of hurricane wind speed; peels surface off roofs; mobile homes pushed off foundations or overturned; moving autos pushed off the roads; attached garages may be destroyed.</td>
</tr>
</tbody>
</table>

---


<table>
<thead>
<tr>
<th>F2</th>
<th>Significant tornado</th>
<th>113-157 mph</th>
<th>Considerable damage. Roofs torn off frame houses; mobile homes demolished; boxcars pushed over; large trees snapped or uprooted; light object missiles generated.</th>
</tr>
</thead>
<tbody>
<tr>
<td>F3</td>
<td>Severe tornado</td>
<td>158-206 mph</td>
<td>Roof and some walls torn off well-constructed houses; trains overturned; most trees in forest uprooted.</td>
</tr>
<tr>
<td>F4</td>
<td>Devastating tornado</td>
<td>207-260 mph</td>
<td>Well-constructed houses leveled; structures with weak foundations blown off some distance; cars thrown and large missiles generated.</td>
</tr>
<tr>
<td>F5</td>
<td>Incredible tornado</td>
<td>261-318 mph</td>
<td>Strong frame houses lifted off foundations and carried considerable distances to disintegrate; automobile sized missiles fly through the air in excess of 100 meters; trees debarked; steel reinforced concrete structures badly damaged.</td>
</tr>
<tr>
<td>F6</td>
<td>Inconceivable tornado</td>
<td>319-379 mph</td>
<td>These winds are very unlikely. The small area of damage they might produce would probably not be recognizable along with the mess produced by F4 and F5 wind that would surround the F6 winds. Missiles, such as cars and refrigerators would do serious secondary damage that could not be directly identified as F6 damage. If this level is ever achieved, evidence for it might only be found in some manner of ground swirl pattern, for it may never be identifiable through engineering studies.</td>
</tr>
</tbody>
</table>
Table below illustrates the Enhanced Fujita (EF) Scale, currently in use. Tornadoes that have occurred since February, 2007 are classified using the Enhanced Fujita Scale.

Table 17-27: Enhanced Fujita Scale (February 2007 and Later)\(^{125}\)

<table>
<thead>
<tr>
<th>Enhanced Fujita Category</th>
<th>Wind Speed</th>
<th>Potential Damage</th>
</tr>
</thead>
<tbody>
<tr>
<td>EF0</td>
<td>65-85 mph</td>
<td>Light damage. Peels surface off some roofs; some damage to gutters or siding; branches broken off trees; shallow-rooted trees pushed over.</td>
</tr>
<tr>
<td>EF1</td>
<td>86-110 mph</td>
<td>Moderate damage. Roofs severely stripped; mobile homes overturned or badly damaged; loss of exterior doors; windows and other glass broken.</td>
</tr>
<tr>
<td>EF2</td>
<td>111-135 mph</td>
<td>Considerable damage. Roofs torn off well-constructed houses; foundations of frame homes shifted; mobile homes completely destroyed; large trees snapped or uprooted; light-object missiles generated; cars lifted off ground.</td>
</tr>
<tr>
<td>EF3</td>
<td>136-165 mph</td>
<td>Severe damage. Entire stories of well-constructed houses destroyed; severe damage to large buildings such as shopping malls; trains overturned; trees debarked; heavy cars lifted off the ground and thrown; structures with weak foundations blown away some distance.</td>
</tr>
<tr>
<td>EF4</td>
<td>166-200 mph</td>
<td>Devastating damage. Well-constructed houses and whole frame houses completely leveled; cars thrown and small missiles generated.</td>
</tr>
</tbody>
</table>

Incredible damage. Strong frame houses leveled off foundations and swept away; automobile-sized missiles fly through the air in excess of 100 m (107 yd); high-rise buildings have significant structural deformation; incredible phenomena will occur.

Based on the extent ranking factors identified (above), the planning committee ranks the extent of tornados as **LOW**.

**Extent: Hail**

The National Oceanic and Atmospheric Administration and the Tornado and Storm Research Organization (TORRO) have combined efforts to create the Hailstorm Intensity Scale. Table 17-XX provides details of this scale.

Table 17-28: Combined NOAA/TORRO Hailstorm Intensity Scale

<table>
<thead>
<tr>
<th>Size Code</th>
<th>Intensity Category</th>
<th>Typical Hail Diameter</th>
<th>Approximate Size</th>
<th>Typical Damage Impacts</th>
</tr>
</thead>
<tbody>
<tr>
<td>H0</td>
<td>Hard Hail</td>
<td>Up to 0.33”</td>
<td>Pea</td>
<td>No damage</td>
</tr>
<tr>
<td>H1</td>
<td>Potentially Damaging</td>
<td>0.33” – 0.60”</td>
<td>Marble or Mothball</td>
<td>Slight damage to plants and crops</td>
</tr>
<tr>
<td>H2</td>
<td>Potentially Damaging</td>
<td>0.60” – 0.80”</td>
<td>Dime or grape</td>
<td>Significant damage to fruit, crops, and vegetation</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Damage Severity</th>
<th>Diameter Range</th>
<th>Material</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>H3</td>
<td>Severe</td>
<td>0.80” – 1.20”</td>
<td>Nickel to Quarter</td>
<td>Severe damage to fruit and crops, damage to glass and plastic structures, paint and wood scored</td>
</tr>
<tr>
<td>H4</td>
<td>Severe</td>
<td>1.20” – 1.60”</td>
<td>Half Dollar to Ping Pong Ball</td>
<td>Widespread glass damage, vehicle body damage</td>
</tr>
<tr>
<td>H5</td>
<td>Destructive</td>
<td>1.60” – 2.0”</td>
<td>Silver Dollar to Golf Ball</td>
<td>Wholesale destruction of glass, damage to tiled roofs, significant risk of injuries</td>
</tr>
<tr>
<td>H6</td>
<td>Destructive</td>
<td>2.0” – 2.4”</td>
<td>Lime or Egg</td>
<td>Aircraft body dented; brick walls pitted</td>
</tr>
<tr>
<td>H7</td>
<td>Very Destructive</td>
<td>2.4” – 3.0”</td>
<td>Tennis Ball</td>
<td>Severe roof damage, risk of serious injuries</td>
</tr>
<tr>
<td>H8</td>
<td>Very Destructive</td>
<td>3.0” – 3.5”</td>
<td>Baseball to Orange</td>
<td>Severe damage to aircraft body</td>
</tr>
</tbody>
</table>
Based on those extent ranking factors identified (above), the planning committee ranks the extent of the hail hazard as **LOW**.

**Extent: Lightning**

The National Weather Service (NWS) uses a Lightning Activity Level (LAL) scale to indicate the frequency and character of cloud-to-ground (C/G) lightning. The scale uses a range of 1 – 6, with 6 being the high end of the scale. Table below provides details of the LAL scale.

Table 17-29: Lightning Activity Level (LAL) Scale

<table>
<thead>
<tr>
<th>Rank</th>
<th>Cloud and Storm Development</th>
<th>Areal Coverage</th>
<th>Counts C/G per 5 Minutes</th>
<th>Counts C/G per 15 Minutes</th>
<th>Average C/G per Minute</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>No Thunderstorms</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>2</td>
<td>Cumulus clouds are common but only a few reaches the towering stage. A single thunderstorm must be confirmed in the rating area. The clouds mostly produce virga, but light rain will occasionally reach ground. Lightning is very infrequent.</td>
<td>&lt;15%</td>
<td>1-5</td>
<td>1-8</td>
<td>&lt;1</td>
</tr>
</tbody>
</table>

### Lightning Activity Level Scale

<table>
<thead>
<tr>
<th>Rank</th>
<th>Cloud and Storm Development</th>
<th>Areal Coverage</th>
<th>Counts C/G per 5 Minutes</th>
<th>Counts C/G per 15 Minutes</th>
<th>Average C/G per Minute</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>Cumulus clouds are common. Swelling and towering cumulus cover less than 2/10 of the sky. Thunderstorms are few, but 2 to 3 occur within the observation area. Light to moderate rain will reach the ground, and lightning is infrequent.</td>
<td>15% to 24%</td>
<td>6-10</td>
<td>9-15</td>
<td>1-2</td>
</tr>
<tr>
<td>4</td>
<td>Swelling cumulus and towering cumulus cover 2-3/10 of the sky. Thunderstorms are scattered but more than three must occur within the observation area. Moderate rain is commonly produced, and lightning is frequent.</td>
<td>25% to 50%</td>
<td>11-15</td>
<td>16-25</td>
<td>2-3</td>
</tr>
<tr>
<td>5</td>
<td>Towering cumulus and thunderstorms are numerous. They cover more than 3/10 and occasionally obscure the sky. Rain is moderate to heavy, and lightning is frequent and intense.</td>
<td>&gt;50%</td>
<td>&gt;15</td>
<td>&gt;25</td>
<td>&gt;3</td>
</tr>
<tr>
<td>6</td>
<td>Dry lightning outbreak. (LAL of 3 or greater with majority of storms producing little or no rainfall.)</td>
<td>&gt;15%</td>
<td>None</td>
<td>None</td>
<td>None</td>
</tr>
</tbody>
</table>

Based on those extent ranking factors identified (above), the planning committee ranks the extent of the lightening hazard as **LOW**.

*Extent: Thunderstorms that Generate Wind, Tornado, Hail, and Lightning Hazard Events*
Thunderstorms are not explicitly identified as a severe weather category for this hazard profile. However, they are responsible for most tornado, lightning, and hail hazard events – as well as a significant number of wind hazard events – across California and the CSU system. While individual thunderstorms affect relatively small areas, there are many instances in which thunderstorms can cluster together and/or travel in a line over long distances, producing significant damage over large geographic areas.

A thunderstorm is classified as “severe” when certain meteorological parameters within the thunderstorm are reached (i.e., damaging winds or speeds of 58 mph (50 knots) or greater, hail 1 inch in diameter or larger, and/or a tornado). However, there is currently no established, objective severity scale for thunderstorms. That said, according to the Glossary of Meteorology published by the American Meteorological Society (AMS), a thunderstorm is reported as light, medium, or heavy according to following five (5) characteristics:

- the nature of the lightning and thunder;
- the type and intensity of the precipitation, if any;
- the speed and gustiness of the wind;
- the appearance of the clouds; and
- the effect upon surface temperature.

A thunderstorm may also be classified by the nature of the overall weather situation in which the thunderstorm is produced, including:

- **Airmass Thunderstorm**: A thunderstorm produced by local convection within an unstable air mass;

- **Frontal Thunderstorm**: An individual thunderstorm the initiation of which results from rising motion associated with a front, or a thunderstorm within a convective system generated and organized by frontal rising motion;

128 Retrieved on 07.15.2021 from https://www.noaa.gov/explainers/severe-storms
129 Retrieved on 07.15.2021 from https://www.weather.gov/safety/thunderstorm
**Squall-line Thunderstorm**: An individual thunderstorm included within a squall line (i.e., a continuous or broken line of active deep moist convection frequently associated with thunder). \(^{133}\) \(^{134}\)

Based on the extent ranking factors identified (above) in relation to campus layout and operations, and past event low degree of severity, the planning committee ranks the extent of the thunderstorm hazard as **LOW**.

**History of the Hazard**

Severe weather hazards have been an annual occurrence in Los Angeles County and on the Cal Poly Pomona campus in Los Angeles County. Severe weather hazards have also been an annual occurrence at satellite campus facilities in both Santa Paula (Ventura County) and Chino (San Bernardino County). Historical data for these hazards are presented below.

**Historical Storm Data Collection: NCEI Storm Events Database**

Historical information regarding severe weather hazards can be found using The National Centers for Environmental Information (NCEI) Storm Events Database. The Storm Events Database contains searchable, archived National Weather Service (NWS) storm data from January 1950 to April 2021, as entered by NOAA’s National Weather Service (NWS). Due to changes in the data collection and processing procedures over time, there are unique periods of record available depending on the event type.\(^{135}\) For example, from 1950 through 1954, only tornado events were recorded; from 1955 through 1995, only tornado, thunderstorm wind, and hail events were introduced into the database; from 1996 to present, 45 additional event types are recorded, including high wind, strong wind, and lightning events.\(^{136}\) To obtain the most accurate portrayal of severe weather event frequency, searches of the Storm Events Database are conducted using data collected since 01/01/1996. As a reminder, all official severe weather event data is at the county level. Severe weather data do not exist at the campus level. That said, it may be the case that the campus to some degree experiences the severe weather events reported for the surrounding community and County.

**Los Angeles County**

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**Wind Hazards (excluding Tornadoes)**

Information obtained from the NCEI Storm Event Database website shows the number of events (or occurrences) of wind hazard events in Los Angeles County since 1996.\(^{137}\) Here, wind hazard events include all “High Wind,” “Strong Wind,” and “Thunderstorm Wind” storm reports.\(^{138}\)

- **High Wind**: at least 387 events, or approximately 15.28 events per year\(^ {139}\)
- **Strong Wind**: at least 3 events, or 0.12 events per year\(^ {140}\)
- **Thunderstorm Wind**: at least 43 events, or approximately 1.70 events per year\(^ {141}\)
- **All Wind Hazard events** (excluding Tornadoes): at least 427 events, or approximately 16.86 events per year.\(^ {142}\) (Note: This was determined by conducting a simultaneous search of the component wind hazards of high wind, strong wind and thunderstorm wind.)


\(^{139}\) National Climatic Data Center. Storm Events Database. Retrieved 07.29.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28Z%29+High+Wind&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=LOS%2BANGELES%3A37&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA

\(^{140}\) National Climatic Data Center. Storm Events Database. Retrieved 07.29.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28Z%29+Strong+Wind&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=LOS%2BANGELES%3A37&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA

\(^{141}\) National Climatic Data Center. Storm Events Database. Retrieved 07.29.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Thunderstorm+Wind&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=LOS%2BANGELES%3A37&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA

\(^{142}\) National Climatic Data Center. Storm Events Database. Retrieved 07.29.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28Z%29+High+Wind&eventType=%28Z%29+Strong+Wind&eventType=%28C%29+Thunderstorm+Wind&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=LOS%2BANGELES%3A37&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA
Overall, in Los Angeles County, there have been at least 427 wind hazard events since 1996, excluding tornadoes.\textsuperscript{143} That translates to an approximate average historical frequency of occurrence of \textbf{16.86} wind hazard events per year.

Please note: Differences between the sums of individual component severe weather hazard event Database searches (i.e., 433 events) and simultaneous Database searches of all severe weather hazard events (i.e., 427 events) may be due to the following factors: (1) multiple event types are in the same record (e.g., "Thunderstorm Wind/Hail" or "Hail/Tornado;" and/or (2) severe weather hazard events such as “Thunderstorm Wind” or “Hail” that are reported for Los Angeles County have actually taken place hundreds of miles away, but are erroneously recorded as events that have occurred in the County.\textsuperscript{144} When such a discrepancy arises, the more conservative aggregate hazard wind event value (i.e., 427 events) is used to determine the historical frequency of occurrence for the severe weather hazard. The origin of this discrepancy is unknown at this time.

**Historical Wind Hazard Losses for Los Angeles County since 1996**

According to the NCEI Storm Events Database, the wind hazard events that Los Angeles County has experienced since 1996 have been costly. There have been 2 deaths and 4 injuries reported from wind hazard events (excluding tornadoes) in Los Angeles County; no property or crop damage has been reported.\textsuperscript{145}

**Tornado Wind Hazards**

Information from the NCEI Storm Events Database indicates that since 1996, there have been 12 reported events of tornadoes in Los Angeles County, which translates to approximately \textbf{0.47} tornado events per year.\textsuperscript{146}

\textsuperscript{143} National Climatic Data Center. Storm Events Database. Retrieved 07.29.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Thunderstorm+Wind&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=LOS%2BANGELES%3A37&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA


\textsuperscript{145} National Climatic Data Center. Storm Events Database. Retrieved 07.29.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28Z%29+Strong+Wind&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=LOS%2BANGELES%3A37&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA

\textsuperscript{146} National Climatic Data Center. Storm Events Database. Retrieved 07.29.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Tornado&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=LOS%2BANGELES%3A37&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA
The vast majority of tornado reports in Los Angeles County since 1996 have been of tornadoes with a severity rating of F0/EF0. Only one (1) or 12 of the tornadoes reported in has been rated F1/EF1 or higher (it was an F1 tornado that occurred in 1998); that translates to approximately 0.04 events of F1/EF1 tornadoes have occurred per year in Los Angeles County.¹⁴⁷

Historical Tornado Hazard Losses for Los Angeles County since 1996

According to the NCEI Storm Events Database, the tornado hazard events that Los Angeles County has experienced since 1996 have been minimal. There have been no deaths, or property or crop damage reported; however, 1 injury has been reported.¹⁴⁸ (Note: The F1/EF1 tornado that occurred in Los Angeles County in 1998 caused the one (1) reported injury.)

Hail

Information from the NCEI Storm Events Database indicates that since 1996, there have been 18 reported events of hail in Los Angeles County, which translates to approximately 0.71 hail events per year.¹⁴⁹ (Note: The NCEI Storm Event Database search results for hail indicate that there has been a total of 19 reports of hail since 1996. However, one (1) entry is for a hail event in San Diego County, over 100 miles away from Los Angeles County. The origin of this error is unknown at this time.)

Historical Hail Hazard Losses for Los Angeles County since 1996

According to the NCEI Storm Events Database, the hail hazard events that Los Angeles County has experienced since 1996 have been costly. While there have been no deaths, injuries, or crop damages reported, property damage estimates have totaled approximately $3,500,000; the property damage estimate reflects one hail hazard event that occurred in 2003.¹⁵⁰ (Note: The San Diego County hail event that was included

¹⁴⁷ National Climatic Data Center. Storm Events Database. Retrieved 07.29.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Tornado&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=12&endDate_dd=31&endDate_yyyy=2021&county=LOS%2BANGELES%3A37&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA

¹⁴⁸ National Climatic Data Center. Storm Events Database. Retrieved 07.29.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Tornado&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=12&endDate_dd=31&endDate_yyyy=2021&county=LOS%2BANGELES%3A37&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA

¹⁴⁹ National Climatic Data Center. Storm Events Database. Retrieved 07.29.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Hail&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=12&endDate_dd=31&endDate_yyyy=2021&county=LOS%2BANGELES%3A37&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA

¹⁵⁰ National Climatic Data Center. Storm Events Database. Retrieved 07.29.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Hail&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=12&endDate_dd=31&endDate_yyyy=2021&county=LOS%2BANGELES%3A37&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA
erroneously in the search results for hail hazard events in Los Angeles County accounted
for all injuries (i.e., 5) and crop damage estimates (i.e., $300,000) presented in the search
results.)

**Lightning**

Information from the NCEI Storm Events Database indicates that since 1996, there have
been 9 reported events of lightning in Los Angeles County, which translates to
approximately 0.36 lightning events per year.\(^{151}\)

**Historical Lightning Hazard Losses for Los Angeles County since 1996**

According to the NCEI Storm Events Database, the lightning hazard events that Los
Angeles County has experienced since 1996 have been costly. While no property or crop
damages have been reported, there have been 2 deaths and 13 injuries attributed to
lightning hazard events.\(^{152}\)

**All Severe Weather Hazard Events Recorded by the NCEI Storm Events Database**

**(Los Angeles County)**

Information obtained from the NCEI Storm Events Database indicates that there have
been 466 occurrences of the severe weather hazard in Los Angeles County. This
translates to 18.39 severe weather hazard occurrences per year.\(^{153}\)

Please note: Differences between the sums of individual component severe weather
hazard event Database searches (i.e., 472 events) and simultaneous Database searches of
all severe weather hazard events (i.e., 466 events) may be due to the following factors: (1)

\(^{151}\) National Climatic Data Center. Storm Events Database. Retrieved 07.29.2021 from
https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Lightning&beginDate_mm=01&
beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=LOS%2B
ANGELES%3A37&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitButton=Search&statefips=6%2C
CALIFORNIA

\(^{152}\) National Climatic Data Center. Storm Events Database. Retrieved 07.29.2021 from
https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Lightning&beginDate_mm=01&
beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=LOS%2B
ANGELES%3A37&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitButton=Search&statefips=6%2C
CALIFORNIA

\(^{153}\) National Climatic Data Center. Storm Events Database. Retrieved 07.29.2021 from
https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Hail&eventType=%28Z%29+High+Wind&eventType=%28C%29+Lightning&eventType=%28Z%29+Strong+Wind&eventType=%28C%29+Thunderstorm+Wind&eventType=%28C%29+Tornado&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=LOS%2BANGELES%3A37&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitButton=Search&statefips=6%2C
CALIFORNIA
multiple event types are in the same record (e.g., "Thunderstorm Wind/Hail" or "Hail/Tornado;" and/or (2) severe weather hazard events such as “Thunderstorm Wind” or “Hail” that are reported for Los Angeles County have actually taken place hundreds of miles away, but are erroneously recorded as events that have occurred in the County.\textsuperscript{154} When such a discrepancy arises, the more conservative aggregate hazard wind event value (i.e., 466 events) is used to determine the historical frequency of occurrence for the severe weather hazard. The origin of this discrepancy is unknown at this time.

**Historical, Aggregated Severe Hazard Losses for Los Angeles County since 1996**

According to the NCEI Storm Events Database, the severe weather events that Los Angeles County has experienced since 1996 have been costly. There have been 4 deaths and 18 injuries, and property damage estimates have totaled approximately $3,500,000; no crop damage has been reported. *It is important to note that for all Los Angeles County severe weather hazard events recorded on the Storm Events Database, lightning has accounted for half of the deaths, and 13 out of 14 (92.9\%) injuries reported. However, hail has accounted for all estimated property damage.*

**Ventura County**

**Wind Hazards (excluding Tornadoes)**

Information obtained from the NCEI Storm Event Database website shows the number of events (or occurrences) of wind hazard events in Ventura County since 1996.\textsuperscript{155} Here, wind hazard events include all “High Wind,” “Strong Wind,” and “Thunderstorm Wind” storm reports.\textsuperscript{156}

- *High Wind:* at least 233 events, or approximately 9.20 events per year\textsuperscript{157}

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\end{itemize}


\textsuperscript{155} National Climatic Data Center. Storm Events Database. Retrieved on 07.29.2021 from https://www.ncdc.noaa.gov/stormevents/

\textsuperscript{156} National Climatic Data Center. Storm Events Database. Retrieved on 07.29.2021 from https://www.ncdc.noaa.gov/stormevents/

\textsuperscript{157} National Climatic Data Center. Storm Events Database. Retrieved on 07.29.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28Z%29+High+Wind&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=VENTURA%3A111&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA
- **Strong Wind**: at least 3 events, or 0.12 events per year\(^{158}\)
- **Thunderstorm Wind**: at least 10 events, or approximately 0.39 events per year\(^{159}\)
- **All Wind Hazard events** (excluding Tornadoes): at least 240 events, or approximately 9.47 events per year.\(^{160}\) (Note: This was determined by conducting a simultaneous search of the component wind hazards of high wind, strong wind and thunderstorm wind.)

Overall, in Ventura County, there have been at least **240** wind hazard events since 1996, excluding tornadoes.\(^{161}\) That translates to an approximate average historical frequency of occurrence of **9.47** wind hazard events per year.

Please note: Differences between the sums of individual component severe weather hazard event Database searches (i.e., 246 events) and simultaneous Database searches of all severe weather hazard events (i.e., 240 events) may be due to the following factors: (1) multiple event types are in the same record (e.g., "Thunderstorm Wind/Hail" or "Hail/Tornado;" and/or (2) severe weather hazard events such as “Thunderstorm Wind” or “Hail” that are reported for Ventura County have actually taken place hundreds of miles away, but are erroneously recorded as events that have occurred in the County.\(^{162}\) When such a discrepancy arises, the more conservative aggregate hazard wind event

\(^{158}\) National Climatic Data Center. Storm Events Database. Retrieved on 07.29.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28Z%29+Strong+Wind&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=VENTURA%3A111&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA

\(^{159}\) National Climatic Data Center. Storm Events Database. Retrieved on 07.29.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Thunderstorm+Wind&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=VENTURA%3A111&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA

\(^{160}\) National Climatic Data Center. Storm Events Database. Retrieved on 07.29.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28Z%29+High+Wind&eventType=%28Z%29+Strong+Wind&eventType=%28C%29+Thunderstorm+Wind&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=VENTURA%3A111&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA

\(^{161}\) National Climatic Data Center. Storm Events Database. Retrieved on 07.29.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28Z%29+Strong+Wind&eventType=%28C%29+Thunderstorm+Wind&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=VENTURA%3A111&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA

value (i.e., 240 events) is used to determine the historical frequency of occurrence for the severe weather hazard. The origin of this discrepancy is unknown at this time.

**Historical Wind Hazard Losses for Ventura County since 1996**

According to the NCEI Storm Events Database, the wind hazard events that Ventura County has experienced since 1996 have been costly. There has been 1 death associated with wind hazards; however, there have been no injuries, or property and crop damage.¹⁶³

**Tornado Wind Hazards**

Information from the NCEI Storm Events Database indicates that since 1996, there have been 5 reported events of tornadoes in Ventura County, which translates to approximately **0.20** tornado events per year.¹⁶⁴ All tornado reports in Ventura County since 1996 have been of tornadoes with a severity rating of F0/EF0.¹⁶⁵

**Historical Tornado Hazard Losses for Ventura County since 1996**

According to the NCEI Storm Events Database, the tornado hazard events that Ventura County has experienced since 1996 have not generated any known losses; no deaths, injuries, or property or crop damage have been reported in Ventura County from tornado hazard events.¹⁶⁶

**Hail**

¹⁶³ National Climatic Data Center. Storm Events Database. Retrieved on 07.29.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28Z%29+High+Wind&eventType=%28Z%29+Strong+Wind&eventType=%28C%29+Thunderstorm+Wind&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=VENTURA%3A111&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA

¹⁶⁴ National Climatic Data Center. Storm Events Database. Retrieved on 07.29.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Tornado&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=VENTURA%3A111&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA

¹⁶⁵ National Climatic Data Center. Storm Events Database. Retrieved on 07.29.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Tornado&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=VENTURA%3A111&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA

¹⁶⁶ National Climatic Data Center. Storm Events Database. Retrieved on 07.29.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Tornado&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=VENTURA%3A111&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA
Information from the NCEI Storm Events Database indicates that since 1996, there have been three (3) reported events of hail in Ventura County, which translates to approximately 0.12 hail events per year.\(^{167}\) (Note: The NCEI Storm Event Database search results for hail indicate that there has been a total of four (4) reports of hail since 1996. However, one (1) entry is for a hail event in San Diego County, hundreds of miles away from Ventura County. The origin of this discrepancy is unknown at this time.)

**Historical Hail Hazard Losses for Ventura County since 1996**

According to the NCEI Storm Events Database, the hail hazard events that Ventura County has experienced since 1996 have generated no known losses. There have been no deaths, injuries, or property or crop damage reported.\(^{168}\) (Note: The San Diego County hail event that was included erroneously in the search results for hail events in Ventura County accounted for all injuries (i.e., 5) and crop damage estimates (i.e., $300,000) presented in the search results.)

**Lightning**

Information from the NCEI Storm Events Database indicates that since 1996, there have been two (2) reported events of lightning in Ventura County, which translates to approximately 0.08 lightning events per year.\(^{169}\)

**Historical Lightning Hazard Losses for Ventura County since 1996**

According to the NCEI Storm Events Database, the lightning hazard events that Ventura County has experienced since 1996 have been costly. While there have been no deaths, or

\(^{167}\) National Climatic Data Center. Storm Events Database. Retrieved on 07.29.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Hail&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=VENTURA%3A111&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA

\(^{168}\) National Climatic Data Center. Storm Events Database. Retrieved on 07.29.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Hail&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=VENTURA%3A111&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA

\(^{169}\) National Climatic Data Center. Storm Events Database. Retrieved on 07.29.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Lightning&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=VENTURA%3A111&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA
property or crop damage, there have been 3 injuries associated with a lightning strike that occurred in 2011.\textsuperscript{170}

**All Severe Weather Hazard Events Recorded by the NCEI Storm Events Database (Ventura County)**

Information obtained from the NCEI Storm Events Database indicates that there have been \textbf{250} occurrences of the severe weather hazard in Ventura County. This translates to \textbf{9.87} severe weather hazard occurrences per year.\textsuperscript{171}

Please note: Differences between the sums of individual component severe weather hazard event Database searches (i.e., 256 events) and simultaneous Database searches of all severe weather hazard events (i.e., 250 events) may be due to the following factors: (1) multiple event types are in the same record (e.g., "Thunderstorm Wind/Hail" or "Hail/Tornado," and/or (2) severe weather hazard events such as “Thunderstorm Wind” or “Hail” that are reported for Ventura County have actually taken place hundreds of miles away, but are erroneously recorded as events that have occurred in the County.\textsuperscript{172} When such a discrepancy arises, the more conservative aggregate hazard wind event value (i.e., 250 events) is used to determine the historical frequency of occurrence for the severe weather hazard. The origin of this discrepancy is unknown at this time.

**Historical, Aggregated Severe Hazard Losses for Ventura County since 1996**

According to the NCEI Storm Events Database, the severe weather hazard events that Ventura County has experienced since 1996 have been costly. There has been 1 death and 3 injuries, but no property or crop damage.\textsuperscript{173} \textit{However, it is important to note that for all ________}

\textsuperscript{170} National Climatic Data Center. Storm Events Database. Retrieved on 07.29.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Lightning&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=VENTURA%3A111&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA

\textsuperscript{171} National Climatic Data Center. Storm Events Database. Retrieved on 07.29.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Hail&eventType=%28Z%29+High+Wind&eventType=%28C%29+Lightning&eventType=%28Z%29+Strong+Wind&eventType=%28C%29+Thunderstorm+Wind&eventType=%28C%29+Tornado&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=VENTURA%3A111&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA


\textsuperscript{173} National Climatic Data Center. Storm Events Database. Retrieved on 07.29.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Hail&eventType=%28Z%29+High+Wind&eventType=%28C%29+Lightning&eventType=%28Z%29+Strong+Wind&eventType=%28C%29+Thunderstorm+Wind&eventType=%28C%29+Tornado&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=VENTURA%3A111&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA

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Ventura County severe weather hazard events recorded on the Storm Events Database, all deaths and injuries have been caused by wind hazard events alone. (Again, there have been no reported property or crop damages associated with severe weather hazards in Ventura County since 1996.)

San Bernardino County

Wind Hazards (excluding Tornadoes)

Information obtained from the NCEI Storm Event Database website shows the number of events (or occurrences) of wind hazard events in San Bernardino County since 1996. Here, wind hazard events include all “High Wind,” “Strong Wind,” and “Thunderstorm Wind” storm reports.

- **High Wind**: at least 493 events, or approximately 19.46 events per year
- **Strong Wind**: at least 70 events, or 2.76 events per year
- **Thunderstorm Wind**: at least 116 events, or approximately 4.58 events per year


176 National Climatic Data Center. Storm Events Database. Retrieved 07.30.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28Z%29+High+Wind&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=SAN%2BBERNARDINO%3A71&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA

177 National Climatic Data Center. Storm Events Database. Retrieved 07.30.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28Z%29+Strong+Wind&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=SAN%2BBERNARDINO%3A71&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA

178 National Climatic Data Center. Storm Events Database. Retrieved 07.30.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Thunderstorm+Wind&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=SAN%2BBERNARDINO%3A71&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA
Overall, in San Bernardino County, there have been at least 673 wind hazard events since 1996, excluding tornadoes. That translates to an approximate average historical frequency of occurrence of 26.57 wind hazard events per year.

Please note: Differences between the sums of individual component severe weather hazard event Database searches (i.e., 679 events) and simultaneous Database searches of all severe weather hazard events (i.e., 673 events) may be due to the following factors: (1) multiple event types are in the same record (e.g., "Thunderstorm Wind/Hail" or "Hail/Tornado"; and/or (2) severe weather hazard events such as “Thunderstorm Wind” or “Hail” that are reported for San Bernardino County have actually taken place hundreds of miles away, but are erroneously recorded as events that have occurred in the County. When such a discrepancy arises, the more conservative aggregate hazard wind

179 National Climatic Data Center. Storm Events Database. Retrieved 07.30.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28Z%29+High+Wind&eventType=%28Z%29+Strong+Wind&eventType=%28C%29+Thunderstorm+Wind&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=SAN%2BBERNARDINO%3A71&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA

180 National Climatic Data Center. Storm Events Database. Retrieved 07.30.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28Z%29+High+Wind&eventType=%28Z%29+Strong+Wind&eventType=%28C%29+Thunderstorm+Wind&beginDate_mm=01&beginDate_dd=30&beginDate_yyyy=2016&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=SAN%2BBERNARDINO%3A71&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA

181 National Climatic Data Center. Storm Events Database. Retrieved 07.30.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28Z%29+High+Wind&eventType=%28Z%29+Strong+Wind&eventType=%28C%29+Thunderstorm+Wind&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=SAN%2BBERNARDINO%3A71&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA

182 National Climatic Data Center. Storm Events Database. Retrieved 07.30.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28Z%29+High+Wind&eventType=%28Z%29+Strong+Wind&eventType=%28C%29+Thunderstorm+Wind&beginDate_mm=01&beginDate_dd=30&beginDate_yyyy=2016&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=SAN%2BBERNARDINO%3A71&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA

event value (i.e., 673 events) is used to determine the historical frequency of occurrence for the severe weather hazard. The origin of this discrepancy is unknown at this time.

**Historical Wind Hazard Losses for San Bernardino County since 1996**

According to the NCEI Storm Events Database, the wind hazard events that San Bernardino County has experienced since 1996 have been costly. There have been 4 deaths and 42 injuries, and property and crop damage estimates have totaled approximately $52,873,000 and $2,000,000, respectively.  

**Tornado Wind Hazards**

Information from the NCEI Storm Events Database indicates that since 1996, there have been 16 reported events of tornadoes in San Bernardino County, which translates to approximately 0.63 tornado events per year.

The 11 out of the 16 the tornadoes reported in San Bernardino County since 1996 have been of tornadoes with a severity rating of F0/EF0. Each of the remaining five (5) tornadoes have had a severity rating of F1/EF1; that translates to approximately 0.20 events of F1/EF1 tornadoes that have occurred per year in San Bernardino County.

**Historical Tornado Hazard Losses for San Bernardino County since 1996**

According to the NCEI Storm Events Database, the tornado hazard events that San Bernardino County has experienced since 1996 have been moderate. There have been no

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184 National Climatic Data Center. Storm Events Database. Retrieved 07.30.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28Z%29+High+Wind&eventType=%28Z%29+Strong+Wind&eventType=%28C%29+Thunderstorm+Wind&beginDate_mm=01&beginDate_dd=01&begin Date_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=SAN%2BBERNARDINO%3A71&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA

185 National Climatic Data Center. Storm Events Database. Retrieved 07.30.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28Z%29+High+Wind&eventType=%28Z%29+Strong+Wind&eventType=%28C%29+Thunderstorm+Wind&beginDate_mm=01&beginDate_dd=01&begin Date_yyyy=2016&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=SAN%2BBERNARDINO%3A71&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA

186 National Climatic Data Center. Storm Events Database. Retrieved 07.30.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Tornado&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=SAN%2BBERNARDINO%3A71&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA

187 National Climatic Data Center. Storm Events Database. Retrieved 07.30.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Tornado&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=SAN%2BBERNARDINO%3A71&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA
deaths, injuries, or crop damages reported, but property damage estimates have totaled approximately $41,000.188

**Hail**

Information from the NCEI Storm Events Database indicates that since 1996, there have been 52 reported events of hail in San Bernardino County, which translates to approximately 2.05 hail events per year.189 (Note: The NCEI Storm Event Database search results for hail indicate that there has been a total of 53 reports of hail since 1996. However, one (1) entry is for a hail event in San Diego County, hundreds of miles away from San Bernardino County. The origin of this error is unknown at this time.)

**Historical Hail Hazard Losses for San Bernardino County since 1996**

According to the NCEI Storm Events Database, the hail hazard events that San Bernardino County has experienced since 1996 have been costly. While there have been no deaths, injuries, or crop damages reported, property damage estimates have totaled approximately $358,100.190 (Note: The San Diego County hail event that was included erroneously in the search results for hail hazard events in San Bernardino County accounted for all injuries (i.e., 5) and crop damage estimates (i.e., $300,000) presented in the search results.)

**Lightning**

Information from the NCEI Storm Events Database indicates that since 1996, there have been 55 reported events of lightning in San Bernardino County, which translates to approximately 2.17 lightning events per year.191

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188 National Climatic Data Center. Storm Events Database. Retrieved 07.30.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Tornado&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=SAN%2BBBBERNARDINO%3A71&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA

189 National Climatic Data Center. Storm Events Database. Retrieved 07.30.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Hail&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=SAN%2BBBBERNARDINO%3A71&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA

190 National Climatic Data Center. Storm Events Database. Retrieved 07.30.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Hail&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=SAN%2BBBBERNARDINO%3A71&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA

191 National Climatic Data Center. Storm Events Database. Retrieved 07.30.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Lightning&beginDate_mm=01&
Historical Lightning Hazard Losses for San Bernardino County since 1996

According to the NCEI Storm Events Database, the lightning hazard events that San Bernardino County has experienced since 1996 have been costly. There have been 3 deaths and 9 injuries, and property damage estimates have totaled approximately $1,343,000; reported crop damage estimates have been negligible (i.e., $100).  

All Severe Weather Hazard Events Recorded by the NCEI Storm Events Database (San Bernardino County)

Information obtained from the NCEI Storm Events Database indicates that there have been 796 occurrences of the severe weather hazard in San Bernardino County. This translates to 31.42 severe weather hazard occurrences per year. 

Please note: Differences between the sums of individual component severe weather hazard event Database searches (i.e., 803 events) and simultaneous Database searches of all severe weather hazard events (i.e., 796 events) may be due to the following factors: (1) multiple event types are in the same record (e.g., "Thunderstorm Wind/Hail" or "Hail/Tornado;" and/or (2) severe weather hazard events such as “Thunderstorm Wind” or “Hail” that are reported for San Bernardino County have actually taken place hundreds of miles away, but are erroneously recorded as events that have occurred in the

\[ \text{beginDate}_dd=01&\text{endDate}_mm=04&\text{endDate}_yyyy=2021&\text{county}=\text{SANBERNARDINO}\%3A71&\text{hailfilter}=0.00&\text{tornfilter}=0&\text{windfilter}=000&\text{sort}=\text{DT}&\text{submitbutton}=\text{Search}&\text{statefips}=6%2CCALIFORNIA\]

192 National Climatic Data Center. Storm Events Database. Retrieved 07.30.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Lightning&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=SANBERNARDINO%3A71&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA

193 National Climatic Data Center. Storm Events Database. Retrieved 07.30.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Hail&eventType=%28Z%29+High+Wind&eventType=%28C%29+Lightning&eventType=%28Z%29+Strong+Wind&eventType=%28C%29+Thunderstorm+Wind&eventType=%28C%29+Tornado&beginDate_dd=01&beginDate_yyyy=1996&endDate_dd=30&endDate_yyyy=2021&county=SANBERNARDINO%3A71&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA

194 National Climatic Data Center. Storm Events Database. Retrieved 07.30.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Hail&eventType=%28Z%29+High+Wind&eventType=%28C%29+Lightning&eventType=%28Z%29+Strong+Wind&eventType=%28C%29+Thunderstorm+Wind&eventType=%28C%29+Tornado&beginDate_dd=09&beginDate_yyyy=2012&endDate_dd=30&endDate_yyyy=2021&county=SANBERNARDINO%3A71&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA
When such a discrepancy arises, the more conservative aggregate hazard wind event value (i.e., 796 events) is used to determine the historical frequency of occurrence for the severe weather hazard. The origin of this discrepancy is unknown at this time.

Historical, Aggregated Severe Hazard Losses for San Bernardino County since 1996

According to the NCEI Storm Events Database, the severe weather events that San Bernardino County has experienced since 1996 have been costly. There have been 7 deaths and 51 injuries, and property and crop damage estimates have totaled approximately $54,615,000 and $2,000,000, respectively. It is important to note that for all San Bernardino County severe weather hazard events recorded on the Storm Events Database, more than half of all deaths, the vast majority of injuries, all estimated crop damages, and approximately 96.8% of all estimated property damages have been caused by wind hazard events alone.

Wind Hazards Not Included in the NCEI Storm Events Database

Santa Ana Winds

Santa Ana wind events occur at least twice per month from October through April. From 1948 to 2012, total of 2056 events on the 65-year record were recorded in the Southern California region, yielding an average of 32 occurrences per year. Typical Santa Ana wind events last 1–2 days and represent 27% of the occurrences, with events lasting


196 National Climatic Data Center. Storm Events Database. Retrieved 07.30.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Hail&eventType=%28Z%29+High+Wind&eventType=%28C%29+Lightning&eventType=%28Z%29+Strong+Wind&eventType=%28C%29+Thunderstorm&eventType=%28C%29+Tornado&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=SAN%2BBERNARDINO%3A71&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA

197 National Climatic Data Center. Storm Events Database. Retrieved 07.30.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Hail&eventType=%28Z%29+High+Wind&eventType=%28C%29+Lightning&eventType=%28Z%29+Strong+Wind&eventType=%28C%29+Thunderstorm&eventType=%28C%29+Tornado&beginDate_mm=09&beginDate_dd=11&beginDate_yyyy=2012&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=SAN%2BBERNARDINO%3A71&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA

up to 6 days accounting for 90% of all occurrences. The remaining 10% are made up almost entirely of events lasting between 7 and 12 days.199 200

Figure below shows the mean monthly frequency per season of Santa Ana Wind events detected from 1948 to 2012. Extreme Santa Ana wind events are shown in dark red, and are defined as those events that are above the 90th percentile of all events on record.

Figure 17-14: Mean Annual Frequency of Santa Ana Wind events (1948-2012)201 202

Diablo Winds

Diablo wind events occur approximately **2.5 events per year**. These events are most frequent during the fall and early winter seasons, with the highest frequency of events occurring in October. As a result, the highest risk of Diablo-wind-related damage is in the fall and early winter.²⁰³

Figure below shows the monthly frequency of Diablo winds (along with average live fuel moisture content). The Diablo Wind data are derived from a 17-year climatology of San Francisco Bay Area regional surface weather stations.²⁰⁴

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²⁰⁴ Retrieved on 07.15.2021 from https://www.fireweather.org/diablo-winds
Strong sundowner wind events occur approximately **2-3 times per year**. These events can create sharp temperature rises, local gale force winds, and significant weather-related problems. Rare, “explosive” types of sundowner wind events occur about 6 times per century that present dangerous weather situations, generating extremely strong and hot winds that can reach gale force or higher speeds.\(^\text{206}\)

**Historical Frequency of All Severe Weather Hazards**

The following tables show the average historical frequencies of severe weather hazard events for Los Angeles County, Ventura County, and San Bernardino County, respectively, since 1996.

Table 17-30: Severe Weather Hazard Event Frequencies for Los Angeles County since 1996.

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\(^{205}\) Retrieved on 07.13.2021 from https://www.fireweather.org/diablo-winds

## Severe Weather Hazard Event Frequencies for Ventura County since 1996.

<table>
<thead>
<tr>
<th>Severe Weather Hazard Category</th>
<th>Average Number of Hazard Events Per Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wind (Includes High, Strong and Thunderstorm Winds ONLY)</td>
<td>16.86</td>
</tr>
<tr>
<td>Tornado</td>
<td>0.47</td>
</tr>
<tr>
<td>Hail</td>
<td>0.71</td>
</tr>
<tr>
<td>Lightning</td>
<td>0.36</td>
</tr>
<tr>
<td>Diablo Wind*</td>
<td>2.5</td>
</tr>
<tr>
<td>Santa Ana Wind</td>
<td>32</td>
</tr>
<tr>
<td>Sundowner Wind*</td>
<td>2 to 3</td>
</tr>
</tbody>
</table>

* Note: The Diablo and Sundowner wind hazards are not present in Los Angeles County. They are included here for information purposes only.

Table 17-31: Severe Weather Hazard Event

## Severe Weather Hazard Event Frequencies for Ventura County since 1996.

<table>
<thead>
<tr>
<th>Severe Weather Hazard Category</th>
<th>Average Number of Hazard Events Per Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wind (Includes High, Strong and Thunderstorm Winds ONLY)</td>
<td>9.47</td>
</tr>
<tr>
<td>Tornado</td>
<td>0.20</td>
</tr>
<tr>
<td>Hail</td>
<td>0.12</td>
</tr>
<tr>
<td>Lightning</td>
<td>0.08</td>
</tr>
<tr>
<td>Diablo Wind*</td>
<td>2.5</td>
</tr>
<tr>
<td>Santa Ana Wind</td>
<td>32</td>
</tr>
<tr>
<td>Sundowner Wind</td>
<td>2 to 3</td>
</tr>
</tbody>
</table>

* Note: The Diablo wind hazard is not present in Ventura County; it is included here for
information purposes only. The Sundowner wind hazard is close in proximity to the CSU Channel Islands main campus, and directly affects a satellite campus facility in Santa Barbara County owned by the University; therefore, it is considered to be a wind hazard event for CSU Channel Islands.

Table 17-32: Severe Weather Hazard Event

Frequencies for San Bernardino County since 1996.

<table>
<thead>
<tr>
<th>Severe Weather Hazard Category</th>
<th>Average Number of Hazard Events Per Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wind (Includes High, Strong and Thunderstorm Winds ONLY)</td>
<td>26.57</td>
</tr>
<tr>
<td>Tornado</td>
<td>0.63</td>
</tr>
<tr>
<td>Hail</td>
<td>2.05</td>
</tr>
<tr>
<td>Lightning</td>
<td>2.17</td>
</tr>
<tr>
<td>Diablo Wind*</td>
<td>2.5</td>
</tr>
<tr>
<td>Santa Ana Wind</td>
<td>32</td>
</tr>
<tr>
<td>Sundowner Wind*</td>
<td>2 to 3</td>
</tr>
</tbody>
</table>

* Note: The Diablo and Sundowner wind hazards are not present in San Bernardino County. They are included here for information purposes only.

Potential Impacts of the Hazard

The significance (or priority) of a hazard’s potential impacts is based primarily on the frequency and resulting damage caused by the hazard, including deaths/injuries and property, crop, and economic damage. All assets and people at all Cal Poly Pomona campuses are at risk from the effects of severe weather hazards.
Please Note: The Cal Poly Pomona main campus is located primarily in an unincorporated area of Los Angeles County adjacent to the City of Pomona; however, the university owns some land within the Pomona city limits.\textsuperscript{207} As a result, hazard mitigation plans for both Los Angeles County and the City of Pomona are used as information resources for parts of this section.)

\textbf{Wind Hazards (Including Tornadoes)}

Wind hazard events have the potential to impact people, property, and operations on campuses across the CSU system. People caught in the open during an extreme wind event are exposed to high winds and debris, and could be injured or killed.

The habitability of buildings can be compromised (by damaging roofs, windows, or other weak points in the building envelope), leading to long-term operational issues for the campus. As with most university campuses, space is always at a premium at the Cal Poly Pomona campus, and the loss of any currently utilized space due to building or structural damage would likely disrupt operations and the University’s mission.

Extreme wind events can result in power failure, which would impact the operation of the campus. Fallen tree limbs and other potential transportation hazards may also cause disruption to the surrounding community and limit ingress/egress to the campus.

\textbf{Cal Poly Pomona Main Campus, Unincorporated Los Angeles County and City of Pomona (Los Angeles County)}

According to the 2015 City of Pomona Natural Hazards Mitigation Plan (NHMP), “windstorms” (excluding tornadoes) are not a serious hazard for the city overall. However, the Pomona NHMP acknowledges that severe windstorms, originating mostly from Santa Ana wind events, can pose a significant risk to – and have a significant potential impact on – the City of Pomona.\textsuperscript{208} The 2019 County of Los Angeles All-Hazards Mitigation Plan is climate-change-focused, and does not include explicitly any severe weather hazards in its hazard identification profiles and risk assessments.\textsuperscript{209} To accommodate both hazard mitigation plans’ wind hazard assessments, as well as NCEI Storm Events Database historical frequencies, wind hazards (excluding tornadoes) are identified here as having low to medium significance for and minimal to moderate impact on both the City of Pomona and (by extension) the Cal Poly Pomona main campus. Due to their exclusion from both the city and County hazard mitigation plans, tornado hazards

\begin{footnotesize}


\end{footnotesize}
are considered to have low significance for and minimal potential impact on the city and on Cal Poly Pomona main campus areas.

**Cal Poly Pomona – Pine Tree Ranch Campus, Santa Paula (Ventura County)**

According to the 2015 Ventura County Multi-Hazard Mitigation Plan, the high wind hazard component of “winter storms” is considered to be significant, and may have a moderate potential impact on the County and on the Cal Poly Pomona main campus. Because the County is at very low risk from tornadoes, and tornadoes are not included in any hazard profile of the Plan, the potential impacts from tornadoes are considered to be minimal for the County and for the Cal Poly Pomona – Pine Tree Ranch Campus.210

**Cal Poly Pomona – Westwind Ranch Campus, Chino (San Bernardino County)**

The 2018 City of Chino Hazard Mitigation Plan does not address any severe weather hazards, as severe weather is not considered to be a hazard with significant potential to occur in the city. As a result, wind hazards are considered to be of low significance, and therefore to have a minimal potential impact on the city and (by extension) the Cal Poly Pomona – Westwind Ranch Campus.211

**Hail**

Hail typically impacts property by damaging structures, cars, and utilities as it falls. Dents in cars, broken glass, and holes in roofs are common impacts of hail. Injuries to people from hail are less common, though they can happen, as hail is a hard object falling in an unpredictable manner at a fairly high rate of speed.

**Cal Poly Pomona Main Campus, Unincorporated Los Angeles County and City of Pomona (Los Angeles County)**

According to both the 2015 City of Pomona Natural Hazards Mitigation Plan (NHMP) and the 2019 County of Los Angeles All-Hazards Mitigation Plan, hail hazards are not explicitly identified to be significant hazards. Therefore, the hail hazard is considered to be of low significance for

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significance and therefore to have minimal potential impact on the City of Pomona and (by extension) the Cal Poly Pomona main campus.\textsuperscript{212} \textsuperscript{213}

**Cal Poly Pomona – Pine Tree Ranch Campus, Santa Paula (Ventura County)**

According to the 2015 Ventura County Multi-Hazard Mitigation Plan, the hail hazard component of “winter storms” is considered to be a hazard that may accompany winter storms, but it is not a significant hazard in and of itself. As a result, it has a minimal potential impact on the County and on the Cal Poly Pomona – Pine Tree Ranch campus.\textsuperscript{214}

**Cal Poly Pomona – Westwind Ranch Campus, Chino (San Bernardino County)**

The 2018 City of Chino Hazard Mitigation Plan does not address any severe weather hazards, as severe weather is not considered to be a hazard with significant potential to occur in the city. As a result, hail hazards are considered to be of low significance, and therefore to have a minimal potential impact on the city and (by extension) the Cal Poly Pomona – Westwind Ranch Campus.\textsuperscript{215}

**Lightning**

Lightning strikes the United States about 20-25 million times a year.\textsuperscript{216} Although most lightning occurs in the summer months, people can be struck at any time of year. Since 1990, lightning has killed an average of 39 people each year in the United States, and hundreds more have been injured.\textsuperscript{217} Property losses due to lightning have been very costly across the U.S. For example, from 2005 through 2020, U.S. homeowner’s insurance claim payouts for lightning losses totaled approximately $15,334,600,000, or $958,412,500 worth of payouts per year.\textsuperscript{218} (Commercial claim payouts for lightning losses for the U.S. were not available.)


\textsuperscript{218} Retrieved on 07.21.2021 from https://www.iii.org/table-archive/20504
Cal Poly Pomona Main Campus, Unincorporated Los Angeles County and City of Pomona (Los Angeles County)

According to both the 2015 City of Pomona Natural Hazards Mitigation Plan (NHMP) and the 2019 County of Los Angeles All-Hazards Mitigation Plan, lightning hazards are not explicitly identified to be significant hazards. Therefore, the lightning hazard is considered to be of low significance and therefore to have minimal potential impact on the City of Pomona and (by extension) the Cal Poly Pomona main campus.219 220

Cal Poly Pomona – Pine Tree Ranch Campus, Santa Paula (Ventura County)

According to the 2015 Ventura County Multi-Hazard Mitigation Plan, the lightning hazard component of “winter storms” is considered to be a hazard that may accompany winter storms, but it is not a significant hazard in and of itself. As a result, it has a minimal potential impact on the County and on the Cal Poly Pomona – Pine Tree Ranch campus.221

Cal Poly Pomona – Westwind Ranch Campus, Chino (San Bernardino County)

The 2018 City of Chino Hazard Mitigation Plan does not address any severe weather hazards, as severe weather is not considered to be a hazard with significant potential to occur in the city. As a result, lightning hazards are considered to be of low significance, and therefore to have a minimal potential impact on the city and (by extension) the Cal Poly Pomona – Westwind Ranch Campus.222

Probability of Future Occurrence of the Hazard

Areas throughout California, including all California State University (CSU) campuses, experience severe weather events every year, and future occurrences of such events are projected to increase in both their frequency and intensity.

Cal Poly Pomona Main Campus, Unincorporated Los Angeles County and City of Pomona (Los Angeles County)

Areas throughout California, including all California State University (CSU) campuses, experience severe weather events every year, and future occurrences of such events are projected to increase in both their frequency and intensity. While the 2019 County of Los Angeles All-Hazards Mitigation Plan has little (if any) explicit quantitative assessment on the probability of future occurrence of severe weather hazards, the 2015 City of Pomona Natural Hazards Mitigation Plan (NHMP) does state that windstorm events can be expected “perhaps annually” across the region.\textsuperscript{223} 224 Also, according to the NCEI Storm Events Database, some of the severe weather hazards have occurred in Los Angeles County at least once per year. Furthermore, while the severe weather hazard is a non-spatial hazard that affects all areas of the Cal Poly Pomona main campus equally, the smallest geographic unit of measurement for almost all official severe weather event data is at the county level. Because the severe weather data used in this assessment do not exist at the campus level, it is assumed that the severe weather probabilities for the Cal Poly Pomona main campus reflect those of the surrounding community and County.

Based on the data available the NCEI Storm Events Database, the severe weather hazard is expected to occur on (or otherwise impact) the Cal Poly Pomona main campus at least once on an annual basis. Therefore, the probability of future occurrence of the severe weather hazard for the Cal Poly Pomona main campus is \textbf{HIGHLY LIKELY}.

\textbf{Cal Poly Pomona – Pine Tree Ranch Campus, Santa Paula (Ventura County)}

The 2015 Ventura County Multi-Hazard Mitigation Plan states that a “winter storm” with high winds, hail, and lightning can occur every year in the County.\textsuperscript{225} Also, according to the NCEI Storm Events Database, severe weather wind hazard events have occurred in Ventura County considerably more than once per year – at an average of 9.47 events per year since 1996. Furthermore, while the severe weather hazard is a non-spatial hazard that affects all areas of the Cal Poly Pomona – Pine Tree Ranch campus equally, the smallest geographic unit of measurement for almost all official severe weather event data is at the county level. Because the severe weather data used in this assessment do not exist at the campus level, it is assumed that the severe weather probabilities for Cal Poly Pomona – Pine Tree Ranch campus reflect those of the surrounding community and County.

Based on the data available from both the 2015 Ventura County Multi-Hazard Mitigation Plan and the NCEI Storm Events Database, the severe weather hazard is expected to occur on (or otherwise impact) the Cal Poly Pomona – Pine Tree Ranch campus at least once on an annual basis. Therefore, the probability of future occurrence of the severe weather hazard for the Cal Poly Pomona – Pine Tree Ranch campus is \textbf{HIGHLY LIKELY}.

\begin{itemize}
\end{itemize}
once on an annual basis. Therefore, the probability of future occurrence of the severe weather hazard for Cal Poly Pomona – Pine Tree Ranch campus is **HIGHLY LIKELY**.

**Cal Poly Pomona – Westwind Ranch Campus, Chino (San Bernardino County)**

The 2018 City of Chino Hazard Mitigation Plan does not address any severe weather hazards, as severe weather is not considered to be a hazard with significant potential to occur in the city. However, according to the NCEI Storm Events Database, wind hazards have occurred in San Bernardino County far more than once annually – at an average of 26.57 events per year since 1996. Furthermore, while the severe weather hazard is a non-spatial hazard that affects all areas of the Cal Poly Pomona – Westwind Ranch campus equally, the smallest geographic unit of measurement for almost all official severe weather event data is at the county level. Because the severe weather data used in this assessment do not exist at the campus level, it is assumed that the severe weather probabilities for the Cal Poly Pomona – Westwind Ranch campus reflect those of the surrounding community and County identified in the Table below.

Based on the data available from both the 2018 City of Chino Hazard Mitigation Plan and the NCEI Storm Events Database, the severe weather hazard is expected to occur on (or otherwise impact) the Cal Poly Pomona – Westwind Ranch campus at least once on an annual basis. Therefore, the probability of future occurrence of the severe weather hazard for the Cal Poly Pomona – Westwind Ranch is **HIGHLY LIKELY**.

**Cal Poly Pomona – All Campus Areas**

The probability of future occurrence of the severe weather hazard for all Cal Poly Pomona campus areas is **HIGHLY LIKELY**.

The following tables show the probabilities of future occurrence for component severe weather hazards for Cal Poly Pomona campus facilities in Los Angeles, Ventura, and San Bernardino Counties.

Table 17-33: Severe Weather Hazard Probabilities of Future Occurrence for Los Angeles County and Cal Poly Pomona Main Campus (Pomona, CA)

<table>
<thead>
<tr>
<th>Severe Weather Hazard Category</th>
<th>Average Number of Hazard Events Per Year</th>
<th>Probability of Future Occurrence</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Wind (Includes High, Strong and Thunderstorm Winds ONLY)</th>
<th>16.86</th>
<th>Highly Likely</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tornado</td>
<td>0.47</td>
<td>Possible</td>
</tr>
<tr>
<td>Hail</td>
<td>0.71</td>
<td>Likely</td>
</tr>
<tr>
<td>Lightning</td>
<td>0.36</td>
<td>Possible</td>
</tr>
<tr>
<td>Diablo Wind**</td>
<td>2.5</td>
<td>Not Rated</td>
</tr>
<tr>
<td>Santa Ana Wind</td>
<td>32</td>
<td>Highly Likely</td>
</tr>
<tr>
<td>Sundowner Wind**</td>
<td>2 to 3</td>
<td>Not Rated</td>
</tr>
<tr>
<td><strong>Severe Weather Hazard</strong></td>
<td></td>
<td><strong>Highly Likely</strong></td>
</tr>
</tbody>
</table>

** Note: The Diablo and Sundowner wind hazards are not present in Los Angeles County, and therefore are not rated for probability of future occurrence. They are included here for information purposes only.
<table>
<thead>
<tr>
<th>Severe Weather Hazard Category</th>
<th>Average Number of Hazard Events Per Year</th>
<th>Probability of Future Occurrence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wind (Includes High, Strong and Thunderstorm Winds ONLY)</td>
<td>9.47</td>
<td>Highly Likely</td>
</tr>
<tr>
<td>Tornado</td>
<td>0.20</td>
<td>Possible</td>
</tr>
<tr>
<td>Hail</td>
<td>0.12</td>
<td>Possible</td>
</tr>
<tr>
<td>Lightning</td>
<td>0.08</td>
<td>Unlikely</td>
</tr>
<tr>
<td>Diablo Wind**</td>
<td>2.5</td>
<td>Not Rated</td>
</tr>
<tr>
<td>Santa Ana Wind</td>
<td>32</td>
<td>Highly Likely</td>
</tr>
<tr>
<td>Sundowner Wind</td>
<td>2 to 3</td>
<td>Highly Likely</td>
</tr>
<tr>
<td>** Note: The Diablo wind hazards is not present in Ventura County, and therefore is not rated for probability of future occurrence. It is included here for information purposes only. The Sundowner wind hazard is close in proximity to the CSU Channel Islands main campus, and directly affects a satellite campus facility in Santa Barbara County owned by the University; therefore, it is considered to be a wind hazard event for CSU Channel Islands, and is rated here for probability of future occurrence.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Table 17-35: Severe Weather Hazard Probabilities of Future Occurrence for San Bernardino County and Cal Poly Pomona – Westwind Ranch (Chino, CA)

<table>
<thead>
<tr>
<th>Severe Weather Hazard Category</th>
<th>Average Number of Hazard Events Per Year</th>
<th>Probability of Future Occurrence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wind (Includes High, Strong and Thunderstorm Winds ONLY)</td>
<td>26.57</td>
<td>Highly Likely</td>
</tr>
<tr>
<td>Tornado</td>
<td>0.63</td>
<td>Likely</td>
</tr>
<tr>
<td>Hail</td>
<td>2.05</td>
<td>Highly Likely</td>
</tr>
<tr>
<td>Lightning</td>
<td>2.17</td>
<td>Highly Likely</td>
</tr>
<tr>
<td>Diablo Wind**</td>
<td>2.5</td>
<td>Not Rated</td>
</tr>
<tr>
<td>Santa Ana Wind</td>
<td>32</td>
<td>Highly Likely</td>
</tr>
<tr>
<td>Sundowner Wind**</td>
<td>2 to 3</td>
<td>Not Rated</td>
</tr>
</tbody>
</table>

Vulnerability to the Hazard

People, structures, and assets at all Cal Poly Pomona campus areas are all vulnerable to the impacts associated with severe weather. Infrastructure can be damaged or destroyed by hail, wind, tornadoes, thunderstorms, and lightning, which can result in service interruptions and outages. Structures can be damaged or destroyed by hail, wind, tornadoes, thunderstorms, and lightning. People can be injured or killed by lightning, flying debris, hail, or extreme wind events. Cal Poly Pomona campuses also have vehicles that are all vulnerable to a severe weather event.

Estimate of Potential Losses

Severe weather is a non-spatial hazard that affects the all Cal Poly Pomona campus areas. Each of the hazards associated with severe weather can result in losses throughout the planning area.

All structures within Cal Poly Pomona campuses are at risk from severe weather. There are approximately 429 campus buildings that could be damaged by wind, hail, and/or lightning. If even a fraction of these assets were to be damaged, the resulting estimated losses would still be in the millions of dollars. The total replacement costs due to severe weather hazard are $355,971,530 for 255 buildings, and are unknown for the remaining 174 buildings. An analysis of projected dollar losses to campus buildings from severe
The populations at all Cal Poly Pomona campuses vary throughout the day. As of Fall, 2019, Cal Poly Pomona had 27,914 students and 2,650 faculty and staff. All are at risk from severe weather events, with 30,564 being directly vulnerable in this scenario.

Vulnerability Assessment Conclusions

Severe weather presents a variety of hazards to all Cal Poly Pomona campuses. People, assets, infrastructure, and vehicles can all be damaged by this hazard, and losses can quickly begin to rise. In the aggregate, severe weather is a frequently occurring hazard (mostly in the form of wind hazard events) that presents a variety of risks to Cal Poly Pomona.

It is evident that Cal Poly Pomona has vulnerabilities to and risks from severe weather hazard incidents, and that pre-event planning, communication, and mitigation efforts should be implemented. Public education and outreach regarding areas of shelter that could be used by campus populations during severe weather events is considered by campus leadership to be one viable mitigation option. The campus planning committee will continue to look for feasible and cost-effective options for the mitigation of severe weather risks going forward.

Identified Data Limitations

Numerous federal agencies maintain a variety of records regarding losses associated with hazards. Unfortunately, no single source is considered to offer a definitive accounting of all losses. The Federal Emergency Management Agency (FEMA) maintains records on federal expenditures associated with declared major disasters. The US Army Corps of Engineers (USACE) and the Natural Resources Conservation Service (NRCS) collect data on losses during the course of some of their ongoing projects and studies. Additionally, the National Oceanic and Atmospheric Administration’s (NOAA) National Centers for Environmental Information (NCEI) collects and maintains data about natural hazards in summary format, as well as occurrences, dates, injuries, deaths, and estimated costs for individual storm events. Many of these databases and other data collection services, including the NCEI, have inherent data limitations when searching for information at a scale as small as a single campus.

The best available data and records have been used throughout this section. Where no data or records exist or could be located, that deficiency is noted.

227 Retrieved on 07.19.2021 from https://www2.calstate.edu/csu-system/about-the-csu/facts-about-the-csu/enrollment/Pages/default.aspx

17.4 Social Vulnerability Assessment

Overview

While every person is vulnerable to risk, individuals from diverse populations such as those with access and functional needs are disproportionately more vulnerable and may be at a higher risk to harm in a disaster event. In addition to physical vulnerabilities, the intersectionality between physical hazard risks and population social vulnerabilities must be considered to holistically address overall campus risk.

As inclusivity is a high priority for CSU, addressing campus risk and resilience must be done through the lens of inclusion and equity. Addressing social vulnerability is an increasingly critical requirement of state and national doctrines and described in Section 4.4 of the HVRA Base Plan. Every individual of the campus’s richly diverse population group needs to have the capacity, skills, and knowledge in order to understand, access, and participate in risk reduction and disaster response in ways that are meaningful to their own unique situation. In a campus community, having strong social support networks and active involvement in community disaster responses may negatively or positively impact these opportunities and reduce the resilience-building process. This section offers a glimpse into the CSU Pomona campus’s unique social construct, population demographics, strengths and concerns and presents a high-level assessment of the resilience, coping capacities and potential social vulnerabilities of students, staff and faculty. The research variables that were asked are often considered sensitive subjects, and few are traditionally included in emergency management/hazard mitigation planning.

This social resilience assessment of college campuses is the first of its kind in the nation. The research methodology unfolded as the interviews with campuses progressed. The assessment data presented are not definitive or authoritative. The answers, analysis, and suggested trends are strictly indicators for potential social risk. They do not represent an accurate data capture as limitations on the data gathering process influenced an ability to provide accuracy. This assessment provides indications of increased risk, not accuracy of response or a true reflection of the situation of the campus. The information presented is to be considered in the context of the more detailed system-wide CSU social vulnerability assessment that is included in the baseline HVRA.
Campus-Identified Populations of Concern

During the campus interview, the following responses were provided when asked, “In considering the diverse population group(s) amongst student body, faculty and staff, which are of the most concern in your emergency management planning?”

Table 17-36: High level summary of campus populations of concern

<table>
<thead>
<tr>
<th>Question</th>
<th>Campus Response</th>
</tr>
</thead>
</table>
| Which population groups amongst the student body, faculty, and staff, are of the most concern for physical and social vulnerabilities in emergency management planning? | ▪ International students  
▪ Students from out-of-state  
▪ Students in or aging out of foster care  
▪ Populations experiencing homelessness |
| Which population groups are most difficult to reach in an event?           | Populations who speak English as a second language                               |
| Which population groups have little/limited support networks if impacted by an event? | ▪ Vulnerable populations with high levels of inequity  
▪ Populations with limited digital connectivity |

Resilience Variables Related to Campus Emergency Management

The interviewees were asked to reflect on a set of 12 variables for the campus populations of student, faculty and staff: homelessness (*housing insecurity*), food
security, health and wellness, disability/access and functional needs (AFN), racial equity, digital equity, communications, international students, immigrants/immigration status issues (undocumented, DACA, etc.), LGBTQI (Lesbian Gay Bisexual Transgender Questioning (or queer) Intersex), and transportation dependency. They were also offered an opportunity to add any other factor they wanted to include. The following two questions were asked:

- Is this factor a particular issue of concern for emergency management on your campus? Responses were summarized as Very High, High, Medium, Low
- Is this factor reflected in the emergency plans and processes for your campus? Responses were summarized as Yes, No, In Progress, NA

In order to provide a high-level qualitative response for the answers, the approach of averaging response was taken. If conflicting answers were expressed by the interviewees, the answer (code) was averaged out. A detailed explanation of the response averaging approach is included in the base HVRA.

Table 17-37: Campus-specific emergency management issues of concern and inclusion in emergency management plans and processes.

<table>
<thead>
<tr>
<th>Issue of Concern</th>
<th>Plans &amp; Processes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Homelessness (Housing Insecurity)</td>
<td>Low</td>
</tr>
<tr>
<td>Food Security</td>
<td>Low</td>
</tr>
<tr>
<td>Health &amp; Wellness</td>
<td>Low</td>
</tr>
<tr>
<td>AFN</td>
<td>Low</td>
</tr>
<tr>
<td>Racial Equity</td>
<td>Low</td>
</tr>
<tr>
<td>Digital Equity</td>
<td>High</td>
</tr>
<tr>
<td>Comms.</td>
<td>High</td>
</tr>
<tr>
<td>International Students</td>
<td>Low</td>
</tr>
<tr>
<td>Immigrants / Immigration Status</td>
<td>Low</td>
</tr>
<tr>
<td>LGBTQI</td>
<td>Low</td>
</tr>
<tr>
<td>Transportation Dependency</td>
<td>Low</td>
</tr>
</tbody>
</table>
Qualitative Narrative: Campus Overview of Potential Resilience Vulnerabilities

The following are interview notes of interest:

- Those first identified as most difficult to reach in emergency communications are those with ESL language barriers, notably the top five languages of Spanish, Arabic, Chinese, Japanese and Korean.
- There is a communications plan that will be turned into an EOP annex.
- There is a MOU with a food vendor for the campus and while a planning has taken place, an annex for the dining services needs to be added into the EOP.
- There have been trainings for evacuation coordinators on how to help the AFN populations and there is an effort to add a component for bringing representatives into the EOC.
- COVID has “opened their eyes” and there is a need to add digital equity into the EOP.
- They have just started thinking about the impact of disasters on the living/shelter situation of the international students.
- There is a low concern regarding the students who are immigrants or have immigration status issues, as they are anticipated to have families and they will go back to their homes.
- If LGBTQI clubs reached out for emergency management training they would provide it, but they don’t reach out the groups specifically.
- For transportation, most students have cars and ride shares to the metro and bus lines.
- A noted issue was coordination with a broader spectrum of partners of the campus for planning purposes.

Campus High Hazards and Potentially Vulnerable Populations

This section provides a brief introduction to the link between socially vulnerable populations and a particular hazard type. While extensive research has been conducted on the impacts of hazards, not all linkages have been documented or published, and detail for finding them are beyond the scope of this assessment. It’s important to note, the intersectional nature of what makes an individual’s personal experience and resilience
to an event is played out by unique factors for that individual or population. The nuanced social vulnerabilities often come from the social and physical environment in which a person is embedded.

In order to aid in further assessing campus resilience, below is a general description of the known impacts. From some hazards, the descriptions are robust, while others are only brief introductions.

Table 17-38: CSU Pomona *Highly Likely, Likely and Possible* Hazards

<table>
<thead>
<tr>
<th>Hazard</th>
<th>Future Occurrence Probability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Communicable Disease</td>
<td>Highly Likely</td>
</tr>
<tr>
<td>Drought</td>
<td>Highly Likely</td>
</tr>
<tr>
<td>Earthquake</td>
<td>Possible</td>
</tr>
<tr>
<td>Erosion</td>
<td>Likely</td>
</tr>
<tr>
<td>Extreme Temperature</td>
<td>Possible (Heat only)</td>
</tr>
<tr>
<td>Hazardous Materials</td>
<td>Possible</td>
</tr>
<tr>
<td>Landslide</td>
<td>Likely</td>
</tr>
<tr>
<td>Power Outage</td>
<td>Likely</td>
</tr>
<tr>
<td>Wildfire</td>
<td>Possible (Fire); Possible (Smoke)</td>
</tr>
</tbody>
</table>

*Drought*

The 2012-2016 drought had severe effects on two vulnerable sectors of our population: those in low-income brackets, and those, especially Native Americans, who rely on subsistence fishing for their livelihoods.229 Water bills increased throughout the state. Due to rising water prices, for the working poor, many have paid four to five percent of their income for water. Since many CSU students are commuters, and many living with families, future drought impacts may potentially affect a percentage of non-resident students. NASA’s modeling shows that future droughts are likely to last longer and be

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more intense, even leading to “megadroughts” in the western states. Fresh water supplies are predicted to be full of extremes, with both droughts and extreme precipitation events being more severe. The interrelationship between drought and other hazard conditions may lead to a set of secondary impacts. Drought conditions lead to water quality issues due to loss of drinking water, increased fire danger that leads to drought-induced fires and elevated AQI levels, as well as extreme heat or prolonged heat events.

**Earthquake**

Impacts on populations from earthquakes are complex, with long-term implications on social stability for all populations. In addition to the physical impact exposure during a no-notice earthquake event and the social and logistical challenges of a recovering community, an earthquake can have lasting impacts long afterwards due to post traumatic stress disorder (PTSD).

Socioeconomic vulnerabilities of populations at risk were analyzed in the hypothetical yet scientifically realistic earthquake sequence that is being used to better understand hazards for the San Francisco Bay region during and after a magnitude-7 earthquake (mainshock) on the Hayward Fault and its aftershocks. In this study, the at-risk populations located in areas of concentrated damage are anticipated to experience longer recovery trajectories, increased long term housing displacement, and transportation impacts due to dependencies on transit dependencies. When neighborhood schools close, families with school age children may move to other areas to keep their children in schools. Persons with access and functions needs are likely to be more dependent on access to functioning medical, social and personal health care services that would be overwhelmed by the event and therefore increasing their vulnerabilities. For the homeless populations, the loss of social community services and damages to shelters could add to protracted relocations. For the young and mobile populations who rent, the major disruption to housing, jobs and transit will also drive relocation. Widespread housing damage and preexisting housing market constraints will make it “extremely challenging” for the socially and economically vulnerable populations to find alternative housing near their home communities. Those who utilize interim and irregular housing for months and years after a disaster are more vulnerable to physical, social, and mental disorders, including suicide, substance abuse, and physical and verbal abuse. Aftershocks and post disaster conditions delay population return and increase outmigration.231


**Erosion**

Risk from erosion relates to earthen and infrastructural losses. The degree of vulnerability to these events and their impacts depends on human behavior and the traditional social factors such as situational awareness, prior knowledge of hazards, social capital and decision-making capabilities, as well as increased vulnerability due to social factors, such as racial and economic disparities.

**Extreme Temps**

People susceptible to respiratory ailments (asthma, lower and upper respiratory disease) disproportionately suffer from the effects of fire, smoke, air pollutions, allergens, heat and PSPS. Those with limited income or without resources are affected disproportionately due to the inability to provide safe shelter, air conditioning, cooling, air purification, medical care, and quality foods, and are also least able to obtain information related to climate risks and adaptation strategies.

**Heat**

Heatstroke, cardiovascular disease, respiratory disease and cerebrovascular disease are related to extreme heat events. Increased number of heat waves creates heat-related physical stress on populations and is exacerbated in the metropolitan areas where greater amounts of heat-absorbing surfaces (e.g., asphalt and concrete) trap heat and emit higher temperatures throughout the night.

The heat also extends the geographic range and the distribution of disease-carrying insects and pests. Health professionals are concerned that California’s warming climate will allow species to acclimate. Such vectors include such pests as ticks that carry Lyme disease, and mosquitos that transmit Zika, dengue fever, West Nile, plague and tularemia. Some others, such as chikungunya, Chagas disease, and Rift Valley fever virus, are threats as well.

Some communities of color and some low-income, homeless, and immigrant populations are more exposed to heat waves, as these groups often reside in urban areas affected by heat island effects. In addition, these populations are likely to have limited adaptive capacity due to a lack of adequately insulated housing, inability to afford or to use air conditioning, inadequate access to public shelters such as cooling centers, and inadequate access to both routine and emergency health care. These social, economic, and health risk factors give rise to the observed increase in deaths and disease from extreme heat in some immigrant and impoverished communities.

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Heat stroke, the most serious heat-related illness, occurs when the body is unable to control its temperature. Body temperature rises rapidly, the sweating mechanism fails, and the body cannot cool down. In extreme causes, heat stroke can cause confusion and unconsciousness, so the victim is unable to seek treatment without assistance.

There are several groups of people who are uniquely vulnerable to the effects of extreme heat, such as infants and children, older adults aged 65 and up, athletes and outdoor workers, low-income households, and individuals with certain chronic medical conditions.

When dealing with an extreme heat event, the most common impacts are those generally felt by the people living in the targeted area. For people in particular, heat can kill when the body is pushed beyond its limits. Most heat disorders occur because the victim has been overexposed to heat. As discussed, the major human risks associated with extreme heat include dehydration, sunburn, fatigue, heat exhaustion, heat stroke, and in severe cases, death.

Some portions of the population are more at risk to the effects of extreme heat. The very young, the elderly, and certain groups with chronic medical conditions (such as asthma or other pulmonary illnesses, heart disease, poor blood circulation, neurological illnesses, and obesity) are generally more vulnerable to the effects of extreme heat, and are more likely to suffer illness or death as a result.

This is especially true if exposure is extended for a period of time and preventative measures are not taken immediately. Distributional implications of impacts, and even less on distributional implications of adaptation actions.” 232

**Hazardous Materials**

The severity of a hazardous materials release depends upon the type of material released, the amount of the release, and the proximity to populations or environmentally sensitive areas such as wetlands or waterways. The release of materials can lead to injuries or evacuation of nearby residents. Wind direction at the time of the release can also have a bearing on the severity (as well as the location and extent) of a hazardous materials release.

The primary threat from the hazardous materials incident hazard is to the structures located along transmission lines and transportation routes or near facilities that use or store hazardous materials. Minor incidents would likely cause no damage and little disruption, assuming they could be contained quickly. Major incidents could have fatal and disastrous consequences. The severity of a hazardous material release relates

primarily to its impact on human safety and welfare and on the threat to the environment. Threats to human safety and welfare include:

- Poisoning of water or food sources and/or supply
- Presence of toxic fumes or explosive conditions
- Damage to personal property
- Need for the evacuation of people
- Interference with public or commercial transportation

Environmental risks are not uniformly distributed across groups of people. Age, poverty, and minority status place some groups at a disproportionately high risk for environmental disease. Poor access to health information and health care means less health promotion, less risk avoidance, a less healthy diet, and more adverse conditions that increase susceptibility to exposure. Delayed recognition of exposure, diagnosis, and treatment allows effects to accumulate.

**Landslides**

Although infrastructural losses are of secondary importance to the risk to humans themselves, research investigating the vulnerability of people to landslides is rare. The many reasons for this lack of data are related to the fact that the collapse of occupied buildings which makes it a function of structural vulnerability and therefore, indirect. The degree of vulnerability to landslides by an individual considered at high risk, or even the general populations, also depends on human behavior, including many of the traditional social factors that are difficult to measure such as situational awareness, prior knowledge of hazards, and decision-making capabilities.

Landslides can result in primary lifeline failures through the loss of roads or power and communication lines. Transportation routes are often expensive to clean up, and prolonged obstruction can disrupt the movement of people and goods. Risk from landslide relates to earthen and infrastructural losses. The degree of vulnerability to these events and their impacts depends on human behavior and the traditional social factors such as situational awareness, prior knowledge of hazards, social capital and decision-making capabilities, as well as increased vulnerability due to social factors, such as racial and economic disparities.

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233 https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3222496/


Power Outage/Public Safety Power Shutdowns (PSPS)

Loss of power creates economic hardship to a region experiencing regular PSPS events, such as those experienced throughout the state over the recent years. Many businesses close, including gas stations, grocery stores, and local retail establishments. These impacts may deeply impact students dependent on support jobs, as well impacting family members of campus staff and faculty. PSPS increases risks to the public due to inability to use medical devices, spoilage of food and medicines, and disruption to infrastructure, such as supply of clean water and electricity used to run home medical equipment, such as lift chairs and ventilators.

Wildfire

Increased wildfire threat occurs especially in the end of fall, when conditions are driest, but before the winter rains have come; an east-to-west wind gusts exacerbate fire risk. Wildfire threats have the concomitant threat of Public Safety Power Shutoffs (PSPS). And, in the case of an actual wildfire, danger exists both from fire and from the smoke. Recent wildfires have demonstrated that some demographics are disproportionately affected. Native Americans are six times more likely to be affected than white people. Blacks and Hispanic people are 50 percent more vulnerable. These values take into account the likelihood of a community being affected and the greater difficulty of that community to recover. These statistics reflect the lack of access to resources to pay for insurance, to rebuild and recover, to implement fire safety measures, and to access other resources. Price gouging after a fire (such as documented in Sonoma County after the 2017 Tubbs Fire) further exacerbates the disparity.

Furthermore, the disabled and the elderly are at particular risk from extreme wildfire conditions, as they are often not as able to effectively evacuate. Of the 85 people who died in the Camp Fire in Butte in 2018, 62 of them were at least 65 years old.

Smoke from wildfires creates a significant public health threat. Especially vulnerable are individuals who have heart or lung issues, such heart disease, lung disease or asthma. Those most vulnerable include the medically fragile, elderly and children. Air Quality Indexes track the level of the following: particulate matter, surface levels of ozone,


carbon monoxide, sulfur dioxide, and nitrogen dioxide. All of these can cause respiratory distress and harm lungs.\textsuperscript{239}

The California Department of Public Health reports the increased public health risks, and risk indicators that include: heat-related ED visits, populations living in wildfire areas, adults with multiple chronic conditions, populations living in poverty, race/ethnicity, outdoor workers, public transit access, air conditioner ownership and tree canopy.\textsuperscript{240}

**Hazard Mitigation and Emergency Management Planning**

The goal of this high-level assessment is to provide a starting point to encourage further exploring campus social risks and vulnerabilities, as well as to inform and to enhance holistic emergency management and hazard mitigation decision making, planning processes and future adaptive risk management strategies. By including the social resilience factors, mitigation investments may move beyond standardized planning and regulations, structure and infrastructure projects, and natural systems protections to embrace a more expanded, customized emergency operations plan and an education and outreach program unique to the campus.

A more robust social resilience inquiry is strongly encouraged to develop an accurate picture, based on methodical and scientific research-based data. Such an effort would be envisioned through both nuanced discussions with a variety of campus stakeholders and the invitation of nontraditional stakeholders to join in a collaborative resilience partnership. Such a forward-leaning effort would be directly in keeping with CSU’s commitment to inclusion and equity in risk reduction.


Section 18
California State University, Sacramento

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18.1 University Profile

University History

CSU Sacramento or Sacramento State University came into existence in 1947. The current site has not always been the location CSU Sacramento has been at. Originally, Sacramento State was known as Sacramento State College and was located on the grounds of the current Sacramento City College. The site of the current campus was broke ground on May of 1951. Today, Sacramento State boasts seven academic colleges and a college of continuing education.

Sacramento State College, it is the eleventh oldest school in the 23-campus California State University system. The university enrolls approximately 31,500 students annually. The university offers 151 different Bachelor’s degrees, 69 Master’s degrees, 28 types of teaching credentials, and 5 Doctoral degrees.

CSU Sacramento is designated as both a Hispanic-Serving Institution (HSI) and an Asian American and Native American Pacific Islander-Serving Institution (AANAPISI).

University Governance

The campus president is the chief executive officer who oversees the administration of the entire university. The president manages campus operations and fundraising, sets campus priorities, and oversees the hiring and support of staff and faculty. The president also maintains a close working relationship with the CSU’s systemwide office, reporting to the chancellor and participating in the systemwide Executive Council.

The provost is the chief academic officer of the university, overseeing all academic affairs and programs of the university. The provost reports directly to the president.

The ABA Administrative Council serves as an advisory body to the vice president and chief financial officer (CFO). Information is disseminated through this body, and it is expected that members of the Council convey this information to managers and staff of their individual ABA families – Budget Planning & Administration, Facilities Management, Financial Services, Human Resources, Sacramento State Police Department, Resource & Organizational Management, Risk Management Services, University Support Services and the Vice President for Administration, which includes Administrative Operations and Auditing & Consulting Services. This group is also responsible for initiating, implementing, and enhancing ABA’s organizational development, which includes strategic planning. This encompasses a variety of activities that promote cultural change to meet the evolving needs of the campus, employee productivity, morale and communications, and advice on other matters brought forward for consideration.

The Administrative and Business Affairs Council serves as an advisory body to the Vice President for Administration. Information is disseminated through this body for distribution to managers and staff of ABA families - Budget Planning & Administration,
Facilities Management, Financial Services, Public Safety, Risk Management Services, Resource & Organizational Management, University Transportation, Parking & Support Services, and the Office of the Vice President for Administration which includes Administrative Operations and Auditing & Consulting Services. The Council is also responsible for initiating, implementing, and enhancing the ABA Change Management Program, which includes Strategic Planning. This encompasses a variety of activities that promote cultural change to meet the evolving needs of the campus, employee productivity, morale and communications, and advice on other matters brought forward for consideration. Members of the Council share operational issues, customer concerns, status of projects and other matters pertinent to ABA. ABA Administrative Council members are expected to be proponents for change to assist in the development of a culture of service, efficiency and professionalism in Administration & Business Affairs, through the support for and advancement of the concepts listed below.

The ABA Management Council is an advisory group to the vice president and the ABA Administrative Council on all matters pertaining to the ABA division’s operations and delivery of customer service. The ABA Management Council will serve as an advisory group to the vice president and the ABA Administrative Council on all matters pertaining to the ABA division’s operations and delivery of customer service. Input from members is expected, and dissemination of critical information to staff will be conveyed through this group regarding changes in policies and procedures, mandates, employee programs and other matters brought forward for discussion.

The ABA Professionals Team, consisting of all ABA managers and staff, serves as an advisory group to the Vice President for Administration and the ABA Administrative Council, providing input on the operations of the division from the unit perspective. The vice president communicates critical information from the president or President’s Cabinet, divisional changes and program and budget information through team meetings each semester, or more frequently as needed.

University Mission

“As California’s capital university, we transform lives by preparing students for leadership, service, and success.”

CSU Sacramento outlines six strategic priorities in support of their goals by focusing on students’ success, providing opportunities for scholarship, research, and creative activity, diversity and inclusion. Additionally, proactively engage with the community, on-going innovation, maintaining integrity and remaining accountable to its community and stakeholders.

University Location

The campus sits on 300 acres, covered with over 3,500 trees and over 1,200 resting in the University Arboretum. The university is the site of two National Register of Historic Places, the Julia Morgan House and the terminus of the Pony Express. CSU Sacramento is located in the capital city of California, within the Sacramento County.
University Population

In the Fall of 2019, the total enrollment exceeded over 31,000 students. Latino students made up 34% of the student population, with White students making up 19% of the student population.

18.2 Interim Final Rule for Hazard Vulnerability and Risk Assessment

Requirement §201.6(c)(2): The plan shall include a risk assessment that provides the factual basis for activities proposed in the strategy to reduce losses from identified hazards. Local risk assessments must provide sufficient information to enable the jurisdiction to identify and prioritize appropriate mitigation actions to reduce losses from identified hazards.

Requirement §201.6(c)(2)(i): [The risk assessment shall include a] description of the type...location and extent of all natural hazards that can affect the jurisdiction. The plan shall include information on previous occurrences of hazard events and on the probability of future hazard events.

Requirement §201.6(c)(2)(ii): [The risk assessment shall include a] description of the jurisdiction’s vulnerability to the hazards described in paragraph (c)(2)(i) of this section. This description shall include an overall summary of each hazard and its impact on the community.

Requirement §201.6(c)(2)(ii): [The risk assessment] must also address National Flood Insurance Program (NFIP) insured structures that have been repetitively damaged floods.

Requirement §201.6(c)(2)(ii)(A): The plan should describe vulnerability in terms of the types and numbers of existing and future buildings, infrastructure, and critical facilities located in the identified hazard area.

Requirement §201.6(c)(2)(ii)(B): [The plan should describe vulnerability in terms of an] estimate of the potential dollar losses to vulnerable structures identified in paragraph (c)(2)(ii)(A) of this section and a description of the methodology used to prepare the estimate.

Requirement §201.6(c)(2)(ii)(C): [The plan should describe vulnerability in terms of] providing a general description of land uses and development trends within the community so that mitigation options can be considered in future land use decisions.

Requirement §201.6(c)(2)(iii): For multi-jurisdictional plans, the risk assessment must assess each jurisdiction’s risks where they vary from the risks facing the entire planning area.
18.3 Hazard Identification and Risk Assessment

Overview of California State University, Sacramento History of Hazards

Numerous federal agencies maintain a variety of records regarding losses associated with hazards. Unfortunately, no single source is considered to offer a definitive accounting of all losses. The Federal Emergency Management Agency (FEMA) maintains records on federal expenditures associated with declared major disasters. The US Army Corps of Engineers (USACE) and the Natural Resources Conservation Service (NRCS) collect data on losses during the course of some of their ongoing projects and studies. Additionally, the National Oceanic and Atmospheric Administration’s (NOAA) National Centers for Environmental Information (NCEI) database collects and maintains data about natural hazards in summary format. The data includes occurrences, dates, injuries, deaths, and estimated costs. Many of these databases and other data collection services, including the NCEI, have inherent data limitations when searching for information at a university scale.

The best available data and records were used throughout this assessment.

Hazard Identification

As part of the initial hazard identification process, the Campus Assessment Team considered potential hazards with the most chance to significantly affect the planning area. The hazards include those that have occurred in the past and may occur in the future. A variety of sources were used to develop the list of hazards considered including national, regional, and local sources such as emergency operations plans, FEMA’s How-To Series, websites, published documents, databases, and maps, as well as discussion among the Campus Assessment Team members.

In the initial phase of the planning process, the Campus Assessment Team considered 14 hazards and the risks they create for the University and its material assets, population, and operations. The hazards initially considered, and the determinations as to the treatment of those hazards, are shown in Table 18-1 (following).

Table 18-1: Hazard Identification Determinations

<table>
<thead>
<tr>
<th>Hazard</th>
<th>Determination (Yes/No)</th>
<th>Reason for Determination</th>
<th>Future Occurrence Probability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Communicable Disease</td>
<td>Yes</td>
<td>Hazard of concern for campus</td>
<td>Highly Likely</td>
</tr>
<tr>
<td>Dam and Levee Failure</td>
<td>Yes</td>
<td>Hazard of concern for campus</td>
<td>Unlikely</td>
</tr>
<tr>
<td>Drought</td>
<td>Yes</td>
<td>Hazard of concern for campus</td>
<td>Highly Likely</td>
</tr>
<tr>
<td>Hazard</td>
<td>Occurrence</td>
<td>Hazard of concern for campus</td>
<td>Probability</td>
</tr>
<tr>
<td>------------------------</td>
<td>------------</td>
<td>-----------------------------</td>
<td>---------------------------</td>
</tr>
<tr>
<td>Earthquake</td>
<td>Yes</td>
<td>Hazard of concern for campus</td>
<td>Possible</td>
</tr>
<tr>
<td>Erosion</td>
<td>Yes</td>
<td>Hazard of concern for campus</td>
<td>Likely</td>
</tr>
<tr>
<td>Extreme Temperature</td>
<td>Yes</td>
<td>Hazard of concern for campus</td>
<td>Highly Likely (Heat); Unlikely (Cold)</td>
</tr>
<tr>
<td>Flood</td>
<td>Yes</td>
<td>Hazard of concern for campus</td>
<td>Possible</td>
</tr>
<tr>
<td>Hazardous Materials</td>
<td>Yes</td>
<td>Hazard of concern for campus</td>
<td>Possible</td>
</tr>
<tr>
<td>Landslide</td>
<td>Yes</td>
<td>Hazard of concern for campus</td>
<td>Unlikely</td>
</tr>
<tr>
<td>Power Outage</td>
<td>Yes</td>
<td>Hazard of concern for campus</td>
<td>Likely</td>
</tr>
<tr>
<td>Sea Level Rise</td>
<td>No</td>
<td>Not a hazard of concern for campus</td>
<td>N/A</td>
</tr>
<tr>
<td>Tsunami</td>
<td>No</td>
<td>Not a hazard of concern for campus</td>
<td>N/A</td>
</tr>
<tr>
<td>Volcano</td>
<td>Yes</td>
<td>Hazard of concern for campus</td>
<td>Unlikely</td>
</tr>
<tr>
<td>Wildfire</td>
<td>Yes</td>
<td>Hazard of concern for campus</td>
<td>Unlikely (Fire); Possible (Smoke)</td>
</tr>
</tbody>
</table>

**Future Occurrence Probability**

In order to determine the probability of future occurrences of each hazard profiled, the following scale was developed:

- **Highly Likely**- 76%-100% that the hazard would occur annually.
- ** Likely**- 50%-75% that the hazard would occur annually.
- **Possible**- 11%-49% that the hazard would occur each annually.
- **Unlikely**- 0%-10% that the hazard would occur each annually.
Communicable Disease

Description of the Hazard

Communicable diseases are illnesses that occur due to infectious agents or their toxic products and are infectious due to their potential of transmission from one person or species to another by a replicating agent. They may be transmitted from a reservoir to a susceptible host either directly as from an infected person or animal or indirectly through the agency of an intermediate plant or animal host, vector, or the inanimate environment. Communicable diseases are clinically evident illness resulting from the presence of pathogenic microbial agents, including pathogenic viruses, pathogenic bacteria, fungi, protozoa, multi-cellular parasites, and aberrant proteins known as prions. The degree of spread of a communicable disease depends on both the ability of an organism to enter, survive and multiply in the host and the comparative ease with which the disease is transmitted to other hosts.

Some ways in which communicable diseases spread are by:

- Travel through the air, such as tuberculosis, measles, or COVID-19;
- Physical contact with an infected person, such as through touch (staphylococcus), sexual intercourse (gonorrhea, HIV), fecal/oral transmission (hepatitis A), or droplets (influenza, TB, COVID-19);
- Contact with a contaminated surface or object (Norwalk virus), food (salmonella, E. coli), blood (HIV, hepatitis B), or water (cholera); and
- Bites from insects or animals capable of transmitting the disease (mosquito: malaria and yellow fever; flea: plague)

Collectively, the twenty-three (23) campuses and Chancellor’s Office of the California State University (CSU) system have identified nine (9) communicable disease hazards that have had significant impacts on their respective student, faculty, and staff populations. Of these communicable diseases, COVID-19 is considered to be the most prominent and widespread agent across all CSU campuses. (See Table 18-2 below.)

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Table 18-2: Communicable Diseases at Identified CSU Campuses

<table>
<thead>
<tr>
<th>Collective List of Communicable Diseases Identified by All CSU Campuses</th>
<th>Number of CSU Campuses (Including Chancellor’s Office) Identifying Communicable Disease Having Significant Impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>COVID-19 (SARS-CoV-2)</td>
<td>24</td>
</tr>
<tr>
<td>Meningitis</td>
<td>7</td>
</tr>
<tr>
<td>Measles</td>
<td>6</td>
</tr>
<tr>
<td>Influenza (Including H1N1/Swine Flu)</td>
<td>6</td>
</tr>
<tr>
<td>Tuberculosis</td>
<td>5</td>
</tr>
<tr>
<td>Norovirus</td>
<td>4</td>
</tr>
<tr>
<td>Mumps</td>
<td>2</td>
</tr>
<tr>
<td>E. Coli</td>
<td>2</td>
</tr>
<tr>
<td>Sexually Transmitted Diseases (STDs)</td>
<td>2</td>
</tr>
</tbody>
</table>

(Source: Interviews with CSU campus staff at CSU campuses and at CSU Chancellor’s Office.)

With the exception of COVID-19, there is variability among CSU campuses regarding which communicable diseases have had the greatest impact on individual campus communities. Table 18-3 shows the communicable disease hazards that have had the greatest impact on each CSU campus.

Table 18-3: Communicable Disease Hazards at CSU Campuses with Greatest Impact

<table>
<thead>
<tr>
<th>CSU Campus</th>
<th>Identified Communicable Disease Hazards with the Greatest Impact on CSU Campus</th>
</tr>
</thead>
<tbody>
<tr>
<td>CSU Bakersfield</td>
<td>COVID-19, Meningitis</td>
</tr>
<tr>
<td>CSU Channel Islands</td>
<td>COVID-19, Measles</td>
</tr>
<tr>
<td>Chico State</td>
<td>COVID-19, Tuberculosis</td>
</tr>
<tr>
<td>CSU Dominguez Hills</td>
<td>COVID-19</td>
</tr>
<tr>
<td>Cal State East Bay</td>
<td>COVID-19, Meningitis</td>
</tr>
<tr>
<td>Fresno State</td>
<td>COVID-19, Meningitis, Tuberculosis</td>
</tr>
<tr>
<td>Cal State Fullerton</td>
<td>COVID-19, Influenza</td>
</tr>
<tr>
<td>Humboldt State</td>
<td>COVID-19, Measles, Norovirus, Influenza, STDs</td>
</tr>
<tr>
<td>Institution</td>
<td>Disease(s)</td>
</tr>
<tr>
<td>---------------------------------</td>
<td>-------------------------------------------------</td>
</tr>
<tr>
<td>Cal State Long Beach</td>
<td>COVID-19</td>
</tr>
<tr>
<td>Cal State LA</td>
<td>COVID-19, E. coli, Measles</td>
</tr>
<tr>
<td>Cal Maritime</td>
<td>COVID-19</td>
</tr>
<tr>
<td>CSU Monterey Bay</td>
<td>COVID-19</td>
</tr>
<tr>
<td>CSUN (Northridge)</td>
<td>COVID-19, Measles</td>
</tr>
<tr>
<td>Cal Poly Pomona</td>
<td>COVID-19, Influenza (Swine Flu - H1N1)</td>
</tr>
<tr>
<td>Sacramento State</td>
<td>COVID-19</td>
</tr>
<tr>
<td>Cal State San Bernardino</td>
<td>COVID-19, Tuberculosis</td>
</tr>
<tr>
<td>San Diego State</td>
<td>COVID-19, Meningitis, Mumps</td>
</tr>
<tr>
<td>San Francisco State</td>
<td>COVID-19</td>
</tr>
<tr>
<td>San José State</td>
<td>COVID-19, H1N1</td>
</tr>
<tr>
<td>Cal Poly San Luis Obispo</td>
<td>COVID-19, Meningitis, Norovirus</td>
</tr>
<tr>
<td>CSU San Marcos</td>
<td>COVID-19</td>
</tr>
<tr>
<td>Sonoma State</td>
<td>COVID-19, H1N1, Norovirus</td>
</tr>
<tr>
<td>Stanislaus State</td>
<td>COVID-19, Tuberculosis</td>
</tr>
<tr>
<td>Office of the Chancellor</td>
<td>COVID-19</td>
</tr>
<tr>
<td>CSU System-Wide</td>
<td>COVID-19, Meningitis, Measles, Tuberculosis, Influenza-Swine Flu-H1N1, Mumps, Norovirus, E. coli, STDs</td>
</tr>
</tbody>
</table>

(Source: Interviews with CSU campus staff at CSU campuses and at CSU Chancellor’s Office.)

**Descriptions of Identified Communicable Disease Hazards at Sacramento State**

Sacramento State has identified one (1) communicable disease hazard that has had the greatest impact on campus – COVID-19. The following is a brief description of the communicable disease hazard at Sacramento State.

**COVID-19 (SARS-CoV-2)**

Coronaviruses are a family of viruses that can cause illnesses such as the common cold, severe acute respiratory syndrome (SARS) and Middle East respiratory syndrome (MERS). In 2019, a new coronavirus was identified as the cause of a disease outbreak that originated in China. This virus is now known as the **severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2)**. The disease it causes is called Coronavirus Disease 2019 (COVID-19). In March 2020, the World Health Organization (WHO) declared the COVID-19 outbreak a pandemic.
Signs and symptoms of coronavirus disease 2019 (i.e., COVID-19) may appear two to 14 days after exposure. Common signs and symptoms can include fever, cough, and tiredness. Early symptoms of COVID-19 may also include a loss of taste or smell.

The virus that causes COVID-19 spreads easily among people, and more continues to be discovered over time about how it spreads. Data has shown that the COVID-19 virus spreads mainly from person to person among those in close contact (within about 6 feet, or 2 meters). The virus is transmitted by respiratory droplets being released when someone with the virus coughs, sneezes, breathes, sings or talks. These droplets can be inhaled or land in the mouth, nose or eyes of a person nearby. In some situations, the COVID-19 virus can spread by a person being exposed to small droplets or aerosols that stay in the air for several minutes or hours (i.e., airborne transmission). It's not yet known how common it is for the virus to spread this way. The COVID-19 virus can also spread if a person touches a surface or object with the virus on it and then touches his or her mouth, nose or eyes; however, this is not considered to be a main way it spreads.

The severity of COVID-19 symptoms can range from very mild to severe. Some people may have only a few symptoms, and some people may have no symptoms at all. However, some people may experience worsened symptoms, such as worsened shortness of breath and pneumonia. People who are older have a higher risk of serious illness from COVID-19, and the risk increases with age. People who have existing medical conditions also may have a higher risk of serious illness from COVID-19. In some cases, the disease can cause severe medical complications and may even lead to death.  

Location of the Hazard

Communicable diseases have the potential to affect the entire CSU Sacramento (Sacramento State) planning area equally. As a result, the communicable disease hazard can be found at the Sacramento State campus located in Sacramento, CA (Sacramento County). The communicable disease hazard can also be found at four (4) offsite facilities owned and run by Sacramento State. Two (2) of these facilities – Hornet Commons (upcoming new student housing) and Folsom Hall – are located adjacent to the central campus. A third facility, the Julia Morgan House Event and Conference Center, is located approximately 3 miles away from the central campus. The fourth facility, The Sacramento State Aquatic Center, is located 14 miles away from the main campus, in Gold River, an unincorporated area in Sacramento County. Because of the ubiquitous nature of many communicable diseases, students, faculty, staff at (and visitors to) the Sacramento State main campus and offsite facilities are at risk of exposure to the communicable disease.

CSU Student Housing Locations and Populations

Although CSU-campus-owned student housing opportunities have been severely limited due to the COVID-19 pandemic, this situation is temporary. Eventually, students will be

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allowed back on campus at full capacity, and many of these students will be living in campus-owned housing. When this occurs, over 53,000 students (i.e., just over 11% of the CSU total enrollment) will be at increased risk of exposure to communicable disease hazards, owing to the “close-quarters” living arrangements in student housing. For Sacramento State, approximately 6% of its 31,156 enrolled students (or 1,869 students) reside in student housing.  

Extent of the Hazard

Various communicable diseases are categorized by the Center for Disease Control and Prevention (CDC) by levels of containment called Biosafety Levels (or BSLs). The higher the BSL, the greater the level of containment and level of effort necessary to prevent transmission of the disease, and therefore the greater the hazard. Biosafety Levels prescribe procedures and levels of containment for a particular microorganism or material (including research involving recombinant or synthetic nucleic acid molecules) and procedures associated with that containment. BSLs also consider primary barriers (e.g., biosafety cabinets), secondary barriers, facility design, air handling, laboratory security, etc. BSLs are graded from 1 to 4; as the BSL increases so does the relative risk of the agent/procedures as well the stringency of procedures and facility design.

Figure 22-1 describes the different BSLs, and provides examples of communicable diseases that would typically fall in to these classifications, as well as the typical protections that would be necessary to prevent transmission of each of the diseases.

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7 California State University. CSU Campus Match. Retrieved 04.30.2021 from: https://www2.calstate.edu/attend/campuses/campus-match/Pages/campus-match.aspx
The Extent of CSU Sacramento Communicable Disease Hazards Except COVID-19:

Besides COVID-19, there was no information provided on other communicable disease hazards on campus.

The Extent of CSU Sacramento COVID-19 Communicable Disease Hazard:

As a microorganism, the SARS-CoV-2 (COVID-19) virus requires a high level of containment. It is therefore classified at BSL-3.  

History of the Hazard

Over an approximately one-year period, from mid-March, 2020 to March 23, 2021, there were a reported 293 cases of COVID-19 at CSU Sacramento. Most communicable disease data are maintained by at the state and at the county levels and are not generally available at the municipal or campus levels, unless (a) the CSU campus falls under the jurisdiction of a city-level health department, or (b) a geographically specific outbreak occurs on campus or in the local community. The exception to this is the current COVID-19 pandemic, where both campus and County-level case data have been collected. As a

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result, it is important to provide COVID-19 case statistics for both CSU campuses and the counties where CSU campus assets are located.

Tables 18-5 and 18-6 show campus-level and County-level COVID-19 Case data for Sacramento State. These case data are updated on at least a weekly basis. (Please note that the COVID-19 case numbers here may not reflect the most recent updates.)

Table 18-4: Cumulative Confirmed COVID-19 Cases at Sacramento State University (as of 01/21/2021)\(^{10}\)

<table>
<thead>
<tr>
<th>COVID-19 Statistic</th>
<th>Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reported Cases at Sacramento State</td>
<td>293</td>
</tr>
</tbody>
</table>

Table 18-5: Sacramento County COVID-19 Statistics (as of 03/18/2021)\(^{11}\)

<table>
<thead>
<tr>
<th>COVID-19 Statistic</th>
<th>Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cases</td>
<td>96,377</td>
</tr>
<tr>
<td>Deaths</td>
<td>1,582</td>
</tr>
</tbody>
</table>

Potential Impacts of the Hazard

Communicable disease outbreaks and pandemics have (and will continue to have) direct impact on life, health, and safety across the CSU system (including the Sacramento State campus). The extent of this impact is contingent on the type of infection or contagion, the severity of the outbreak, and the speed at which it is transmitted. Property and infrastructure integrity may be affected if large portions of campus population contract communicable diseases at the same time and are therefore unable to perform maintenance, operations, and educational tasks. This would be particularly disruptive if those impacted are first responders or other essential personnel. Long-term outbreaks affecting large numbers of Sacramento State students could result in cancelled classes, delayed matriculation, or other disruptions to the CSU System’s mission. This has already occurred with the current COVID-19 pandemic and could occur again with more virulent strains of communicable diseases, including COVID-19.

Communicable disease hazards found across the CSU system (including Sacramento State) vary both by level of containment (BSL) (described previously) and by level of individual/public health risk, or Risk Group (RG) level. While BSLs describe the


procedures and required levels of containment in a laboratory setting, Risk Groups (RGs) reflect the potential effects of disease exposure on humans or animals. Like BSLs, RGs range from Level 1 (RG1) to Level 4 (RG4), with Level 1 (RG1) posing minimal risk to healthy individuals and public health and Level 4 (RG4) posing a very serious or extreme risks to individuals and public. BSLs generally correlate with Risk Group (RG) Levels (e.g., a RG2 agent is worked with at BSL-2), but there are exceptions (e.g., production volumes, high-risk procedures, etc.).

The World Health Organization’s (WHO) Laboratory Biosafety Manual, 3rd ed., NIH Guidelines, categorizes Risk Groups (RGs) in the following way:

Table 18-6: WHO Risk Group Categorization

<table>
<thead>
<tr>
<th>Risk Group (RG)</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>RG1</td>
<td>Rarely associated with disease in healthy adult humans or animals and pose no-to-little public health risk (e.g., Saccharomyces cerevisiae, E. coli K-12 strain derivatives often used for recombinant/molecular biology, many environmental organisms)</td>
</tr>
<tr>
<td>RG2</td>
<td>Associated with mild to moderate disease for which preventative measures or post exposure treatments are often available; public health impact is limited (e.g., Streptococcus pyogenes, Salmonella, hepatitis B virus)</td>
</tr>
<tr>
<td>RG3</td>
<td>Associated with serious to lethal human disease for which preventative vaccines or post-exposure therapies may be scarce. Public health impact is limited-to-moderate (e.g., Mycobacterium tuberculosis, hantaviruses, West Nile virus, SARS)</td>
</tr>
<tr>
<td>RG4</td>
<td>Associated with serious to lethal human disease for which preventative vaccines or post exposure therapies are not usually available. Public health impact is high (e.g., Ebola virus, Marburg virus, smallpox virus, etc.)</td>
</tr>
</tbody>
</table>

Table 18-8 describes the four (4) Risk Group Levels (RGs), and provides examples of communicable diseases that would typically fall in to these classifications, and the typical protections that would be necessary to prevent transmission of the disease. It is important to note that all but two (2) communicable disease hazards identified by CSU campuses fall under either the lower-risk RG1 or RG2 categories. COVID-19 and tuberculosis are the two (2) communicable diseases fall under the higher-risk RG3


category. However, with the advent of the recently-developed COVID-19 vaccine, and with the expectation of an increasingly robust vaccine supply, it is possible that the RG level for COVID-19 could be lowered in the future, thereby reducing both the extent and the potential impact of COVID-19.

Table 18-7: Risk Group Levels (RGs) with Example Diseases and Recommended Precautions

<table>
<thead>
<tr>
<th>Level</th>
<th>Examples</th>
<th>Typical Protection to Prevent Transmission</th>
</tr>
</thead>
<tbody>
<tr>
<td>RG 1</td>
<td>E. Coli</td>
<td>Precautions are minimal, most likely involving gloves and some sort of facial protection. Usually, contaminated materials are left in open (but separately indicated) waste receptacles. Decontamination procedures for this level are similar in most respects to modern precautions against everyday viruses (i.e.: washing one's hands with anti-bacterial soap, washing all exposed surfaces of the lab with disinfectants, etc.).</td>
</tr>
<tr>
<td>RG 2</td>
<td>Chicken Pox, Hepatitis A, B, C, Lyme disease, Salmonella, Mumps, Measles, Malaria, Scrapie, Dengue Fever, HIV</td>
<td>These bacteria and viruses cause mild disease in humans or are difficult to contract via aerosol. Routine diagnostic work with clinical specimens can be done safely at BSL-2, using BSL-2 practices and procedures.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>RG 3</th>
<th>Anthrax</th>
<th>West Nile Virus</th>
<th>SARS Virus (Including COVID-19)</th>
<th>Tuberculosis</th>
<th>Typhus</th>
<th>Yellow Fever</th>
<th>Hantaviruses</th>
<th>Avian Flu</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
| These bacteria and viruses cause severe to fatal disease in human, but vaccines or other treatments do exist to combat them. Laboratory personnel have specific training in handling pathogenic and potentially lethal agents and are supervised by competent scientists who are experienced in working with these agents. This is considered a neutral or warm zone.

<table>
<thead>
<tr>
<th>RG 4</th>
<th>H5N1 (Bird Flu)</th>
<th>Dengue Hemorrhagic Fever</th>
<th>Marburg Virus</th>
<th>Ebola Virus</th>
<th>Smallpox</th>
<th>Lassa Fever</th>
<th>Crimean-Congo Hemorrhagic Fever</th>
<th>Other Hemorrhagic Diseases</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
| These viruses and bacteria cause severe to fatal disease in humans, for which vaccines or other treatments are not available. When dealing with biological hazards at this level the use of a Hazmat suit and a self-contained oxygen supply is mandatory. The entrance and exit of a BSL-4 lab will contain multiple showers, a vacuum room, an ultraviolet light room, autonomous detection system, and other safety precautions designed to destroy all traces of the biohazard. Multiple airlocks are employed and are electronically secured to prevent both doors opening at the same time. All air and water service going to and coming from a BSL-4 lab will undergo similar decontamination procedures to eliminate the possibility of an accidental release.

**Probability of Future Occurrence of the Hazard**

There are significant data limitations regarding non-COVID-19 communicable disease cases, as the information thereof is outdated, anecdotal, and/or inadequate. As a result, it is not feasible to provide quantitative probabilities of future occurrence for non-COVID-19 communicable disease hazards. However, based on the limited data, it is feasible to present qualitative probabilities of future occurrence based on ranges of communicable disease frequency.
Table 18-9 shows a probability scale of future occurrence for the nine (9) communicable disease hazards profiled in this assessment. This scale is divided into four (4) levels of probability:

Table 18-8: Likelihood of Future Hazard Occurrence

<table>
<thead>
<tr>
<th>Likelihood</th>
<th>Parameters for Determining Likelihood</th>
</tr>
</thead>
<tbody>
<tr>
<td>Highly Likely</td>
<td>76 – 100% probability that hazard will occur annually (high to very high frequency)</td>
</tr>
<tr>
<td>Likely</td>
<td>50 – 75% probability that hazard will occur annually (moderate to high frequency)</td>
</tr>
<tr>
<td>Possible</td>
<td>11 – 49% probability that hazard will occur annually (low to moderate frequency)</td>
</tr>
<tr>
<td>Unlikely</td>
<td>0 – 10% probability that hazard will occur annually (very low to low frequency)</td>
</tr>
</tbody>
</table>

Due to significant data limitations surrounding non-COVID communicable diseases, the probability of future occurrence of CSU-system-wide communicable disease is measured by the proportion of campuses that have identified a particular communicable disease as having an impact on the campus community. In this measure, the more frequent a communicable disease is seen as impactful CSU-wide, the greater the probability of future occurrence. Note: Each communicable disease’s probability of future occurrence ranking CSU-system-wide reflects the ranking at the individual CSU campus level unless noted otherwise.

Table 18-9: Probability of Future Occurrence of Communicable Disease Hazard for CSU System

<table>
<thead>
<tr>
<th>Collective List of Communicable Diseases Identified by All CSU Campuses</th>
<th>Number of CSU Campuses (Including Chancellor’s Office) Identifying Communicable Disease Having Significant Impact</th>
<th>Proportion of CSU Campuses Identifying Communicable Disease as Having Significant Impact System-Wide</th>
<th>CSU System-Wide Probability Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>COVID-19 (SARS-CoV-2)</td>
<td>24</td>
<td>1.00</td>
<td>Highly Likely</td>
</tr>
<tr>
<td>Meningitis</td>
<td>7</td>
<td>0.29</td>
<td>Possible</td>
</tr>
<tr>
<td>Measles</td>
<td>6</td>
<td>0.25</td>
<td>Possible</td>
</tr>
<tr>
<td>Influenza (Including H1N1/Swine Flu)</td>
<td>6</td>
<td>0.25</td>
<td>Possible</td>
</tr>
<tr>
<td>Disease</td>
<td>Score</td>
<td>Probability</td>
<td>Potential</td>
</tr>
<tr>
<td>---------------------------------</td>
<td>-------</td>
<td>-------------</td>
<td>-----------</td>
</tr>
<tr>
<td>Tuberculosis</td>
<td>5</td>
<td>0.21</td>
<td>Possible</td>
</tr>
<tr>
<td>Norovirus</td>
<td>4</td>
<td>0.17</td>
<td>Possible</td>
</tr>
<tr>
<td>Mumps</td>
<td>2</td>
<td>0.08</td>
<td>Unlikely</td>
</tr>
<tr>
<td>E. Coli</td>
<td>2</td>
<td>0.08</td>
<td>Unlikely</td>
</tr>
<tr>
<td>Sexually Transmitted Diseases (STDs)</td>
<td>2</td>
<td>0.08</td>
<td>Unlikely</td>
</tr>
</tbody>
</table>

(Source: Interviews with staff at CSU campuses and at the CSU Chancellor’s Office.)

Vulnerability to the Hazard

Vulnerability to a communicable diseases hazard resides in the population of a given area – both human and animal – not in the infrastructure or physical assets. While CSU assets and infrastructure could be impacted indirectly by the communicable disease hazard, these impacts would be secondary to the impact that the communicable disease hazard would have on students, faculty, staff, and visitors at CSU campuses. CSU campus settings are geographically diverse, with locations ranging from small towns to medium-sized cities to densely populated urban areas. Hundreds of thousands of people work, study, and/or pass through CSU campuses on any given day. (As of Fall 2019, CSU - Sacramento had 31,156 students and additional faculty and staff.) Each of these persons is vulnerable to communicable disease, particularly if it is a pathogen that individual has not been immunized against, or for which no immunization exists. Prolonged outbreaks could result in a loss of services, failure of infrastructure (from lack of operators or maintenance), and closure of facilities. This exact scenario has played out in the current COVID-19 pandemic at Sacramento State

Estimate of Potential Losses

COVID-19 Pandemic Health Impact on CSU Campuses and Surrounding Communities

The most prescient metric for estimating losses from COVID-19 is loss of life. The nationwide campus-related COVID-19 death rate of 0.02% remains well below the average COVID-19 death rate in the U.S. However, due to data limitations, there is no information on CSU-campus-specific deaths by COVID-19 or by any other communicable diseases. In fact, COVID-19 is the only communicable disease for which case reports have been readily available for CSU campuses.

15 The California State University. Enrollment. Retrieved 05.03.2021 from: https://www2.calstate.edu/csustystem/about-the-csu/facts-about-the-csu/enrollment/Pages/default.aspx

16 The California State University. Employee Head Count by Campus. Retrieved 05.03.2021 from: https://www2.calstate.edu/csustystem/faculty-staff/employee-profile/csustystem/workforce/Pages/employee-headcount-by-campus.aspx
At some point in the future, CSU campuses will return to full capacity. Without adequate surveillance regarding campus access and student and employee interaction, CSU campuses (including Sacramento State) are at risk of developing an extreme incidence of COVID-19 and may become “super-spreaders” for adjacent communities. The emergence of more virulent COVID-19 variants would only add to the potential for high negative impacts on life safety, operations, and service delivery across the CSU system. (Other communicable diseases would also re-emerge, but with low to moderate negative impacts on life safety, operations, and service delivery.)

Economic Impact of COVID-19 Pandemic on CSU Financial Health

During the first few months of the COVID-19 pandemic in 2020, the CSU system suffered tremendous negative fiscal impacts. From March through July of 2020 alone, over $146 million worth of revenue losses were sustained across the CSU system due to refunds to students for parking, housing and dining service fees during Spring Semester, 2020. (See Figure 18-2 below for the economic impact to the Sacramento State campus). Several CSU campuses saw refund losses surpass $10 million. (See Figure 18-2.)

Figure 18-2: CSU COVID-19 Cost Tracking Showing Revenue Refund Losses and Increased Costs

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Mitigative Relief from Federal Assistance

The $1.5 billion in total federal assistance sent to the CSU system will help relieve the losses of revenues from services like dorms, parking and dining services during a year of mainly empty campuses. (See Table 18-11.) However, because of staggering COVID-related revenue losses, the CSU system is planning for three (3) years of fiscal duress.

Table 18-10: Total Federal Assistance to CSU for COVID-19 Related Losses, 2020 – 2021

---


<table>
<thead>
<tr>
<th>Institution</th>
<th>Federal Funding</th>
<th>State Funding</th>
<th>Total Funding</th>
<th>Total State Funding</th>
</tr>
</thead>
<tbody>
<tr>
<td>California Polytechnic State University</td>
<td>$20,752,799</td>
<td>$14,725,000</td>
<td>$37,000,928</td>
<td>$72,478,727</td>
</tr>
<tr>
<td>California State Polytechnic University, Pomona</td>
<td>$48,614,353</td>
<td>$31,102,000</td>
<td>$86,044,649</td>
<td>$165,761,002</td>
</tr>
<tr>
<td>California State University Channel Islands</td>
<td>$14,288,099</td>
<td>$8,512,000</td>
<td>$24,915,170</td>
<td>$47,715,269</td>
</tr>
<tr>
<td>California State University Maritime Academy</td>
<td>$1,381,700</td>
<td>$1,204,000</td>
<td>$2,472,622</td>
<td>$5,058,322</td>
</tr>
<tr>
<td>California State University - Sacramento</td>
<td>$59,891,260</td>
<td>$35,643,000</td>
<td>$104,900,133</td>
<td>$200,434,393</td>
</tr>
<tr>
<td>California State University, Bakersfield</td>
<td>$22,855,632</td>
<td>$12,483,000</td>
<td>$40,285,656</td>
<td>$75,624,197</td>
</tr>
<tr>
<td>California State University, Chico</td>
<td>$31,603,856</td>
<td>$20,019,000</td>
<td>$55,754,538</td>
<td>$107,377,394</td>
</tr>
<tr>
<td>California State University, Dominguez Hills</td>
<td>$31,843,563</td>
<td>$18,312,000</td>
<td>$55,915,410</td>
<td>$106,070,973</td>
</tr>
<tr>
<td>California State University, East Bay</td>
<td>$24,243,652</td>
<td>$14,394,000</td>
<td>$42,929,208</td>
<td>$81,566,860</td>
</tr>
<tr>
<td>California State University, Fresno</td>
<td>$52,725,317</td>
<td>$32,557,000</td>
<td>$92,926,594</td>
<td>$178,208,911</td>
</tr>
<tr>
<td>California State University, Fullerton</td>
<td>$67,736,949</td>
<td>$41,088,000</td>
<td>$120,859,884</td>
<td>$229,684,833</td>
</tr>
<tr>
<td>California State University, Long Beach</td>
<td>$67,421,424</td>
<td>$41,202,000</td>
<td>$119,508,329</td>
<td>$228,131,753</td>
</tr>
<tr>
<td>California State University, Los Angeles</td>
<td>$61,905,561</td>
<td>$40,067,000</td>
<td>$108,543,672</td>
<td>$210,516,233</td>
</tr>
<tr>
<td>California State University, Monterey Bay</td>
<td>$13,455,716</td>
<td>$8,705,000</td>
<td>$23,922,768</td>
<td>$46,083,484</td>
</tr>
<tr>
<td>California State University, Northridge</td>
<td>$74,004,088</td>
<td>$47,458,000</td>
<td>$131,021,450</td>
<td>$252,483,538</td>
</tr>
<tr>
<td>California State University, San Bernardino</td>
<td>$42,438,131</td>
<td>$27,924,000</td>
<td>$74,982,459</td>
<td>$145,344,590</td>
</tr>
<tr>
<td>California State University, San Marcos</td>
<td>$26,602,684</td>
<td>$15,542,000</td>
<td>$46,496,808</td>
<td>$88,641,492</td>
</tr>
<tr>
<td>California State University, Stanislaus</td>
<td>$22,007,207</td>
<td>$12,928,000</td>
<td>$38,636,391</td>
<td>$73,571,598</td>
</tr>
<tr>
<td>Humboldt State University</td>
<td>$16,130,016</td>
<td>$11,146,000</td>
<td>$28,831,619</td>
<td>$56,107,635</td>
</tr>
<tr>
<td>San Diego State University</td>
<td>$45,914,127</td>
<td>$30,394,000</td>
<td>$80,592,385</td>
<td>$156,900,512</td>
</tr>
<tr>
<td>San Francisco State University</td>
<td>$47,404,409</td>
<td>$30,000,000</td>
<td>$83,075,470</td>
<td>$160,479,879</td>
</tr>
<tr>
<td>San Jose State University</td>
<td>$46,631,939</td>
<td>$30,977,000</td>
<td>$82,976,130</td>
<td>$160,585,069</td>
</tr>
<tr>
<td>Sonoma State University</td>
<td>$13,980,795</td>
<td>$9,153,000</td>
<td>$24,732,994</td>
<td>$47,866,789</td>
</tr>
<tr>
<td><strong>CSU System-Wide Totals</strong></td>
<td><strong>$853,833,277</strong></td>
<td><strong>$535,535,000</strong></td>
<td><strong>$1,507,325,177</strong></td>
<td><strong>$2,896,693,454</strong></td>
</tr>
</tbody>
</table>

**Vulnerability Assessment Conclusions**

Before the COVID-19 pandemic, populations at all CSU campuses and CSU-affiliated facilities were substantial. Collectively, as of Fall 2019, CSU campuses had 480,541 students and 53,763 faculty and staff. All were at risk from the communicable disease events, with 534,304 people being directly vulnerable. The COVID-19 pandemic has caused campus population numbers to plummet to a small fraction of full capacity.

At some point in the future, campus population numbers will return to their pre-pandemic levels, and students, faculty, and staff will again be vulnerable to the communicable
disease hazard. *If just 10% of the total CSU population were to become ill with a highly infective communicable disease like influenza or another strain of SARS, this would mean that approximately 53,430 people would be sick at the same time.* This scenario would likely overwhelm available on-campus medical services could even overwhelm portions of the larger community’s medical resources – especially if there were large numbers of infected people with immune system compromises or other underlying health problems.

See Table 18-12 below for the “10% outbreak scenario” projections both for each CSU campus and for the entire CSU system.

Table 18-11: Scenario of Communicable Disease Hazard Affecting 10% of the CSU Population

<table>
<thead>
<tr>
<th>CSU Campus</th>
<th>Approximate Enrollment Population (Fall 2019)²²</th>
<th>Approximate Total FT/PT Faculty/Staff Population (Fall 2019)²³</th>
<th>Total Combined Approximate Student and Faculty/Staff Population</th>
<th>10% Outbreak Scenario (Students and Faculty/Staff Combined)</th>
</tr>
</thead>
<tbody>
<tr>
<td>CSU Bakersfield</td>
<td>11,199</td>
<td>1,277</td>
<td>12,476</td>
<td>1,248</td>
</tr>
<tr>
<td>CSU Channel Islands</td>
<td>7,093</td>
<td>994</td>
<td>8,087</td>
<td>809</td>
</tr>
<tr>
<td>Chico State</td>
<td>17,019</td>
<td>1,969</td>
<td>18,988</td>
<td>1,899</td>
</tr>
<tr>
<td>CSU Dominguez Hills</td>
<td>17,027</td>
<td>1,761</td>
<td>18,788</td>
<td>1,879</td>
</tr>
<tr>
<td>Cal State East Bay</td>
<td>14,705</td>
<td>1,764</td>
<td>16,469</td>
<td>1,647</td>
</tr>
<tr>
<td>Fresno State</td>
<td>24,139</td>
<td>2,534</td>
<td>26,673</td>
<td>2,667</td>
</tr>
<tr>
<td>Cal State Fullerton</td>
<td>39,868</td>
<td>3,736</td>
<td>43,604</td>
<td>4,360</td>
</tr>
<tr>
<td>Humboldt State</td>
<td>6,983</td>
<td>1,171</td>
<td>8,154</td>
<td>815</td>
</tr>
<tr>
<td>Cal State Long Beach</td>
<td>38,074</td>
<td>4,004</td>
<td>42,078</td>
<td>4,208</td>
</tr>
<tr>
<td>Cal State LA</td>
<td>26,361</td>
<td>2,821</td>
<td>29,182</td>
<td>2,918</td>
</tr>
<tr>
<td>Cal Maritime</td>
<td>911</td>
<td>329</td>
<td>1,240</td>
<td>124</td>
</tr>
<tr>
<td>CSU Monterey Bay</td>
<td>7,123</td>
<td>1,059</td>
<td>8,182</td>
<td>818</td>
</tr>
<tr>
<td>CSUN (Northridge)</td>
<td>38,391</td>
<td>3,832</td>
<td>42,223</td>
<td>4,222</td>
</tr>
</tbody>
</table>


<table>
<thead>
<tr>
<th>Institution</th>
<th>Enrollment</th>
<th>Students</th>
<th>Enrollment</th>
<th>Students</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cal Poly Pomona</td>
<td>27,914</td>
<td>2,650</td>
<td>30,564</td>
<td>3,056</td>
</tr>
<tr>
<td>Sacramento State</td>
<td>31,156</td>
<td>3,228</td>
<td>34,384</td>
<td>3,438</td>
</tr>
<tr>
<td>Cal State San Bernardino</td>
<td>20,311</td>
<td>2,118</td>
<td>22,429</td>
<td>2,243</td>
</tr>
<tr>
<td>San Diego State</td>
<td>35,081</td>
<td>3,702</td>
<td>38,783</td>
<td>3,878</td>
</tr>
<tr>
<td>San Francisco State</td>
<td>28,880</td>
<td>3,401</td>
<td>32,281</td>
<td>3,228</td>
</tr>
<tr>
<td>San José State</td>
<td>33,282</td>
<td>3,568</td>
<td>36,850</td>
<td>3,685</td>
</tr>
<tr>
<td>Cal Poly San Luis Obispo</td>
<td>21,242</td>
<td>2,871</td>
<td>24,113</td>
<td>2,411</td>
</tr>
<tr>
<td>CSU San Marcos</td>
<td>14,519</td>
<td>1,687</td>
<td>16,206</td>
<td>1,621</td>
</tr>
<tr>
<td>Sonoma State</td>
<td>8,649</td>
<td>1,338</td>
<td>9,987</td>
<td>999</td>
</tr>
<tr>
<td>Stanislaus State</td>
<td>10,614</td>
<td>1,276</td>
<td>11,890</td>
<td>1,189</td>
</tr>
<tr>
<td>Office of the Chancellor</td>
<td>0</td>
<td>673</td>
<td>673</td>
<td>67</td>
</tr>
<tr>
<td><strong>CSU System-Wide</strong></td>
<td><strong>480,541</strong></td>
<td><strong>53,763</strong></td>
<td><strong>534,304</strong></td>
<td><strong>53,430</strong></td>
</tr>
</tbody>
</table>

*Note: Enrollment figures do not include non-specific CSU campus International Programs (455 students) or CALStateTEACH Program (933 students).*

While the case numbers of COVID-19 have been significantly lower (about 1% of the total CSU population) than those in the 10% scenario, the degree of virulence and resultant morbidity and mortality caused by COVID-19 have led to widespread campus shutdowns, educational disruption, and economic harm to the CSU system (including Sacramento State). In short, the real-time COVID-19 communicable disease outbreak scenario has proven far more devastating than the 10% simulated scenario.

**Identified Data Limitations**

There is a wealth of technical information available for communicable disease. However, there is also limited non-COVID-19 communicable disease data available regarding risk or vulnerability of specific populations throughout the CSU. Much of the data that does exist is protected by privacy policies, and therefore cannot be obtained for more specific populations. As a result, performing a detailed quantitative assessment for this hazard is difficult.

Data that could be collected prior to the next update in order to improve this methodology includes:

- Data regarding infection rates at the campus level and for specific populations;
- Data regarding communicable disease case numbers and outcomes, by CSU campus;
- Data regarding projected population changes;
- Data regarding absenteeism; and
- Data regarding increased operating costs as a result of absenteeism (i.e., temporary shifting of duties resulting in business interruption).

**Dam and Levee Failure**

**Description of the Hazard**

A dam failure represents the structural collapse of a dam that stores water in a reservoir behind the dam. These failures are typically the result of structural age, damage to the structure caused by earthquake or flooding, inadequate discharge or spillway capacity, inadequate maintenance, improper construction materials, or extreme inflow of water into the reservoir. Prolonged precipitation may result in overtopping of the dam resulting in structural compromise. The tremendous energy generated by a sudden breach of the dam will have significant downstream effects. Flood damage resulting from dam failures potentially will result in economic losses, environmental damage, destruction of agriculture, and human casualties. This type of incident is extremely dangerous as it can occur rapidly, with no warning resulting in an inability to effectively evacuate threatened communities.

A levee failure is similar to dam failures as the result will be a breach causing flooding on the dry side of the levee. Levees are embankments whose primary purpose is to furnish flood protection from seasonal high water or divert the flow of water.\(^{24}\) Most levees in California are intended to withstand peak water levels generated by heavy precipitation or rapid snowmelt in a watershed. Other levees are designed to withstand fluctuating water levels on a continuous basis such as those in the California Delta exposed to tidal influences. Levees routinely extend for lengthy distances immediately protecting communities. Levees can be found throughout the state but are most prominent in the Sacramento and San Joaquin Valleys.

Levee failures can vary from over topplings to small uncontrolled discharge to catastrophic failure. Areas downstream of the failure will be subject to inundation dependent on the volume of water released. These levee failures are also typically the result of structural age, damage to the structure caused by earthquake or flooding, slumping, seepage underneath the levee, high velocity flows eroding the levee, inadequate capacity, inadequate maintenance, improper construction materials, or extreme inflow of water into the system. Flood damage resulting from levee failures

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potentially will result in economic losses, environmental damage, destruction of agriculture, and human casualties.

A Dam or levee failure flooding will vary depending on a number of factors including the extent of the collapse or breach, the volume of water behind the structure, and the nature of the exposed downstream features. This unpredictable flooding presents a threat to life and property in addition to critical infrastructure. Lifelines and supply routes will likely be damaged or made impassible by flood erosion or standing water. Water quality and health concerns would likely be cascading effects of dam or levee failures.

Location of the Hazard

Sacramento County is home to a variety of flood control facilities and levee systems mostly along the river systems including along the American River and Sacramento River. The American River drains a large portion of the mountains of the Sierra Nevada draining runoff towards the Sacramento River. The Sacramento River drains a number of northern California watersheds from the Sierra Nevada, Coastal Range, and Cascade Mountains passing 4-5 miles west of the CSU Sacramento campus. The Sacramento River and tributary rivers are regulated by a number of large dam facilities that could pose a hazard to the Sacramento region but do not include the CSU Sacramento campus within their inundation zones. These facilities include Lake Shasta and Oroville Lake.
Figure 18-3A: Dams and Levees near CSU Sacramento

Figure 18-4B: Dams and Levees near CSU Sacramento Folsom
The American River is a year-round flowing natural river. The campus sits at a bend of the river and in a location where the river channel narrows slightly from the channel width upstream. The river feeds into the Sacramento River 6 ¾ miles downstream from the campus and eventually into the Pacific Ocean through the San Francisco Bay. The American River is lined with levees on both banks. The campus is surrounded by dense residential and commercial land uses. Critical transportation networks serving the campus cross the river systems and levees protecting the Sacramento community.
Extent of the Hazard

Dams are classified according to the hazard that they pose to life and property in the event of failure, rather than the likelihood of that failure.

- **High hazard potential dams** may result in loss of human life, and will likely result in economic, environmental, or lifeline losses.
- **Significant hazard potential dams** are not expected to result in loss of life, but are expected to cause economic, environmental, and lifeline losses.
Low hazard potential dams are not expected to result in loss of life, and there is a low expectation of economic, environmental, or lifeline losses. What losses do occur are generally limited to the dam owner.

Dams classified as high hazard are required to have Emergency Action Plans (EAP). EAPS are formal documents that identify potential emergency conditions at the dam and specify preplanned actions to be followed in case of failure. An EAP is required for all high hazard dams and is recommended for all significant hazard dams.

Table 18-12: Sacramento County Dams in Proximity to CSU Sacramento

<table>
<thead>
<tr>
<th>River</th>
<th>Dam</th>
<th>Storage</th>
<th>Hazard Severity</th>
</tr>
</thead>
<tbody>
<tr>
<td>American</td>
<td>Nimbus</td>
<td>8,800af</td>
<td>High Hazard</td>
</tr>
<tr>
<td>American</td>
<td>Folsom</td>
<td>1,002,000af</td>
<td>High Hazard</td>
</tr>
</tbody>
</table>

The CSU Sacramento campus lies within the inundation zone of the dams listed above. In the event of a catastrophic failure of the identified dams, the entire campus is expected to be impacted by the inundation area. The inundation area is expected to spread water across large areas of the Sacramento region. There are multiple transportation corridors that lie within the dam inundation zones that could compromise transportation routes and areas the campus community reside or work. Based on the above factors, the planning committee ranks the extent of the hazard as Moderate.

**Extent – Levee Failure**

Levees are used along numerous rivers, flood control channels, and other waterways including the American River and Sacramento River. The CSU Sacramento campus lies within the levee flood protected area. Recent modifications to the levees lining the American River have been completed enhancing the protection level in these areas. The CSU Sacramento campus additionally lies between the levee lining the southern bank of the American River and a levee on the western border of the campus. Flood waters that may release from the American River may back up further on campus as the water is held by the secondary levee. Based on the above factors, the planning committee ranks the extent of the hazard as Moderate.

**History of the Hazard**

There are no records of dam or levee failures in areas that present a threat to the CSU Sacramento campus. However, Sacramento County has experienced the following levee failures elsewhere in the County:

Table 18-13: Sacramento County Dam or Levee Failures

<table>
<thead>
<tr>
<th>Date</th>
<th>Dam/Levee</th>
<th>Release</th>
<th>Damage</th>
</tr>
</thead>
<tbody>
<tr>
<td>June 1972</td>
<td>Andrus Island Levee</td>
<td>Unknown</td>
<td>Federal Disaster DR-342</td>
</tr>
</tbody>
</table>

While there have been no dam failures in Sacramento County, Folsom Dam has experienced events that have compromised the dam’s functional capabilities. On July 17, 1995 spillway gate #3 failed. This resulted in increasing flows into the American River significantly. No flooding downstream occurred due to the failure of the gate. On May 15, 1997, Folsom Dam experienced cavitation damage to the river outlets. A large hole developed in one of the dam conduits, Minor damage was discovered in five other conduits. No flooding occurred as a result of this incident.

Potential Impacts of the Hazard

Dam Failure Impacts - Water that is released due to a dam that has failed generates tremendous energy and force causing a flood that will be catastrophic to life and property. Water levels from the failed dam could be significantly higher than those experienced in worst case scenario flood events. Areas closer to the failed dam will be more likely to experience complete devastation while other areas within the inundation zone will see varying levels of flood waters. The extent of the impacts of a failed dam would vary based on a number of factors such as the volume of water released, the base flow of the river, the time of the failure, the amount of warning provided, and the distance from the dam. Impacts resulting from a dam failure include:

- Loss of life
- Property destruction or damage
- Loss of property contents
- Infrastructure damage
- Flooded or destroyed lifelines/supply routes
- Damaged or destroyed utilities
- Loss of community economic base
- Employment losses
- Agricultural (crops and livestock) damages or destruction
- Environmental damage
- Floods generating threats to public health
- Flood generated debris

The area downstream from the Folsom and Nimbus Dams includes the populated areas of Sacramento County. CSU Sacramento resides immediately adjacent to the American River and is within the dam inundation zone for the Folsom Dam. Additionally, the inundation zone covers a large portion of Sacramento County providing that those members of the campus community who reside or are employed in these areas would be heavily impacted. The campus would experience the same effects from a dam inundation...
event that would be experienced by the broader region. In addition to damages resulting from the sudden release of water, this would also be in the form of transportation routes and other community critical infrastructure being impacted by the inundation. This specific hazard would substantially alter the ability of the campus to maintain operations as damages would be extensive, the campus community in these areas would be heavily affected with the loss of life and homes, and student financial capacity to support ongoing education being diminished.

**Levee Failure Impacts**

A levee failure may result in substantial amounts of water to enter into developed areas protected by the levee. The force and volume of water that is generated by a levee failure may cause extensive structural damage in close proximity to the breach and effects of flooding spreading well beyond the point of the failure. The extent of the impacts would vary based on a number of factors such as the volume of water released, the time of the failure, the amount of warning provided, the location of the breach, elevation, and distance from the breach. Potential impacts resulting from a levee failure include:

- Loss of life
- Property destruction or damage
- Loss of property contents
- Infrastructure damage
- Public health hazards resulting from mold, mildew, and disease due to flood water
- Flooded or destroyed lifelines/supply routes
- Damaged or destroyed utilities
- Loss of community economic base
- Employment losses
- Agricultural (crops and livestock) damages or destruction
- Environmental damage
- Prolonged periods of necessary dewatering
- Disruptions to education delivery to community

**Probability of Future Occurrence of the Hazard**

Sacramento County is determined to be at risk from dam and levee failure in many parts of the county. The location of the CSU Sacramento campus is on the American River, 21 miles downstream from the Folsom Dam. The American River serves as the eastern boundary of the campus. There are multiple levees in proximity to the campus and thus the campus is within a levee protected zone. There are no official recurrence intervals that
have been calculated for dam or levee failures. Based on historical experience and occurrences, the likelihood of this hazard is low.

The probability of future occurrence for both dam and levee failures is **Unlikely**.

**Vulnerability to the Hazard**

The CSU Sacramento campus is subject to the effects of flooding resulting from compromised dams and levees. The effects would likely be mostly indirect affecting members of the campus community and regional transportation networks and services. However, the campus is located within the dam inundation zone for the Folsom and Nimbus Dams. In the case of dam failure, the amount of time to respond to the needs of the campus community prior to inundation will be limited.

The most significant challenge regarding dam failures is they generally result in catastrophic outcomes. Any breach along a levee is impossible to predict where a failure may occur. It is likely that response action will not be fully implemented until the incident situational intelligence provides adequate information as to compromised locations. These variables place all those working and living within the dam inundation and flood protection zones in vulnerable locations.

Vulnerability to a dam or levee failure on the CSU Sacramento campus will vary depending on when the failure was to occur. The risk to the campus population will be lessened during periods when classes are not in session or during periods of breaks. Conversely, during the days and hours that classes are in session and staff are at their workplaces, the human vulnerability increases. However, in region-wide events this vulnerability may be shared with the homes and workplaces of members of the campus community and their families.

Certain campus populations will experience greater challenges to a post-flood / failure environment. Vulnerable populations will likely need to navigate through flood generated debris, face extreme health safety issues from flood waters, experience extreme stresses of a disaster, an inability to communicate to or gain access to support networks, and find difficulty in accessing equipment or supplies to aid in a specific need.

**Estimate of Potential Losses**

Estimates of potential losses will be influenced by a variety of factors. The volume and force of the water will determine the scale of damages affecting campus infrastructure, equipment, and other impacted features. The proximity to the failure and elevation above flood waters will affect the level of damage and individuals exposed. The time of the academic year, the day of week, and hour in which the failure was to occur will influence the number of people on campus and potential casualties. Losses will be generated by the physical damages, the loss of revenue, loss of academic research, loss of building contents, and community wide economic reductions.

The maximum total replacement costs due to dam and levee failure are **unknown**, as estimated campus facility and structure costs were not available for CSU Sacramento.
Vulnerability Assessment Conclusions

While the occurrence of dam failures has not been historically relevant near the CSU Sacramento campus, the potential for hazards related to the region’s dams still exist. The Sacramento area has experienced threats to its levee systems throughout a number of events. The consequences of a dam failure would generate catastrophic results to downstream communities. The potential for dam or levee failure further generates the added potential for a number of cascading effects such as disruptions to the local economy, utility failures, disruptions to providing for the needs of the community, and development of public health hazards. These effects would be exacerbated by effects of seasonal flooding, ongoing heavy precipitation, or excessive run-off from the watershed contributing to the river system. The potential for widespread flooding and damage of structures due to the force of water has exponentially powerful impacts on particular populations among the campus community including those with access or functional needs, international students, the homeless, and students residing in the residence halls.

Identified Data Limitations

Data limitations include missing campus structural replacement costs, and an incomplete inventory of both building construction features and mitigation efforts to lessen the impact due to flood inundation.

Drought

Description of the Hazard

Drought is defined as a condition where moisture levels fall significantly below normal for an extended period of time over a large area that adversely affects plants, animal life, and humans. Drought is a gradual phenomenon. Although droughts are sometimes characterized as emergencies, they differ from typical emergency events. Most natural disasters, such as floods or forest fires, occur relatively rapidly and afford little time for preparing for disaster response. Droughts occur slowly, over a multi-year period, and it is often not obvious or easy to quantify when a drought begins and ends.

Throughout California, one dry year does not normally constitute a drought. California’s extensive system of water supply infrastructure (reservoirs, groundwater basins, and conveyance assets) mitigates the effect of short-term dry periods for most water users. Defining when a drought begins is a function of drought impacts to water users. Drought in one location may not constitute a drought for all water users, as some users in relative proximity may have a different water supply. For example, individual water suppliers may use a combination of sources such as rainfall/runoff, water in storage, or expected supply from a water wholesaler to define their water supply conditions.

Drought can be characterized as one or more of the four following types:

- **Meteorological drought** is defined on the basis of the degree of dryness (in comparison to some “normal” or average amount) and the duration of the dry
period. A meteorological drought must be considered as region-specific since the atmospheric conditions that result in deficiencies of precipitation are highly variable from region to region.

- **Hydrological drought** is associated with the effects of periods of precipitation (including snowfall) shortfalls on surface or subsurface water supply (e.g., streamflow, reservoir and lake levels, ground water). The frequency and severity of hydrological drought is often defined on a watershed or river basin scale. Although all droughts originate with a deficiency of precipitation, hydrologists are more concerned with how this deficiency plays out through the hydrologic system. Hydrological droughts are usually out of phase with or lag the occurrence of meteorological and agricultural droughts. It takes longer for precipitation deficiencies to show up in components of the hydrological system such as soil moisture, streamflow, and ground water and reservoir levels. As a result, these impacts are out of phase with impacts in other economic sectors.

- **Agricultural drought** focus is on soil moisture deficiencies, differences between actual and potential evaporation, reduced ground water or reservoir levels, and so forth. Plant water demand depends on prevailing weather conditions, biological characteristics of the specific plant, its stage of growth, and the physical and biological properties of the soil.

- **Socioeconomic drought** refers to when physical water shortage begins to affect health, well-being, and quality of life of people, or when the drought starts to affect the supply and demand of an economic product that relies on water.

The drought issue in California is further compounded by water rights. The central challenge is how to prioritize water usage among a broad variety of contexts. It is for this reason that water is a commodity possessed and utilized under a variety of legal doctrines. As such, many competing sets of interests create a dynamic prioritization process between, for example, farming and federally protected fish habitats and water supply for municipal/public use (including usage for CSU - Sacramento) versus water usage for wildfire abatement or natural resource protection.

**Location of the Hazard**

Drought conditions have been identified throughout Sacramento County and on the CSU Sacramento campus. Drought is not a location-specific hazard and affects the entire planning area equally. Drought location is not isolated to the campus footprint but occurs as a geographic sub-set of drought conditions occurring at larger scales. From 2000-2020, drought conditions existed continuously in the state, with 80-100% of the state impacted for 12 of the last 20 years.  

Extent of the Hazard

Given the historical occurrence of severe drought impacts throughout Sacramento County (which includes the campus planning area) and the potential future impact exacerbated by climate change, the CSU Planning Committee recognizes that drought will continue to pose a high degree of risk statewide, potentially impacting crops, livestock, water resources, the natural environment at large, buildings and infrastructure (from land subsidence), and local economies. In addition, although drought affects the entire CSU system-wide planning area, the potential impacts are variable and specific to each campus/jurisdiction, depending on contextual factors such as the degree of assets and activities historically impacted by drought within each jurisdiction.

In addition, drought-related land subsidence has occurred and will continue in areas where the groundwater basin has been subject to overdraft and long-term recharge is inadequate to maintain the water table elevation, leaving underground voids. Subsidence levels have been measured up to 30 feet in California with subsidence bowls covering hundreds of square miles. As such, drought-related subsidence may result in serious structural damage to buildings, roads, irrigation ditches, underground utilities, and pipelines. Though not having occurred on campus, these impacts remain issues of concern for the campus over the long term.

For CSU – Sacramento, the extent of the hazard is Moderate (corresponding to D1-D2 on the extent scale below) and addressed through water conservation and conversion to drought resistant landscaping. However, the campus planning committee recognizes that the potential for more severe conditions exists and is tied to regional water resource vulnerabilities tied to Sacramento and American rivers, and water retention infrastructure.

The U.S. Drought Monitor developed tables of impacts reported during past droughts in California in order to depict the extent of drought risk for each level of drought on the U.S. These possible extent conditions for California complement the general impacts column of the U.S. Drought Monitor Classification Scheme.

Table 18-14: Impacts of Drought Levels as Determined by US Drought Monitor

<table>
<thead>
<tr>
<th>Category</th>
<th>Impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>D0</td>
<td>Soil is dry; irrigation delivery begins early</td>
</tr>
<tr>
<td></td>
<td>Dryland crop germination is stunted</td>
</tr>
<tr>
<td></td>
<td>Active fire season begins</td>
</tr>
<tr>
<td></td>
<td>Winter resort visitation is low; snowpack is minimal</td>
</tr>
</tbody>
</table>

| D1 | Dryland pasture growth is stunted; producers give supplemental feed to cattle |
|    | Landscaping and gardens need irrigation earlier; wildlife patterns begin to change |
|    | Stock ponds and creeks are lower than usual |

| D2 | Grazing land is inadequate |
|    | Producers increase water efficiency methods and drought-resistant crops |
|    | Fire season is longer, with high burn intensity, dry fuels, and large fire spatial extent; more fire crews are on staff |
|    | Wine country tourism increases; lake- and river-based tourism declines; boat ramps close |
|    | Trees are stressed; plants increase reproductive mechanisms; wildlife diseases increase |
|    | Water temperature increases; programs to divert water to protect fish begin |
|    | River flows decrease; reservoir levels are low and banks are exposed |

| D3 | Livestock need expensive supplemental feed, cattle and horses are sold; little pasture remains, producers find it difficult to maintain organic meat requirements |
|    | Fruit trees bud early; producers begin irrigating in the winter |
|    | Federal water is not adequate to meet irrigation contracts; extracting supplemental groundwater is expensive |
|    | Dairy operations close |
|    | Marijuana growers illegally tap water out of rivers |
|    | Fire season lasts year-round; fires occur in typically wet parts of state; burn bans are implemented |
|    | Ski and rafting business is low, mountain communities suffer |
|    | Orchard removal and well drilling company business increase; panning for gold increases |
|    | Low river levels impede fish migration and cause lower survival rates |
|    | Wildlife encroach on developed areas; little native food and water is available for bears, which hibernate less |
|    | Water sanitation is a concern, reservoir levels drop significantly, surface water is nearly dry, flows are very low; water theft occurs |
|    | Wells and aquifer levels decrease; homeowners drill new wells |
|    | Water conservation rebate programs increase; water use restrictions are implemented; water transfers increase |
### History of the Hazard

Historically, drought has been so prevalent in California that its presence is almost continuous. According to the US Drought Monitor, Time Series data, Sacramento County experienced eight drought periods covering 12 years from 2000-2021, which includes the CSU - Sacramento footprint. The 2012-2017 drought period resulted in severe reductions in water supply leading to campus water restrictions and impacts to the campus landscape.

Figure 18-6: Periods of Drought in Sacramento County, CA, 2001 – 2021

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According to the National Drought Mitigation Center, over 3,500 reports and publications covering 370 drought-related events took place across the state (many of which were statewide events) between 2000-2020. In addition, the National Center for Environmental Information (NCEI) reports more than 500 events statewide during this same time period. These events produced a comprehensive range of impacts to water supply, regulations and allocations to businesses and municipalities, budgets and resources for firefighting, water law and policy, and physical impacts to built and natural environments. As such, data records of previous occurrences can be viewed as separate time and event demarcations for a hazard almost continuously in effect across the state with cascading impact potential.

Source: https://droughtmonitor.unl.edu/data/timeseries
Source: https://droughtreporter.unl.edu/advancedsearch.aspx

According to the Department of Water Resources, droughts exceeding three years are relatively common in Southern California, but relatively rare in Northern California - the region is the geographic source of much of the state’s developed water supply. The 1929-34 drought established the criteria commonly used in designing storage capacity and yield of large Northern California reservoirs. 29

According to the US Drought Monitor’s time series data, from 2000-2021 (with the exception of a 2–3-month period in 2000 and 2011), some degree of drought conditions has been continuously in effect somewhere in California. In fact, 80% - 100% of the state has been subjected to drought conditions for 12 of the last 20 years, with the most severe drought being the 100% state-wide event from 2012-2017.

Given the extent of the drought risk in California, the following drought event was selected as an exemplar due to its broad and significant impacts on the state and on Sacramento County which includes the CSU - Sacramento campus planning area:

2012 – 2017 – Drought produced severe impacts to water wells throughout the state of California, with a high number of wells running dry. Land subsidence due to increased groundwater pumping also occurred in numerous areas of the state such as the San Joaquin and Central Valleys. Crop damage was widespread as well. Water allotments were drastically reduced in many towns and water agencies, with extremely high costs for procuring water. In addition, job loss occurred with many families requiring food supply assistance, and water supply assistance provided to home-owners with dry wells. According to a report released by UC Davis Center for Watershed Sciences, the 2012-2017 period of the California drought cost the state’s agriculture industry about $1 billion in lost revenue, with a total statewide economic cost of the drought calculated to be $2.2 billion. The report says, “it is responsible for the greatest water loss ever seen in California agriculture - about one third less than normal”. The report calls the groundwater situation in California "a slow-moving train wreck." Spring snowpack at Donner Summit reached record low levels in 2014, exceeded in 2015 by a remarkable April 1 snow-water-equivalent value of only 5% of average. Decreased precipitation since contributed to near-record low levels in the Shasta Reservoir. The ongoing drought has contributed to declines in crop values across the state. For example, crops including cotton, corn silage and barley (the field crop category) fell by 42 percent. 31

Potential Impacts of the Hazard

Drought impacts are wide-reaching and may be economic, environmental, and/or societal. This assessment of its impact recognizes that historic occurrences of drought


throughout the planning area are a sub-set of larger and inter-connected local and regional droughts, and that the (related) historic impacts provide a sound basis for understanding potential (future) impacts.

The most significant potential impact associated with drought across the CSU - Sacramento campus planning area is a potential reduction in water availability for the regional and municipal area tied to the campus. Other impacts include crop loss and damage to trees and other natural resources (See Tree Mortality below). The footprint of CSU - Sacramento to some extent includes these vulnerable resources based on the campus landscape (trees) and the presence (and footprint size) of agricultural research crops and field stations.

As a secondary impact of drought, wildfire is directly attributable to dry atmospheric conditions. Wildfires almost always coincide with drought in California, though not limited to such. However, the wildfire hazard is analyzed separately in this plan. (See wildfire section below).

In reviewing the occurrences of drought for Sacramento County (which includes CSU - Sacramento), the US Drought Monitor and the National Drought Mitigation Center report that tens of millions of trees died during the (2014-2017) state-wide drought disaster. Though data sources do not provide data for tree mortality specific to CSU - Sacramento, the broad geographic extent of the impact makes it likely that tree mortality occurred to some degree on the campuses. Due to the lasting and ongoing effects of drought on the landscape, trees will continue to be impacted within the municipalities, counties and regions wherein lies the CSU campus system as long as drought conditions continue.

Given the absence of data, in order for the CSU Committee to assess the impact of tree mortality, it is useful to view it as a risk sub-set to the probability, location, extent, severity and duration of the drought hazard within each campus-located municipality, county and region. Regarding potential impacts, standing dead trees could fall, posing a risk to people, buildings, power lines, roads and other infrastructure. In addition, drought-impacted trees become susceptible to diseases and insect infestations (bark beetle) further adding to the risk of tree mortality and related potential impacts. No data are currently available for tree mortality on campus; however, the CSU Planning Team will pursue data on this issue in the future.

As a potential tertiary impact, prolonged and repeated drought conditions over time can produce land subsidence and the risk of damage to building foundations and infrastructure on campus resulting from ground instability and collapse. Land subsidence is defined as the vertical sinking of the land over manmade or natural underground voids. Subsidence is often the direct result of groundwater over-extraction in response to drought conditions, as well as oil and gas extraction. Weight can accelerate the process of subsidence resulting from surface development and infrastructure such as roads and

buildings, vibrations from construction blasting and heavy truck or train traffic. For example, the State Water Project’s 444-mile-long California Aqueduct has required repairs such as the raising of canal linings, bridges, and water control structures on the Aqueduct – in the Central Valley a five-mile reach of the Eastside Bypass was impacted by subsidence, and the Department of Water Resources estimated that it may cost in the range of $250 million to acquire flowage easements and levee improvements to restore the design capacity of the subsided area. 

At present, drought related damage to campus buildings and infrastructure at CSU - Sacramento has not been reported, but the potential for such impacts is possible. With regard to overall potential impact, water supply/availability for CSU - Sacramento is ultimately tied to broader inter-dependent, and more intensive modes of water use at local and regional scales such as agriculture and ranching, wildfire protection, larger metropolitan/municipal usage, manufacturing and commerce, tourism, recreation, and wildlife preservation. During drought periods, the State of California’s regulated water allocations are modified and often reduced, which can result in reduced water availability for all usage contexts, including CSU - Sacramento. A reduction of electric power generation and water quality deterioration are also potential impact factors.

Table 18-15: Summary of Drought Impacts on Water Resources

<table>
<thead>
<tr>
<th>Resource</th>
<th>Type of Impact</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sea Level</td>
<td>Direct</td>
<td>Sea level is rising and will likely impact coastal areas</td>
</tr>
<tr>
<td>Soil Moisture</td>
<td>Direct</td>
<td>Prolonged dry seasons can lead to decreases in soil moisture; drier vegetation</td>
</tr>
<tr>
<td>Vegetation</td>
<td>Indirect</td>
<td>Longer and more intense fire season with increased extent of area burned</td>
</tr>
<tr>
<td>Stream Conditions</td>
<td>Direct</td>
<td>Increases in water temperature; potential effects on fish</td>
</tr>
<tr>
<td>Snowpack</td>
<td>Indirect</td>
<td>Increases in temperature will lead to decreases in snowpack</td>
</tr>
<tr>
<td>Runoff</td>
<td>Direct</td>
<td>Warmer temperatures are likely to lead to a shift in peak runoff from spring to</td>
</tr>
</tbody>
</table>


Probability of Future Occurrence of the Hazard

**Highly Likely** — The US Drought Monitor’s time series data (2000-2020) indicates that some degree of drought has nearly a 100% probability of occurrence in the state in any given year. Given that CSU - Sacramento lies within a drought impacted region, it is prudent to extend this likelihood of occurrence to the planning area.

Vulnerability to the Hazard

In California, rising temperatures are projected to increase the average lowest elevation at which snow falls, reducing water storage in the snowpack, particularly at those lower mountain elevations which are now on the margins of reliable snowpack accumulation. Higher spring temperatures will also result in earlier melting of the snowpack. The shift in snow melt to earlier in the season is critical for California’s water supply because flood control rules require that water be allowed to flow downstream and that water cannot be stored in reservoirs for use in the dry season. As such, state-level drought risk factors that have led to drought’s state-wide severity and extent, and potential impacts also create drought vulnerabilities at the level of the CSU - Sacramento campus.

Moreover, climate change will likely adversely impact the vulnerability of watersheds and ecosystems in their ability to deliver important ecosystem services. These changes may limit the natural capacity of healthy forests to capture water and regulate stream flows. Sierra Nevada mountain winters and springs are warming, and on average, precipitation as snowfall relative to rain is decreasing. A warming climate with reduced snowpack will result in earlier snowmelt and will subsequently reduce downstream water availability during summer and early fall.

As such, all stakeholders at geographic levels from the state down to the CSU - Sacramento planning area, potentially have less capacity to address future drought risks due to projected temperature increases and shortages in water; ground-water
withdrawals have been occurring at a deficit rate of 1 – 2 million acre-feet per year, where the impacts of drought include decreased availability of water for agriculture and environmental uses. In forested and other vegetated areas, prolonged drought decreases the moisture content of forest fuels and increases the risk of high severity wildfires.

It should be pointed out that California is the single most productive agricultural state and its agricultural industry relies heavily on reservoir water supplied by snowmelt and rainfall runoff. Yearly variations in snowpack depths have implications for water availability as snowmelt from the winter snowpack feeds a network of reservoirs. Spring snowpack at Donner Summit reached record low levels in 2014, exceeded in 2015 by a remarkable April 1 snow-water-equivalent value of only 5% of average. Decreased precipitation since 2011 has contributed to near-record low levels in the Shasta Reservoir.

### Vulnerability of Populations

Drought vulnerabilities include agricultural sector job loss, secondary economic losses to local businesses and public recreational resources, increased cost to local and state government for large-scale water acquisition and delivery, and water rationing and water wells running dry for individuals and families. As drought is often accompanied by prolonged periods of extreme heat, negative health impacts such as dehydration can also occur, where children and elderly are most susceptible. Air quality often declines in times of drought which can affect those with respiratory ailments. These same vulnerability measures apply to the students, faculty and staff of the CSU - Sacramento campus.

### Property Vulnerability

Drought vulnerabilities include crop loss, injury and death of livestock and pets, and damage to infrastructure, homes and other buildings resulting from the secondary drought impact of land subsidence. The related drought impacts of tree mortality and land subsidence pose risks to vulnerable critical infrastructure and property. These same vulnerability measures apply to the properties of the CSU - Sacramento campus.

### Natural Environment Vulnerability

The historical and potential impacts of drought on the natural environment are widespread throughout public and private lands within the state, including tree mortality, impacts to all flora and fauna, and destabilization (subsidence) of land along streams and rivers, and within watersheds.

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The core issue shaping drought vulnerabilities throughout California is water supply and demand. Several factors play into the issue including groundwater basins, surface water run-off, public and agricultural demand, and surface water storage water sheds. A USGS led analysis was first conducted in 2010 through the Forest and Rangeland Assessment and ongoing through the USGS Forest and Rangeland Ecosystem Science Center to identify threats and assets where water supply would benefit from environmental management designed to protect or enhance water resources, the key effort which, in part, both defines and mitigates the severity of drought risk and vulnerabilities.

With regard to overall threat and asset findings shaping the potential severity of drought, the watersheds in the Sierra region contribute most greatly to the state’s water supply, but are under threat from climate change, wildfire and development. In addition, groundwater basins in the San Joaquin Valley and Sacramento Valley bioregions are an abundant resource that is heavily threatened by over pumping.

**Critical Facilities Vulnerabilities**

Drought vulnerabilities for CSU - Sacramento’s critical facilities include water shortfalls for facility operations and critical functions, and potential structural destabilization and damage resulting from land subsidence.

**Estimate of Potential Losses**

An estimate of potential losses from drought has not been calculated for the campus or the CSU system as a whole. However, drought related losses to the City of Sacramento and the surrounding region such as crop loss and cost increases for water resources have re-occurred over time. Please consult city and county level government, and/or state agricultural agencies for data on the financial impacts from drought.

**Vulnerability Conclusions**

The CSU Planning Committee understands that the high degree of vulnerability posed by drought will be exacerbated by greater climate variation in the future and therefore greater variation and uncertainty regarding the availability of water supplies which are already under tremendous stress. In response to such vulnerability, state legislation passed in 2014 requires local governments to regulate pumping and recharge to better manage groundwater supplies, and groundwater-dependent regions are required to halt overdraft and bring basins into sustainable levels of pumping and recharge by the early 2040s. That said, the Committee will continue to work with local, regional and state partners and stakeholders to explore solutions for mitigating the drought hazard on its campuses by accessing the best available data and resources on climate change and its relationship to drought.

**Identified Data Limitations**
Data is limited concerning campus-related agricultural assets as well as data on campus tree mortality.

**Earthquake**

Description of the Hazard

An earthquake is a sudden motion or shaking caused by the release of pressure accumulated along the edge of tectonic plates covering the earth. These huge plates are constantly moving and move ever so slowly under, over, or by passing one another. This movement is gradual however the plates may lock together accumulating enormous amounts of energy. When this energy builds, stress develops, and the adjoining plates will eventually break free and result in ground shaking – an earthquake.

Large earthquakes may result in fissuring, ground settlement, and/or vertical or horizontal displacement. Earthquakes occur without warning and can result in extensive damages and human casualties. Damages associated to earthquake generated ground shaking is normally confined to a narrow area along fault trend from the earthquake epicenter. However, seismic waves may generate ground shaking resulting in damages in areas outside of the fault trend.

**Fault Rupture** – The rupture of faults is the differential movement of the two sides of the earth’s plates at the point of the fault. Horizontal or vertical displacement may be significant and occur over great distances. The movement and energy that occurs along a fault is released in waves resulting in ground shaking. The intensity of ground shaking varies based on the magnitude of the earthquake, the proximity to the earthquake epicenter, the composition of the ground sediment or rock the waves travel through, and the depth of the earthquake.

**Liquefaction** – In addition to the primary fault rupture that occurs right along a fault during an earthquake, the ground many miles away can also fail during intense shaking. As seismic waves travel through saturated granular soil; the soil begins to liquefy and act as a fluid. Soil strength and stability is lost causing the effects of ground shaking to intensify and for ground deformation to occur. These water saturated soils when shaken quickly lose the ability to support buildings, bridges, utilities, and other structures. Areas susceptible to liquefaction include places where sandy sediments have been deposited by rivers along their course or by wave action along beaches. The greater the magnitude of an earthquake and longer duration of strong ground shaking will result in an enhanced potential for liquefaction to occur. Settlement can cause damage when the amount settlement varies significantly across the length of a structure. Lateral spreading occurs when liquefaction occurs on gently sloping ground and the liquefied material at depth allows the area to slide, often toward a vertical discontinuity or “free face” such as a creek or stream channel. Liquefaction can occur in susceptible soils below bodies of water, and settlement and lateral spreading can damage structures built on or adjacent to
these areas. Transportation bridges across water bodies, wharves, piers and other structures at ports and harbors, and underwater utility lines can be severely damaged by this hidden hazard.

**Subsidence** - Changes in the local environment that cause subsidence or sinkholes are called triggering mechanisms. Water is the primary factor that affects the local environment and causes subsidence. Water level decline, changes in groundwater flow, increased loading, and deterioration (such as abandoned mines) are all triggering mechanisms. Water level decline may occur naturally, or it may be the result of human action. Factors that lead to water decline are pumping (from wells), localized drainage (for construction activities), dewatering, or drought. Changes in groundwater flow can result from an increase in the velocity of groundwater movement, and increase in the frequency of water table fluctuations, and changes in discharge (either increase or decrease). Increased loading can cause pressure in the soil, leading to the failure of underground cavities and space, such as caves. Vibrations from earthquakes, heavy machinery, and blasting may result in structural collapse, followed by surface resettlement.

**Location of the Hazard**

The State of California is particularly vulnerable to earthquake activity due to California’s location residing between two large tectonic plates. CSU Sacramento is located in the southern Sacramento Valley. In general, fault systems extend along the mountain ranges on the eastern and western edges of the valley a distance from CSU Sacramento. There are no known fault systems in the immediate area surrounding the campus.

The Pacific Plate and the North American Plate come together at the San Andreas Fault 85 miles west of the CSU Sacramento campus. In addition to the San Andreas Fault, the Coastal Ranges and Sierra Nevada Mountains are home to or near additional fault systems with the potential to generate strong ground shaking. The Calaveras Fault traverses south to north traversing through the eastern portions if the San Francisco Bay Area extending 60 miles southwest of the CSU Sacramento campus. The Hayward Fault traverses the East Bay communities of Hayward through Berkeley 62 miles southwest of CSU Sacramento. The Green Valley Fault extends along the eastern slopes of the Coastal Ranges to the northwest into the area of Lake Berryessa 40-45 miles west of the CSU Sacramento campus. The 290-mile long Great Valley Fault extends along the eastern base of the Coastal Ranges from Kettleman City north to Orland 30 miles west of the CSU Sacramento campus. The Swain River-Spencerville Fault extends through the foothills of the Sierra Nevada Mountains 28 miles to the northeast of the campus. There are numerous additional faults in the area on all sides of the campus.
The CSU Sacramento campus does not reside in areas designated to be liquefaction zones.

**Extent of the Hazard**

The extent or severity of earthquake damage is expressed in terms of magnitude, intensity, and duration. The amount of energy released during an earthquake is normally conveyed as a magnitude measured from a seismogram. Magnitude is expressed in numbers and decimals representing the physical size of the earthquake. The strength and effect of the shaking on the surface of the earth is classified as the intensity. Intensity is further defined from the effects the earthquake has on people, structures, and the natural environment. The intensity of an earthquake in terms of measuring magnitude and evaluating its effects is generally expressed using the Modified Mercalli (MM) Intensity Scale. Duration is the length of time the earthquake’s energy is released.

The Richter magnitude scale was developed in 1935 by Charles F. Richter of the California Institute of Technology as a mathematical device to compare the size of earthquakes. The Richter Scale is the best-known scale for measuring the magnitude of earthquakes. The magnitude value is proportional to the logarithm of the amplitude of the strongest wave.
during an earthquake. A recording of 7, for example, indicates a disturbance with ground motion 10 times as large as a recording of 6. The energy released by an earthquake increases by a factor of 31 for every unit increase in the Richter scale.

Table 18-16: Earthquake Intensity and Frequency Comparisons

<table>
<thead>
<tr>
<th>Magnitude</th>
<th>Mercalli Intensity</th>
<th>Potential Damage</th>
<th>Global Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 2.0</td>
<td>I</td>
<td>None</td>
<td>Continually</td>
</tr>
<tr>
<td>2.0 - 2.9</td>
<td>I to II</td>
<td>None</td>
<td>&gt; IM per year</td>
</tr>
<tr>
<td>3.0 - 3.9</td>
<td>II to IV</td>
<td>None</td>
<td>&gt; 100,000 per year</td>
</tr>
<tr>
<td>4.0 - 4.9</td>
<td>IV to VII</td>
<td>Light</td>
<td>10K to 15 K per year</td>
</tr>
<tr>
<td>5.0 - 5.9</td>
<td>VI to VII</td>
<td>Moderate</td>
<td>1K to 1,500 per year</td>
</tr>
<tr>
<td>6.0 - 6.9</td>
<td>VII to X</td>
<td>Heavy</td>
<td>100 to 150 per year</td>
</tr>
<tr>
<td>7.0 - 7.9</td>
<td>VII &lt;</td>
<td>Very Heavy</td>
<td>10 - 20 per year</td>
</tr>
<tr>
<td>8.0 - 8.9</td>
<td>VII &lt;</td>
<td></td>
<td>1 per year</td>
</tr>
<tr>
<td>&gt; 9.0</td>
<td>VII &lt;</td>
<td></td>
<td>1 per 10-50 years</td>
</tr>
</tbody>
</table>

The Modified Mercalli Intensity Scale provides descriptive values of earthquake intensity that may provide greater meaning to the broader population as the description of intensity refers to the effects actually experienced. This scale uses an arbitrary ranking based on observed earthquake effects. The scale is composed of increasing levels of intensity ranging from shaking that is not recognizable to intense shaking resulting in catastrophic damages and casualties. The Modified Mercalli Intensity Scale is demonstrated below:
Table 5-17: Modified Mercalli Intensity Scale

<table>
<thead>
<tr>
<th>Intensity</th>
<th>Shaking</th>
<th>Description / Damage</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Not felt</td>
<td>Not felt except by a very few under especially favorable conditions.</td>
</tr>
<tr>
<td>II</td>
<td>Weak</td>
<td>Felt only by a few persons at rest, especially on upper floors of buildings.</td>
</tr>
<tr>
<td>III</td>
<td>Weak</td>
<td>Felt quite noticeably by persons indoors, especially on upper floors of buildings. Many people do not recognize it as an earthquake. Standing motor cars may rock slightly. Vibrations similar to the passing of a truck. Duration estimated.</td>
</tr>
<tr>
<td>IV</td>
<td>Light</td>
<td>Felt indoors by many, outdoors by few during the day. At night, some awakened. Dishes, windows, doors disturbed; walls make cracking sound. Sensation like heavy truck striking building. Standing motor cars rocked noticeably.</td>
</tr>
<tr>
<td>V</td>
<td>Moderate</td>
<td>Felt by nearly everyone; many awakened. Some dishes, windows broken. Unstable objects overturned. Pendulum clocks may stop.</td>
</tr>
<tr>
<td>VI</td>
<td>Strong</td>
<td>Felt by all, many frightened. Some heavy furniture moved; a few instances of fallen plaster. Damage slight.</td>
</tr>
<tr>
<td>VII</td>
<td>Very strong</td>
<td>Damage negligible in buildings of good design and construction; slight to moderate in well-built ordinary structures; considerable damage in poorly built or badly designed structures; some chimneys broken.</td>
</tr>
<tr>
<td>VIII</td>
<td>Severe</td>
<td>Damage slight in specially designed structures; considerable damage in ordinary substantial buildings with partial collapse. Damage great in poorly built structures. Fall of chimneys, factory stacks, columns, monuments, walls. Heavy furniture overturned.</td>
</tr>
</tbody>
</table>

### Earthquake Intensities

<table>
<thead>
<tr>
<th>Intensity</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>IX</td>
<td>Violent</td>
</tr>
<tr>
<td>X</td>
<td>Extreme</td>
</tr>
</tbody>
</table>

- **Damage considerable in specially designed structures; well-designed frame structures thrown out of plumb. Damage great in substantial buildings, with partial collapse. Buildings shifted off foundations.**

- **Some well-built wooden structures destroyed; most masonry and frame structures destroyed with foundations. Rails bent.**

The graph below (Figure 18-8) illustrates the increasing intensity of energy that is released and as the measured magnitude increases. While each whole number increases in magnitude represents a tenfold increase in the measured amplitude, it represents an increasing rate of 32 times more energy released in the same increase in magnitude. As the magnitude of an earthquake is measured higher, the intensity of the earthquake worsens progressively from one category to the next.

#### Figure 18-9: Earthquake Magnitude and Equivalent Energy Release

![Graph Showing Earthquake Magnitudes and Equivalent Energy Release](https://www.usgs.gov/media/images/graph-showing-earthquake-magnitudes-and-equivalent-energy-release)

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Given that earthquakes in this region have remained minor in intensity and infrequent, and that the campus is not located in a liquefication zone or near any fault systems, the planning committee ranks the extent of the hazard on the campus as **Low**.

**History of the Hazard**

The State of California has a long history of chronic and destructive earthquakes throughout the state. On average, earthquakes strong enough to result in structural damages occur three to four times a year in California, while earthquakes Magnitude 6.0 to 6.9 occur once every two to three years. Sacramento County also has a limited history of earthquake activity particularly in the central part of the County including where CSU Sacramento is located. Earthquakes in this region have remained minor in intensity and infrequent. Sacramento has felt shaking from earthquakes from other regions but have not resulted in damages.

Table 18-18: Historic Earthquakes Near Sacramento, CA

<table>
<thead>
<tr>
<th>Date</th>
<th>Location</th>
<th>Magnitude</th>
<th>Damages</th>
</tr>
</thead>
<tbody>
<tr>
<td>8/1/1975</td>
<td>Oroville</td>
<td>5.8</td>
<td>NA in Sacramento</td>
</tr>
<tr>
<td>1/24/1980</td>
<td>Livermore</td>
<td>5.8</td>
<td>NA in Sacramento</td>
</tr>
<tr>
<td>1/27/1980</td>
<td>Livermore</td>
<td>5.8</td>
<td>NA in Sacramento</td>
</tr>
<tr>
<td>4/24/1984</td>
<td>Morgan Hill</td>
<td>6.2</td>
<td></td>
</tr>
<tr>
<td>10/17/1989</td>
<td>Loma Prieta</td>
<td>6.5</td>
<td>Minor in Sacramento (DR-845-CA)</td>
</tr>
<tr>
<td>8/24/2014</td>
<td>American Canyon</td>
<td>6.0</td>
<td>NA in Sacramento</td>
</tr>
</tbody>
</table>

**Potential Impacts of the Hazard**

The shaking of the ground from earthquakes can result in building collapse, bridge failure, utility disruptions and other structural collapse. Large earthquakes can additionally cause natural gas lines to break resulting in structure fires. A major earthquake in the Sacramento area would likely result in region-wide social disruptions in addition to structural damages. The region-wide structural damages may disrupt lifelines and supply chain routes limiting the campus from effective evacuation routes and receiving necessary supplies or equipment.

Most injuries resulting from earthquakes are from collapsing walls, flying glass, or other objects moved by ground shaking. The lack of warning allows individuals minimal time to react and find areas of safety. A moderate earthquake occurring near Sacramento could cause injuries or fatalities to members of the campus community or support networks the campus relies on. These earthquake effects might be aggravated by collateral incidents such as fire, flooding, hazardous material spills, dam/levee compromises, and other cascading events. A catastrophic earthquake near Sacramento could result in extensive casualties, expansive structural damages, panic, widespread utility outages,

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communication failures, and secondary emergencies such as fire. A catastrophic earthquake would certainly affect the broader Sacramento region limiting immediate assistance that the campus may normally expect.

Local impacts to CSU Sacramento campus caused by an earthquake could include:

- Damage to levees surrounding campus
- Damage to upstream flood control systems on American River
- Damage to adjacent water treatment facility and potential hazardous materials release
- Damage and secondary fires to commercial and industrial buildings to the west of campus
- Potential hazardous material releases on and off campus
- Damage to rail lines along western boundary of campus
- Infrastructure damage to freeway system
- Structural damage to bridges over waterways and flood control channels
- Potential isolation of campus from community
- Potential isolation among on-campus residents
- Structural damage to regional levees
- Structural damage to campus academic and support buildings
- Structural damage to residence halls resulting in displaced student populations
- Structural damage to nearby residences
- Community members arriving on campus for refuge from damaged homes
- Damaged university communications, computer systems, and networks
- Considerable stress and fear among community
- Closure or reduction of service to campus operations
- Reduction of campus revenue

Probability of Future Occurrence of the Hazard

The Working Group on California Earthquake Probabilities (WGCEP), a collaboration between the United States Geological Survey (USGS), the Southern California Earthquake Center (SCEC), and the California Geological Survey (CGS) develops Uniform California Earthquake Forecasts (UCERFs) using the best currently available science and technology. The UCERF version 3 provides a three-dimensional view of the likelihood a region in California will experience a Magnitude 6.7 or greater earthquake in the next 30 years. The
likelihood for the fault systems surrounding Sacramento is included in the following table.

Table 18-19: Major Potentially Active Faults in Proximity to CSU Sacramento

<table>
<thead>
<tr>
<th>Fault Zone</th>
<th>Recurrence</th>
<th>Maximum Magnitude</th>
<th>UCERF3 Likelihood</th>
</tr>
</thead>
<tbody>
<tr>
<td>Calaveras</td>
<td>Historic: 1861 (6.5-7)</td>
<td>6.5 to 7.1</td>
<td>6%</td>
</tr>
<tr>
<td>Concord-Green Valley</td>
<td>Varies: 1955 (5.4)</td>
<td>6.0</td>
<td>4 – 7%</td>
</tr>
<tr>
<td>Dunnigan Hills</td>
<td>Historic: Unknown</td>
<td>6.0</td>
<td></td>
</tr>
<tr>
<td>Foothill</td>
<td>Historic: 1975</td>
<td>6.0</td>
<td>2%</td>
</tr>
<tr>
<td>Hayward</td>
<td>Historic: 1836; 1868(7.2)</td>
<td>6.5 to 7.0</td>
<td>14 – 19%</td>
</tr>
<tr>
<td>Midland</td>
<td>Historic: 1895</td>
<td>6.9</td>
<td>1%</td>
</tr>
<tr>
<td>San Andreas</td>
<td>Historic: 1906 (8.25)</td>
<td>7.2</td>
<td>7 – 15%</td>
</tr>
<tr>
<td>Vaca</td>
<td>Historic: 1892 (6.5-7)</td>
<td>6.0 to 7.1</td>
<td>2%</td>
</tr>
</tbody>
</table>

The Sacramento area is not known to be a seismically active area. However, the region is located between two active seismic zones in the Sierra Nevada Mountains and the San Francisco Bay Area. While no major earthquakes have been recorded within Sacramento County, the region has felt shaking from earthquakes located in other parts of Northern California. Based on the earthquake shaking potential in the Sacramento area, the proximity to the fault systems listed above, the probability of seismic ground shaking generating damage is considered Possible.

Vulnerability to the Hazard

A considerable challenge regarding earthquakes is they generally occur without warning. The fault systems surrounding the region tend to remain to the west along the Coastal Ranges and to the east in the Sierra Nevada Mountains. Many of these cross major transportation routes potentially reducing the availability of access and the supply chain. However, Sacramento is likely less vulnerable to the direct effects of earthquake as known fault systems are removed from the area. The geographic location of Sacramento sits at the base of river systems that have deposited sediment from the surrounding mountains. In many cases, these sediment-based soils are loose and expose the potential for liquefaction. The soils of the area surrounding the campus are described by

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the Local Hazard Mitigation Plan as generally being not conducive to significant liquefaction.

The known fault systems generating the threat to Sacramento generally exist to the east and west of the city but do not cross into the city including the CSU Sacramento campus. The distance to these surrounding systems helps mitigate significant vulnerabilities in the event a seismic event was to occur on those systems. In the event of an earthquake occurring in the region on an unknown system, the potential for earthquake damaged structures being left uninhabitable including campus residence halls will result in numerous displaced individuals and households. The lack of earthquake insurance will cause extreme financial burdens on those affected. Campus buildings and equipment would be vulnerable to damages from building, seismic shaking, secondary fires, and secondary building floods from broken pipes.

Elements of the vulnerability to a major earthquake on the CSU Sacramento campus will vary depending on when the earthquake were to strike. The primary basis of vulnerability is based on the population affected and the built environment exposed. In general, newer construction will be more earthquake resistant than older buildings as building codes and construction technology have improved. A locally centered earthquake, even from moderate events, would have the potential for more damaging results when associated with the moderate liquefaction zones of the city. This would particularly be seen with greater damages to unreinforced masonry buildings.

The risk to the campus population will be lessened during periods when classes are not in session or during periods of breaks. Conversely, during the days and hours that classes are in session and staff are at their workplaces, the human vulnerability increases. Generally, people are safer when at home in wood frame structures as earthquakes tend to generate less structural damage to wood construction than in commercial or industrial facilities. The greater number of people on campus at the time of an earthquake will result in more people being exposed to effects from damaged campus facilities or equipment and require greater evacuation assistance. However, in region-wide events this vulnerability may simply shift to the homes and workplaces of members of the campus community and their families.

The aftermath of a major earthquake will likely result in widespread search and rescue operations for trapped and injured individuals. The demand on emergency services will be great, potentially requiring the campus community to be prepared for these scenarios and initiate response actions as needed. There will be needs for emergency medical care, shelter, water, and food for individuals who have been displaced by the earthquake. In earthquakes causing significant damages, there may be a necessity to provide assistance with sheltering and care of those unable or unwilling to return to their homes. Damages to the homes of the members of the campus community may place greater demands on campus resources and capabilities in the short-term period following a seismic event.

There may be a need to evacuate members of the campus community from the campus and to other locations that are deemed to be safer locations. Certain campus populations will experience greater challenges to a post-earthquake environment. Vulnerable
populations including those that rely on specific services, require electrical power, homeless students, experience disabilities, non-English speakers, those whose age make evacuating difficult, and others will be most affected. These individuals will likely need to navigate through earthquake generated debris, extreme stresses of a disaster, an inability to communicate to or gain access to support networks, and find difficulty in accessing equipment or supplies to aid in a specific need.

Certain campus populations will experience greater challenges to a post-earthquake environment. Vulnerable populations including those that rely on specific services, require electrical power, homeless students, experience disabilities, non-English speakers, those whose age make evacuating difficult, and others will be most affected. These individuals will likely need to navigate through earthquake generated debris, extreme stresses of a disaster, an inability to communicate to or gain access to support networks, and find difficulty in accessing equipment or supplies to aid in a specific need.

**Estimate of Potential Losses**

Estimates of potential losses will be influenced by a variety of factors. The intensity of the earthquake will determine what scale of damages affecting campus infrastructure, equipment, and other impacted features. Losses will be generated by the physical damages, the loss of revenue, loss of academic research, loss of building contents, and community wide economic reductions.

The maximum total replacement costs due to earthquake are unknown, as estimated campus facility and structure costs were not available for CSU Sacramento.

Table 18-20: HAZUS Peak Ground Acceleration Zone (PGA) Estimated Losses

<table>
<thead>
<tr>
<th>PGA Zone Designation</th>
<th>Intensity</th>
<th>No of Buildings</th>
<th>Maximum Replacement Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Extreme</td>
<td>X+</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Violent</td>
<td>IX</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Severe</td>
<td>VIII</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Very Strong</td>
<td>VII</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Strong</td>
<td>VI</td>
<td>64</td>
<td>Unknown</td>
</tr>
<tr>
<td>Moderate</td>
<td>V</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Light</td>
<td>IV</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Weak</td>
<td>II-III</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Not Felt</td>
<td>I</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>NA</td>
<td>NA</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>No Building Value Data Provided*</td>
<td>NA</td>
<td>64</td>
<td>Unknown</td>
</tr>
</tbody>
</table>

*Buildings with no value defined are also included in the respective Zones they are found in.

**Vulnerability Assessment Conclusions**

It is difficult to predict the severity of casualties, property, and cascading impacts generated by future seismic events affecting the Sacramento area and the CSU
Sacramento campus. Each of the earthquake generated effects will vary widely based on the intensity of the earthquake, location of the epicenter, proximity to people and development, time of day and year, the soil composition under the impacted structures, building construction, among others. In any case, the potential for a major earthquake exists affecting the campus and causing extensive challenges to the CSU Stanislaus campus and community.

In the event that a major earthquake was to strike along the fault systems surrounding Sacramento, the effects could be significant to the campus community and campus operations. The widespread impacts generated by a major earthquake would extend the effects of casualties, damages, and other impacts to the broader Sacramento County region creating large-scale regionwide needs for critical assistance and a heavy demand on limited emergency resources. The threat and impacts presented to the campus will be shared with the campus community from their homes and places of work. The campus will likely be required to address critical needs independently during early phases of the disaster.

Vulnerabilities will be seen in the physical infrastructure on the campus and the human population of the campus community. Campus infrastructure is vulnerable to severe shaking particularly in areas where the ground is loose or susceptible to liquefaction. Specifically older buildings, masonry constructed buildings, and other structures susceptible to shaking related damage are the most vulnerable. Communication systems, computer networks, and other electronic systems may be vulnerable when overwhelmed by increased demand during emergencies or by shaking related damages. The people of the campus community are vulnerable to effects of intense shaking in the form of injuries from falling debris, exposure to secondary floods or fires, loss of employment, extreme disaster induced stress, and loss of access to critical services or social contacts.

The campus population are additionally vulnerable to the effects of major ground shaking that are far reaching. The psychological and social impacts a major earthquake will give rise to will potentially harm individuals and cause tremendous fear. The willingness to return indoors may be hampered especially as after-shocks continue. These effects are magnified for populations having specific vulnerabilities or access limitations. Populations having various limitations or specific needs may be vulnerable to reduced or eliminated access to essential services that have been rendered incapable to respond.

**Identified Data Limitations**

Data limitations include missing campus structural replacement costs, and lack of a complete inventory of building construction types to include status of earthquake retrofitting. HAZUS generated analysis is focused on the broader community level versus fine-tuning the analysis to the micro-level for facilities such as a university campus.
Erosion

Description of the Hazard

The US Geological Survey (USGS) defines erosion as “the process whereby materials of the earth’s crust are loosened, dissolved, or worn away and simultaneously moved from one place to another”. Erosion may occur in areas of streams and rivers, along bluffs, around immovable objects (such as buildings or bridge abutments), or as a cascading result of other natural hazards, such as earthquakes or wildfires. When erosion occurs along bodies of water, the removal of material causes the shore to move further landward.

Forces such as sea level rise and changes in sediment supply impact erosion gradually and can be difficult to recognize. In contrast, the impacts of short-term events, such as storms and flooding, can be severe and are immediately recognizable.

Location of the Hazard

Erosion is a relatively non-spatial hazard that can occur in any location with conducive soil structure and a source of movement such as water or wind. An area’s potential for erosion is determined by several factors, including rainfall, topography, soil characteristics, and vegetative cover. Streambank and bluff erosion can occur near any riverine area, such as the American River, which is adjacent to the campus. For the purpose of this campus-level analysis, the erosion hazard poses a consistent risk across all those areas of the campus with erosion-prone characteristics. Currently, no such locations have been identified on campus, though campus leadership may consider investigating whether such locations are present on campus in the future.

Extent of the Hazard

There is no published scale of severity or extent for this geologic hazard. If conditions are favorable, erosion is likely to occur. Sacramento County considers waterway bank erosion to be limited in extent, occurring in less than 10% of the County. However, the number of high-risk erosion sites identified by the USACE in an annual erosion inventory of the Sacramento River continues to grow each year. Given no record of occurrence of erosion on campus and ongoing monitoring efforts, the planning committee ranks the extent of the hazard as Low.

History of the Hazard

While there have been no recorded incidents of erosion on the CSU Sacramento campus, several stormwater projects have already been put into place on campus to reduce sediment loads and prevent erosion in the American River.

Potential Impacts of the Hazard

Erosion causes instability in soil. During high-intensity rain events, for example, eroded areas will continue to erode, resulting in additional loss of soil and ground stability in the area. This removal of sediment can result in damage to infrastructure, public health, and safety. On campus, areas of erosion can create pedestrian and transportation hazards, and structures may become unsafe if erosion is not controlled.

Probability of Future Occurrence of the Hazard

Erosion is an on-going and dynamic process that occurs regularly. As climate change induces more frequent and intense weather events, such as wildfires and flooding, erosion may generally become more widespread or severe. These events can cause erosion or exacerbate areas already experiencing erosion. As a result, and in consideration of the potential extent of erosion, the probability of at least a limited degree of erosion taking place somewhere on the campus is **High** over the long term.

Vulnerability to the Hazard

Topography, soil structure, land use, and precipitation are all factors of erosion. CSU Sacramento infrastructure and buildings located on steep slopes, in areas with little vegetation, or in areas with conducive soil types are more vulnerable to erosion.

In the wider Sacramento community, erosion vulnerabilities include agricultural sector job loss, degradation of riverine ecosystems, and loss of water quality.

Estimate of Potential Losses

The historic and potential impacts of erosion on property statewide include reduced agricultural productivity, lower surface water quality, and damaged drainage networks.

Current modeling is not precise enough to allow for an assessment of potential losses to buildings and infrastructure on campus.

Vulnerability Assessment Conclusions

While the ability to predict future erosion on the CSU Sacramento campus is limited, the core issues shaping erosion vulnerability on campus are flora and landscaping. If left unchecked, erosion can cause significant damage to campus infrastructure and the surrounding environment.

Identified Data Limitations

The complex interactions between soil erosion factors make predictive modeling, determination of hazard areas, and quantification of loss difficult. Localized data on this hazard is also limited, resulting in more generalized findings.
**Extreme Temperatures (Includes Extreme Cold and Extreme Heat)**

**Heat**

**Description of the Hazard**

What is considered an excessively hot temperature varies according to the normal climate for that region. However, when temperatures are extremely high, people are at higher risk for heat-related illnesses, such as dehydration, heat exhaustion, heat stroke, and in severe cases, death.\(^{43}\)

Hazards from extreme heat are made worse when high temperatures are accompanied by high levels of humidity, which is defined as the amount of moisture in the air.\(^ {44}\) As the temperature climbs, the air is able to hold more moisture. High humidity prevents the human body from cooling down naturally, which leads people to perceive that the temperatures “feel” hotter. The combination of temperature and humidity is known as the heat index.\(^ {45}\)

Heat stroke, the most serious heat-related illness, occurs when the body is unable to control its temperature. Body temperature rises rapidly, the sweating mechanism fails, and the body cannot cool down.\(^ {46}\) In extreme causes, heat stroke can cause confusion and unconsciousness, so the victim is unable to seek treatment without assistance.

There are several groups of people who are uniquely vulnerable to the effects of extreme heat, such as infants and children, older adults aged 65 and up, athletes and outdoor workers, low-income households, and individuals with certain chronic medical conditions.\(^ {47}\)

**Location of the Hazard**

Extreme heat events are a non-spatial hazard and may occur throughout the Sacramento State campus.

**Extent of the Hazard**


\(^ {45}\) Ibid.


Extreme heat has a wide range of extent and severity markers and characteristics. In the City of Sacramento, monthly average maximum temperatures in June through October range approximately from the low 80s to the mid-90s. Temperatures at or above 90° F are common during the summer in Sacramento. According to data from the National Climatic Data Center (NCDC), the highest daily temperature recorded in the City of Sacramento is 111° F. The city reached this record during a statewide heat wave in July 2006 during a consecutive stretch of triple-digit temperatures, and again on August 15, 2020 during another stretch of statewide heat waves, which caused rolling blackouts to maintain electrical grid stability. Given five extreme heat events from 2006-2020, and the historical impacts to the electrical grid and infrastructure, the planning committee ranks the extent of the hazard as Moderate.

The National Weather Service issues a Heat Advisory when the heat index value is expected to reach 100° – 104° F within the next 12 to 24 hours. Excessive Heat Warnings are issued when there is an anticipated heat index of 105° F or greater that will last for two (2) or more hours. Excessive Heat Warnings are issued by the county when any location in the county is expected to reach those criteria. In anticipation of an Excessive Heat Warning, an Excessive Heat Watch may be issued 1 to 2 days in advance, when the Heat Warning criteria is 50 – 79% likely to occur.

Figure 18-9 (following) depicts the National Weather Service’s methodology for determining the heat index, using the % humidity and the actual temperature.

As the heat index rises, so does the potential danger to people and animals. Table xx (following) shows the health hazards associated with extreme heat.
Table 18-21: Health Risks Associated with Heat Index

<table>
<thead>
<tr>
<th>Category</th>
<th>Heat Index</th>
<th>Health Hazards</th>
</tr>
</thead>
<tbody>
<tr>
<td>Extreme Danger</td>
<td>130° F or higher</td>
<td>Heat stroke / sunstroke is likely with continued exposure.</td>
</tr>
<tr>
<td>Danger</td>
<td>105° – 129° F</td>
<td>Sunstroke, heat cramps, and/or heat exhaustion is likely with prolonged exposure and/or physical activity.</td>
</tr>
<tr>
<td>Extreme Caution</td>
<td>90° – 104° F</td>
<td>Sunstroke, heat cramps, and/or heat exhaustion is possible with prolonged exposure and/or physical activity.</td>
</tr>
<tr>
<td>Caution</td>
<td>80° – 89° F</td>
<td>Fatigue is possible with prolonged exposure and/or physical activity.</td>
</tr>
</tbody>
</table>

History of the Hazard

Based on data gathered from the NCDC and the National Centers for Environmental Information (NCEI) Storm Events Database, there have been five excessive heat events in Sacramento County since 1959, but all occurring from 2006 - present.

**July 2006:** the highest daily temperature recorded in the City of Sacramento of 111° F was reached during a statewide heat wave with a consecutive stretch of triple-digit temperatures

**July 5, 2007:** This was one of the driest summers on record for the state of California, which fueled at least 9,000 separate wildfires for the year.

**June 18, 2017; August 1, 2017:** A lengthy heat wave affected large parts of the western United States during the summer of 2017, with record-breaking temperatures in many major metro areas hitting 115° F or higher. Temperatures in Sacramento reached 104° F or higher on several consecutive days in June.

August 15, 2020: Another stretch of statewide heat waves caused rolling blackouts to maintain electrical grid stability. 111° F was reached.

Potential Impacts of the Hazard

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During an excessive heat event, Sacramento State may experience impacts from extreme heat due to cancelled classes or postponed outdoor events in order to protect students, faculty, and staff from the weather.

In addition to the threat extreme heat poses to humans, high temperatures also pose a threat to utility production, which in turn threaten facilities and operations that rely on utilities. As temperatures rise, more people stay indoors, increasing the demand for air conditioning, fans, and other electronics. This puts a strain on the electrical grid, which can cause temporary outages. These outages can impact operations throughout campus, resulting in interruptions and delays in service. Outages may also negatively impact research efforts on campus, as the inability to maintain a steady, constant temperature may impact research specimens and experimental results.

**Probability of Future Occurrence of the Hazard**

Hot summer temperatures above 90° F are common in the City and County of Sacramento. Notably, the County of Sacramento also includes excessive heat as a critical hazard that is highly susceptible to influence from climate change. It is highly likely that hot days will occur annually. Based on hazard history of extreme heat events, (5 events in the past 17 years) it is possible that an extreme heat event will occur annually.  

**Vulnerability to the Hazard**

When dealing with an extreme heat event, the most common impacts are those generally felt by the people living in the targeted area. For people in particular, heat can kill when the body is pushed beyond its limits. Most heat disorders occur because the victim has been overexposed to heat. As discussed, the major human risks associated with extreme heat include dehydration, sunburn, fatigue, heat exhaustion, heat stroke, and in severe cases, death.

Some portions of the population are more at risk to the effects of extreme heat. The very young, the elderly, and certain groups with chronic medical conditions (such as asthma or other pulmonary illnesses, heart disease, poor blood circulation, neurological illnesses, and obesity) are generally more vulnerable to the effects of extreme heat, and are more likely to suffer illness or death as a result. This is especially true if exposure is extended for a period of time and preventative measures are not taken immediately.

Sacramento State is aware of the potential for extreme heat events. During the summertime, the school holds minimal classes to keep students and faculty off-campus.

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and runs on “summer hours” to keep staff from working outside during the hottest hours of the day. The campus has not been affected by power shut-offs in recent memory. Therefore, while this is a hazard that the campus may experience with regularity, the campus has ample familiarity with heat events to handle the risks and vulnerabilities.

**Estimate of Potential Losses**

Based on the previous historical occurrences, annualized losses are considered to be negligible. In an extreme heat event, loss of human life or health impacts are a greater concern than is property damage.

**Vulnerability Assessment Conclusions**

While the ability to predict future heat events at the Sacramento State campus is limited, the effects of climate change may provide some information. According to the Environmental Protection Agency (EPA), areas of North-Central California have warmed approximately 1.5 – 2 degrees on average over the last century, with less rainfall. This may lead to stronger and more frequent heat events, drought, and an increased risk of wildfires.52

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**Cold**

**Description of the Hazard**

What is considered an excessively cold temperature varies according to the normal climate for that region. However, when temperatures are far below normal, with higher wind speeds, heat leaves the human body more rapidly, which increases the possibility of negative effects from these extreme temperatures.53

The greatest danger from extreme cold is to people, as prolonged exposure can cause frostbite or hypothermia, and can become life threatening. When someone is suffering from hypothermia, body temperatures can become so low that they affect the brain, making it difficult for the victim to think clearly or move well. In the case of frostbite, the frozen tissue becomes numb and the victim may be unaware that anything is wrong until someone else notices.54 This makes hazards from extreme cold particularly dangerous, as people may not understand what is happening to them or what to do about it.

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The primary hazards from extreme cold are frostbite and hypothermia. Frostbite is caused by freezing of the skin and underlying tissue. It causes a loss of feeling and color in the affected areas of the body, and most often affects the nose, chin, fingers, or toes. It can be permanently damaging if not treated promptly and can lead to infection, nerve damage, or amputation in severe cases. The risk of frostbite is increased in people with preexisting conditions, the elderly, people with reduced blood circulation, and people who are not dressed warmly enough for the conditions.

Hypothermia occurs when the body loses heat faster than it can produce heat, causing a dangerously low body temperature. A normal body temperature is around 98.6°F. Hypothermia occurs when your body temperature falls below 95°F. As this happens, the heart and other essential organs cannot work properly. If hypothermia is not treated, it can lead to heart failure, respiratory failure, and eventually to death.

Excessive or extreme cold can accompany severe winter weather, or it can occur without severe weather. For this reason, extreme cold is a separate hazard from severe winter storms.

Location of the Hazard

Extreme cold events are a non-spatial hazard, and may occur at the Sacramento State campus.

Extent of the Hazard

Extreme cold has a wide range of extent and severity markers and characteristics. Average nighttime winter temperatures in the City of Sacramento are typically in the low 40s. According to data from the National Climatic Data Center (NCDC), the lowest daily temperature recorded in Sacramento was 18°F on December 11, 1932. Based on no history of extreme cold and just 6 frosty/freeze events since 1968, the planning committee ranks the extent of the hazard as Low.

The National Weather Service issues Extreme Cold Warnings when the temperature feels like it is -30°F or colder across a wide area for a period of at least several hours. When possible, these advisories are issued a day or two in advance of the conditions.

The most common extent/severity marker for extreme cold is the Wind Chill scale. Figure 18-9 (following) depicts the National Weather Service’s methodology for determining the


56 Ibid.


wind chill, using wind speed and actual temperature. Although wind chill is not necessarily related to extreme cold as a single cause, the advisory system that the NWS currently uses relies on wind chill to relay warning and advisory information to the public. Extreme cold severity is a function of wind chill and other factors, such as precipitation amount (rain, sleet, ice, and/or snow).
In 2011, the National Weather Service introduced an experimental program that issued warnings for extreme cold events, independent of other severe weather warnings. The test areas included North and South Dakota and Minnesota. However, in 2012, after a single season of use, the program was abandoned, based on reports of confusion among test audiences.\(^{59}\)

**History of the Hazard**

Based on data gathered from the National Centers for Environmental Information (NCEI) Storm Events Database, Sacramento County has had six frost/freeze events, dating back to 1998, but no extreme cold hazards. \([Records\ for\ this\ hazard\ were\ first\ recorded\ in\ 1996]\).

**Potential Impacts of the Hazard**

Should an extreme cold event occur, Sacramento State might experience impacts due to cancelled classes.

In addition to the threat posed to humans, extreme cold weather poses a significant threat to utility production, which in turn threatens facilities and operations that rely on utilities, specifically climate stabilization. As temperatures drop and stay low, increased demand for heating places a strain on the electrical grid, which can lead to temporary outages. These outages can impact operations throughout the campus, which can result in interruptions and delays in services. These outages may also negatively impact research efforts throughout the campus, as the inability to maintain a steady, constant temperature may result in unintended effects on research specimens.

**Probability of Future Occurrence of the Hazard**

The City of Sacramento has experienced freeze/frost events but has never experienced an extreme cold event. Due to the campus’s location in a temperate climate, it is **Unlikely** that this hazard will occur annually.

**Vulnerability to the Hazard**

When dealing with an extreme cold event, the most common impacts are those generally felt by the people living in the targeted area. For people in particular, extreme cold can kill when the body is pushed beyond its limits. Most danger due to the cold is because the victim has been overexposed to low temperatures. As discussed, the major human risks associated with extreme cold include frostbite, hypothermia, and in severe cases, death.

Some portions of the population are more at risk to the effects of extreme cold. The elderly, those with certain preexisting conditions (hypothyroidism, diabetes, and high blood pressure, just to name a few), those with poor blood circulation, and people who are not dressed warmly enough for the cold are generally more vulnerable and are more likely to suffer illness or death as a result.60 This is especially true if exposure is extended for a period of time and preventative measures are not taken immediately.

Sacramento State is aware that there is a low chance of an extreme cold event in the Sacramento area.

**Estimate of Potential Losses**

Based on the previous historical occurrences of extreme cold events, annualized losses are considered to be negligible. In an extreme cold event, loss of human life or health impacts are a greater concern than is property damage.

**Vulnerability Assessment Conclusions**

While the ability to predict future extreme cold events at the Sacramento State campus is limited, the effects of climate change may provide some information. According to the Environmental Protection Agency (EPA), areas near Sacramento have warmed

approximately 1.5 – 2 degrees on average over the last century, with less rainfall. This may lead to fewer frost/freeze events in the future.\textsuperscript{61}

**Identified Data Limitations**

Numerous public and private actors conduct research, acquire data and disseminate meteorological information and forecasting to the general public, including the CSU university system. Currently, it is assumed that, apart from regular access to climate change models on changes to temperature extremes over time, the CSU community maintains sufficient access to the data needed to plan for, respond to, and mitigate the effects of extreme heat and cold.

**Flood**

**Description of the Hazard**

The incredible geographic diversity in California presents tremendous challenges for flood planning and response. The state is home to extensive mountain ranges such as the Sierra Nevada, Cascades, Klamath, Coastal Ranges, and the Southern California Transverse Range all creating tremendous watersheds. Large river systems drain the mountains traveling through populated communities including the Sacramento and San Joaquin Rivers draining into the California Delta. The state has a complex system of reservoirs, dams, and levees providing water storage and flood protection. Finally, California’s 840-mile coastline exposes the coastal regions to tidal influences.

Floods are characterized by the rising and overflowing of excess water from a water source such as a stream, river, lake, canal, or coastal body onto an area of normally dry floodplain. A floodplain is a lowland area downstream and adjacent to water bodies that are subject to flood events. Flooding is a naturally occurring event that become hazardous when populations and property are affected.

Flooding can result from excessive precipitation from weather systems generating prolonged rainfall, excessive snowmelt from watersheds upstream from the floodplain, infrastructure failure, exceeding the capacity of dams or levees, tidal influences, or a combination from any of the previous factors.

Floods represent one of the costliest and most frequent natural disasters that influences human suffering and economic impact in the United States. Flooding will likely result in significant damage to structures, infrastructure, utilities, landscapes, and the

environment. Erosion of stream banks, roadways, other feature may result from the movement of flood waters. The saturated ground resulting from standing flood waters may cause ground instability, collapse, erosion, or other damages. Further, floods will often generate substantial debris that will accumulate and be deposited throughout the flooded areas.

Floods can be either slow-rise or rapid onset floods. With slow rise floods, there is often warning preceding water rise by hours or days before dangerous conditions present themselves. Slow rise floods that are expected to enter into populated areas generally allow for some time to initiate evacuation and sand bagging efforts. Flooding that occurs rapidly conversely are water events that present with extremely limited warning times and a limited ability to take response actions until flooding has already begun to occur.

Flooding may take on different forms:

- **Flash Flooding** – Flash flooding is typically characterized by a rapid rise, short duration, and large volume of water in a localized area. Heavy rainfall in areas that have limited drainage capacities often contribute to flash flooding conditions. These flooding events frequently occur with limited notice requiring immediate evacuation or rapid response efforts such as sand bagging. Flash flooding may arrive with fast moving water creating added hazardous conditions.

- **Riverine Flooding** – Riverine flooding is usually caused by prolonged rainfall or rainfall combined with heavy snowmelt. When soils are already saturated, the ability for the ground to absorb water is minimized. In a riverine flood, the water way exceeds channel capacity and extends into areas outside of the channel, often in developed communities. In California, riverine flooding is most likely to occur from November through April. The duration of riverine floods may vary from a period of hours to weeks.

- **Localized Flooding** – Localized flooding is commonly the result of stormwater drainage systems being overwhelmed by unusually heavy rainfall. These flooding events frequently occur in areas that are urbanized or developed with greater amounts of impervious surfaces not allowing ground absorption. This generates added runoff into the drainage systems and onto roadways creating backups.

- **Infrastructure Failure** – Failures of dams or levees presents a serious flooding concern for areas downstream from the compromised structure. This situation may result in a catastrophic flood with limited warning time and widespread areas affected.

- **Coastal Flooding** – Coastal flooding can occur in multiple areas along the California coastline. Flooding may result from intense storms coming from the Pacific Ocean that generate elevated water levels or storm surge. The size, duration, winds generated, and intensity of the storm will influence the effect the waves will have on the shoreline. Periods of high tide can aggravate the conditions allowing greater wave impingement into coastal areas.
Atmospheric Rivers

California, including the location of this campus, is subject to the effects of a phenomenon referred to as atmospheric rivers. These weather events consist of long, narrow regions in the atmosphere transporting tremendous amounts of water vapor from the tropics. These weather regions behave like rivers in the sky. They can carry heavy volumes of water vapor compared to the amount of water flow at the mouth of the Mississippi River. As these atmospheric rivers arrive into California, they tend to generate significant rain and snow.

Atmospheric rivers can arrive in many different shapes and sizes. The larger events are able to generate extreme rainfall amounts resulting in flooding. They can stall over watersheds vulnerable to flooding, often saturated with heavy snow amounts. The atmospheric rivers known as a “Pineapple Express” coming from the tropics and arriving with warmer air may produce heavy rains that will melt ground snow adding to the water volume that will be added in the flood runoff.

These events can produce heavy amounts of precipitation creating extensive damages. However, these events may present as weaker systems that produce precipitation that is enough to be beneficial for the local water supply. At the higher elevations in the California mountains, these events have the potential to generate a tremendous snowpack providing a source of water during the dry summer months.

Figure 18-12: Introduction to Atmospheric Rivers

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Location of the Hazard

Sacramento lies in the heart of the Sacramento Valley between the Sierra Nevada Mountains and the Coastal Ranges. The city is established at the confluence of the Sacramento and American Rivers. These river systems and the regional creeks have been identified as the primary flood sources for Sacramento County. The Sacramento River watershed encompasses more than 27,000 square miles of drainage or approximately 17% of the land area of California carrying 30% of the state’s water surface water. The watershed receives the majority of its water from snowfall generating 22 million acre-feet of surface water run-off into the Sacramento River and eventually the San Francisco Bay. The American River watershed is a portion of the larger Sacramento River watershed drains an area of 2,200 square miles into the Sacramento River through the City of Sacramento.

Figure 18-13: Flood Hazard Areas in Sacramento, CA
The CSU Sacramento campus is located immediately adjacent to the American River. The American River forms a bend turning direction at the point of the campus. Levees protect both sides of the river and form the boundary between the campus and the river. The American River drains Folsom Lake through Folsom Dam. Folsom Dam sits 21 miles upstream from the campus. The CSU Sacramento campus is entirely located in a designated Zone X: Area with Reduced Flood Risk Due to Levee. The access routes into and out of the campus are also found in areas primarily designated as Zone X: Area with Reduced Flood Risk Due to Levee.

Figure 18-14: Flood Hazard Zones Around CSU Sacramento
Extent of the Hazard

The CSU Sacramento campus is entirely located in a designated Zone X: Area with Reduced Flood Risk Due to Levee. The access routes into and out of the campus are also found in areas primarily designated as Zone X: Area with Reduced Flood Risk Due to Levee. However, although the CSU Sacramento campus resides in a minimally threatened flood zone that is protected by levees, flood events are still possible and isolated heavy precipitation events can still pose localized flooding hazards. Access in and out of the campus may become compromised in flooding events on or off campus. There are specific buildings and areas of the campus that are low lying and have a greater risk for isolated flooding. Based on these factors, the planning committee ranks the extent of the hazard as Low to Moderate.

In support of the NFIP, FEMA identifies those areas that are more vulnerable to flooding by producing Flood Hazard Boundary Maps (FHBMs), Flood Insurance Rate Maps (FIRMs), and Flood Boundary and Floodway Maps (FBFMs). Several areas of flood hazards are commonly identified on these maps, including the 1% annual chance flood zone. Flood

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zones are further delineated by risk and are assigned a letter signifier. The flood zone designations are defined and described in the following table.

Table 18-22: Flood Zone Designations and Descriptions

<table>
<thead>
<tr>
<th>Zone Designation</th>
<th>Percent Annual Chance of Flood</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Zone V</td>
<td>1%</td>
<td>Areas along coasts subject to inundation by the 1% annual chance of flooding with additional hazards associated with storm-induced waves. Because hydraulic analyses have not been performed, no BFEs or flood depths are shown.</td>
</tr>
<tr>
<td>Zones VE and V1-30</td>
<td>1%</td>
<td>Areas along coasts subject to inundation by the 1% annual chance of flooding with additional hazards associated with storm-induced waves. BFEs derived from detailed hydraulic analyses are shown within these zones. (Zone VE is used on new and revised map in place of Zones V1-30.)</td>
</tr>
<tr>
<td>Zone A</td>
<td>1%</td>
<td>Areas with a 1% annual chance of flooding and a 26% chance of flooding over the life of a 30-year mortgage. Because detailed analyses are not performed for such areas, no depths or base flood elevations are shown within these areas.</td>
</tr>
<tr>
<td>Zone AE</td>
<td>1%</td>
<td>Areas with a 1% annual chance of flooding and a 26% chance of flooding over the life of a 30-year mortgage. In most instances, BFEs derived from detailed analyses are shown at selected intervals within these zones.</td>
</tr>
<tr>
<td>Zone AH</td>
<td>1%</td>
<td>Areas with a 1% annual chance of flooding where shallow flooding (usually areas of ponding) can occur with average depths between 1 – 3 feet.</td>
</tr>
<tr>
<td>Zone AO</td>
<td>1%</td>
<td>Areas with a 1% annual chance of flooding, where shallow flooding average depths are between 1 – 3 feet.</td>
</tr>
<tr>
<td>Zone X (shaded)</td>
<td>0.2%</td>
<td>Represents areas between the limits of the 1% annual chance flooding and 0.2% chance flooding.</td>
</tr>
</tbody>
</table>
History of the Hazard

Flooding in Sacramento County and the broader Sacramento Valley region have typically occurred during the winter months when Pacific storms are more common. The occurrences of significant flooding typically have been the result of successive intense storms with heavy precipitation. The region has experienced flood events that have caused millions of dollars in damages and casualties. The following provides insight into information of past flooding events that are significant to the CSU Sacramento campus. On campus, heavy rainfall events can produce isolated areas of flooding and ponding, though no record of flooding events are reported specifically for the campus.

Table 18-23: Historic Flooding Events in Sacramento County

<table>
<thead>
<tr>
<th>Date</th>
<th>Event</th>
<th>Declaration</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>February 2017</td>
<td>Flood; Heavy Rains</td>
<td>DR-4308-CA</td>
<td>Countywide</td>
</tr>
<tr>
<td>January 2017</td>
<td>Flood; Winter Storms</td>
<td>DR-4305-CA</td>
<td></td>
</tr>
<tr>
<td>January 2017</td>
<td>Flood; Winter Storms</td>
<td>DR-4301-CA</td>
<td>Countywide</td>
</tr>
<tr>
<td>February 2006</td>
<td>Flood; Winter Storms</td>
<td>DR-1628-CA</td>
<td>$4.5 million</td>
</tr>
<tr>
<td>February 1998</td>
<td>Flood; Winter Storms</td>
<td>DR-1203-CA</td>
<td>$12.1 million; 1 fatality</td>
</tr>
<tr>
<td>January 1997</td>
<td>Flood; Winter Storms</td>
<td>DR-1155-CA</td>
<td>$4.3 million</td>
</tr>
<tr>
<td>March 1995</td>
<td>Flood; Winter Storms</td>
<td>DR-1046-CA</td>
<td></td>
</tr>
<tr>
<td>January 1995</td>
<td>Flood; Winter Storms</td>
<td>DR-1044-CA</td>
<td>Countywide</td>
</tr>
<tr>
<td>February 1986</td>
<td>Flood</td>
<td>DR-758-CA</td>
<td>Extensive infrastructure damage</td>
</tr>
<tr>
<td>February 1980</td>
<td>Flood; Winter Storms</td>
<td>EM-3078-CA</td>
<td>Countywide</td>
</tr>
</tbody>
</table>

The following flood summaries are provided by the Sacramento County Local Hazard Mitigation Plan and the Sacramento Area Flood Control Agency (SAFCA). The CSU campus was not flooded during the events (below), however, the threat of flooding

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66 Sacramento County Local Hazard Mitigation Plan, October 2016
continued to exist during these periods as the American River was also flowing at high levels for long durations of time placing tremendous stress on the levee system. These events did cause localized flooding within the neighborhoods surrounding the campus.

Flooding in January of 1995 was caused by heavy rains over a large portion of northern California including the Sacramento area. Flood damage was reported throughout much of the county, but the most severely impacted area was in the Arcade, Morrison, Florin, and Dry Creek areas. The county received both a governor’s proclamation and a presidential disaster declaration.

The January 1997 flood was the largest flooding event Sacramento County since the 1986 flooding. Counties throughout northern California experienced widespread flooding condition, levee breaks, and local evacuations. The series of tropical storms that contributed to this round of flooding also contributed to rapid snow melt in the Sierra Nevada Mountains increasing the volume of water entering into the Sacramento Valley.

The winter of 2017 brought continuous storms into northern California including the Sacramento area. A series Atmospheric River storm systems began in January of 2017 and continued through February. These storms caused rivers to reach high levels, reservoirs to fill, and the limits of flood control systems to be tested. The Sacramento Weir was fully opened for the first time in 11 years, levees along the Cosumnes River were compromised, and the Oroville Dam spillway failed.

Potential Impacts of the Hazard

A flood will potentially result in extensive amounts of water entering onto developed areas. The force and volume of water that is generated by a flood may cause extensive structural damage in areas subject to standing or moving water. The effects of flooding may spread over significant distances covering large areas of land. The extent of the impacts would vary based on a number of factors such as the volume of water flooding, the time of the flood event, the amount of warning provided, the location and extent of the flood boundary, facility elevation, and distance from the flood source. Potential impacts resulting from flooding include:

- Injuries or loss of life
- Property destruction or damage
- Loss of property contents
- Infrastructure damage including roadways, bridges, other transportation means
- Public health hazards resulting from mold, mildew, and disease due to flood water
- Flooded or destroyed lifelines/supply routes
- Damaged or destroyed utilities
- Loss of community economic base
• Employment losses
• Agricultural (crops and livestock) damages or destruction
• Environmental damage
• Prolonged periods of necessary dewatering
• Flooding erosion may alter natural drainage channels
• Societal and community impacts
• Psychological impacts of impacted populations
• Disruptions to education delivery to community

Additionally, individuals who were unable to evacuate in time or refused to leave will likely need assistance or rescue from the flooded area. Remaining in or being trapped by flood waters places individuals in significant risk of injury or death. The impacts extend beyond the danger placed upon the affected individual and places greater resource demands on agencies and organizations making efforts to rescue trapped individuals.

Probability of Future Occurrence of the Hazard

Sacramento County is determined have considerable portions of the county to be at high risk from flooding. The repeated historic occurrences have shown that the region is subject to flooding in any given year. Sacramento County has a long-documented history of large-scale flood events. Floods can occur at any time but are most common in the Sacramento region with winter storms that are saturated with subtropical moisture.

The area surrounding the CSU Sacramento campus is an urban residential environment. The campus borders the American River which drains the 1,900 square mile American River Watershed. Levees are in place to protect the campus from the river. The campus is located in an area classified as Zone X Special Flood Hazard Area (Area with Reduced Flood Risk Due to Levee). The river channel opposite of the levee is zoned as Zone AE Special Flood Hazard Area (Area Inundated by 1% Annual Chance of Flooding) and has a history of flood events. Access in and out of the campus may become compromised in flooding events on or off campus. There are specific buildings and areas of the campus that are low lying and have a greater risk for isolated flooding. As the area is also subject to isolated urban or street flood events, this provides a further demonstration of potential flood activity.

The probability of future occurrence for flooding is Possible.

Vulnerability to the Hazard

The CSU Sacramento campus is subject to the effects of isolated flooding resulting primarily from excessive precipitation and isolated strong storms. There is a more remote potential for flooding and damage on campus and surrounding residential and commercial areas of Sacramento due to overflow or damage to flood control systems. The flood control channels, levees and drainage systems that surround the campus have
limited storage or volume capacities. The campus and the campus community are vulnerable to the effects generated by flooding from these systems.

Vulnerability to flooding on the CSU Sacramento campus will vary depending on when the flood was to occur and the location of any people and/or assets located in low lying areas. The risk to the campus population will be lessened during periods when classes are not in session or during periods of breaks. Conversely, during the days and hours that classes are in session and staff are at their workplaces, the human vulnerability increases. Members of the campus community may become trapped on campus depending on the level of flooding occurring on surface streets. However, in region-wide events this vulnerability may be extended to the homes and workplaces of members of the campus community and their families.

CSU Sacramento is in proximity to a variety of industrial and commercial facilities in the surrounding communities. When these facilities are inundated with flood water, the potential for chemical release exists presenting possible exposures to individuals from the campus community. These facilities additionally line many of the primary access routes in and out of the campus.

During low probability, severe flood evenbts, some campus buildings and infrastructure would be vulnerable to large-scale flooding if it reaches the university. Campus utilities and communication capabilities might be impacted by flood waters rendering them disabled. A flood covering a large portion of the city might affect communication capabilities well beyond the boundaries of the campus. Remaining flood waters will leave behind molds and other health concerns in affected campus buildings and facilities likely requiring extensive restoration or demolishing. The residents of the on-campus residence halls may have transportation limitations requiring evacuation and alternative housing procedures to be implemented if populated. Flood waters may result in damage to campus equipment, communication systems, protected documents, artwork, academic materials, computer systems, research, and other critical activities on lower levels of buildings.

Certain campus populations will experience greater challenges to a post-flood / failure environment. Vulnerable populations will likely need to navigate through flood generated debris, face extreme health safety issues from flood waters, experience extreme stresses of a disaster, an inability to communicate to or gain access to support networks, and find difficulty in accessing equipment or supplies to aid in a specific need. Students remaining on campus such as those residing in the residence halls would be particularly vulnerable especially those without access to adequate transportation located in isolated low lying areas of the campus.

**Estimate of Potential Losses**

Estimates of potential losses will be influenced by a variety of factors. The volume and force of the water will determine the scale of damages affecting campus infrastructure, equipment, and other impacted features. The location and elevation above flood waters will affect the level of damage and individuals exposed. The time of the academic year,
the day of week, and hour in which the flooding was to occur will influence the number of people on campus and potential casualties. The severity of the storms producing precipitation, the speed of the storms moving across the area, the level of snowpack in the higher elevations, and amount of resulting snowmelt will produce varying effects on damages produced and costs incurred. Losses will be generated by the physical damages, the loss of revenue, loss of academic research, loss of building contents, and community wide economic reductions.

The maximum total replacement costs due to flood are unknown, as estimated campus facility and structure costs were not available for CSU Sacramento.

Table 18-24: Special Flood Hazard Area (SFHA) Estimated Losses

<table>
<thead>
<tr>
<th>Zone Designation</th>
<th>No of Buildings</th>
<th>Maximum Replacement Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Zone V</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Zone VE &amp; V 1-30</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Zone A</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Zone AE</td>
<td>0</td>
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<tr>
<td>Zone AH</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Zone AO</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Zone X .2%</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Zone X Minimal Risk</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Not in a SFHA</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>No Building Value Data Provided*</td>
<td>64</td>
<td>Unknown</td>
</tr>
</tbody>
</table>

*Buildings with no value defined are also included in the respective Zones they are found in.

Vulnerability Assessment Conclusions

While the campus is located in an area of minimal flood potential (Zone X), the primary vulnerabilities to flood on campus are people and assets in low lying areas exposed to mostly localized flooding and ponding from overflow of campus creeks or low probability, large-scale storms that produce heavy amounts of precipitation directly over the campus and surrounding neighborhoods.

The proximity to the American and Sacramento River presents an additional flood hazard for the campus.

The potential for flooding generates the potential for a number of cascading effects such as disruptions to the local economy, utility failures, disruptions to providing for the needs of the community, and development of public health hazards. These effects would be exacerbated by effects of seasonal flooding, ongoing heavy precipitation, or excessive run-off from the watershed contributing to the river system. The potential for widespread flooding and damage of structures due to the force of water, while unlikely, has
exponentially powerful impacts on particular populations among the campus community including those with access or functional needs, international students, the homeless, and students residing in the residence halls located in low lying areas.

**Identified Data Limitations**

Data limitations include missing campus structural replacement costs, and an incomplete inventory of both building construction features and mitigation efforts to lessen the impact due to flood inundation. HAZUS generated analysis is focused on the broader community level versus fine-tuning the analysis to the micro-level for facilities such as a university campus.

**Hazardous Materials**

**Description of the Hazard**

A hazardous material is defined in California’s State Hazardous Materials Incident Contingency Plan (1991) as “a substance or combination of substances which, because of quantity, concentration, physical, chemical, or infectious characteristics may: cause, or significantly contribute to an increase in deaths or serious illnesses; and/or pose a substantial present or potential hazard to humans or the environment.” Hazardous materials are one or more of the following: flammable, corrosive or an irritant, oxidizing, explosive, toxic (poisonous or infectious), thermally unstable or reactive, or radioactive. Hazardous materials are ubiquitous in modern society and may be found at all stages of production, consumption, and disposal.

Federal and state laws permit the intentional release of some hazardous materials into the environment such that the risk to human health and the environment is thought to be acceptable. However, sometimes releases are unintentional, resulting from leaks, accidents, or natural hazards. This section focuses on such accidental releases and fall into the following key categories:

**Fixed Hazardous Materials Incident:** A fixed hazardous materials incident is the accidental release of chemical substances or mixtures during production or handling at a fixed facility.

**Transportation Hazardous Materials Incident:** A transportation hazardous materials incident is the accidental release of chemical substances or mixtures during highway, waterway or air transport. Populations, built and natural environments are potentially impacted.

**Pipeline Incident:** A pipeline transportation incident occurs when a break in a pipeline creates the potential for an explosion or leak of a dangerous substance (oil, gas, etc.)

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possibly requiring evacuation. An underground pipeline incident can be caused by environmental disruption, accidental damage, or sabotage. Incidents can range from a small, slow leak to a large rupture where an explosion is possible. Inspection and maintenance of the pipeline system along with marked gas line locations and an early warning and response procedure can lessen the risk to those near the pipelines.

Hazardous materials can also be classified according to worker safety and health. Information provided by California Division of Safety and Health includes guidelines related to:

- **Safety hazards**: fire and fire byproducts, electricity, flammable gases, unstable structures, demolition, sharp or flying objects, excavations)
- **Health hazards**: carbon monoxide ash, soot and dust; asbestos; hazardous liquids; other hazardous substances; heat illness)

**Natural-Technological Incidents (Natechs):** During the past two decades, increasing attention has been given to hazardous materials releases resulting from *Natechs* or a natural disaster event that triggers a technological hazard event. Natechs are of particular concern for the following reasons:

- They can produce a simultaneous effect on many industrial facilities
- Can overwhelm response capacity
- Containment systems may fail
- May produce cascading disasters
- Response may be hindered by a disaster’s impact on the physical environment

**Location of the Hazard**

Hazardous materials and infrastructure such as fuel tanks, rail lines, chemicals, hazardous waste sites and gas pipelines to varying degrees are located within the CSU system and/or within its surrounding communities. The planning committee indicates that chemicals are located in science labs on campus, and that hazardous materials are transported by rail very close to the campus. Hazmat waste sites are also located near campus. At larger scales (beyond the campus planning area) hazardous materials and

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infrastructure are located throughout the city and county of Sacramento, and reflect different types, configurations and scales dispersed across these geographic areas.

Extent of the Hazard

There is no comprehensive statewide vulnerability assessment available at this time. As such, the true extent of the hazardous materials risk in California and its communities is not known, meaning no overarching conclusions have been reached which have been able to integrate all qualitative and quantitative risk factors to produce a comprehensive measure of the extent of the hazard.

However, for the CSU – Sacramento planning committee, although chemicals are well managed in campus science labs, and no events have taken place on campus, trains transporting chemicals close to the campus (including two derailments to date) increase the extent of the hazard risk. In addition, gas pipelines and hazardous waste sites are located close to the campus. Based on these factors, it is prudent to rank the extent of the hazard for the CSU – Sacramento campus as Moderate, and to consider worst case scenarios as the main driver of policy in order to fully mitigate all possible hazardous materials event outcomes.

For example, according to the 2018 CA State Hazard Mitigation Plan, 400 hazardous materials problems are tied to 32 past earthquakes, including over 150 problems from the Loma Prieta Earthquake alone. That said, the plan indicates that it is likely that many such hazardous materials releases have received little attention in the past because public authorities, the media, and the public have overlooked them in the rush to address and recover from immediate disaster threats, and that responsible parties may have an incentive to understate the extent of releases or not to report them at all.

History of the Hazard

According to the CA Governor’s Office of Emergency Services’ Hazardous Materials Spill Report, the state experiences from 10 to 30 spill events daily. As of April 20th, 2021 already 2096 spill events had occurred. Such events have occurred in all the cities and/or counties where CSU campuses are located.

According to the 2018 CA State Hazard Mitigation Plan, with regard to natural-technological hazard events (Natechs), 400 hazardous materials events are tied to 32 past earthquakes, including over 150 Natech events from the Loma Prieta Earthquake alone.

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According to the campus planning committee, two train derailments took place very close to the campus in approximately 2011/2012 and 2015/2016. No events have taken place since that time.

Potential Impacts of the Hazard

A large hazardous materials release could affect an entire community or city under certain conditions related to direction of air flow (air-based chemical release) and population density or the contamination of a community’s main water supply. Either type of release could necessitate large scale evacuation. By contrast, in the rural unincorporated areas where population densities are low, even in the event of a large release, the number of homes that may need to be evacuated would be significantly lower than in an urban environment. The occurrence of a hazmat incident can also result in the shut-down of transportation corridors which can last for hours at a time while the impacted area is stabilized.

The release of some toxic gases may cause immediate death, disablement, or sickness if absorbed through the skin, injected, ingested, or inhaled. Contaminated water resources become unsafe and unusable, depending on the amount of contaminant. Some chemicals cause painful and damaging burns if they come in direct contact with skin. Prolonged and concentrated exposure to such chemicals can produce severe long-term impacts to respiratory, endocrine and nervous systems, heart and brain health.

The potential impacts of chemicals and toxic gases discussed here also apply to the students, staff and environment on the CSU – Sacramento campus.

With regard to the natural environment overall, contamination of air, ground, or water may result in harm to fish, wildlife, livestock, and crops. The release of hazardous materials into the environment may cause debilitation, disease, or birth defects over a long period of time. Loss of livestock and crops may lead to economic hardships within the community.

Recent California examples include the 2016 Aliso Canyon methane gas leak, which caused evacuation of nearby residents, many of whom experienced temporary health problems such as difficulty breathing and eye irritation; and the 2016 Fruitland metal recycle plant fire in Maywood, which released heavy metals such as lead, magnesium, copper, aluminum, antimony, calcium, iron, sulfur, tin, potassium, and zinc which pose severe risks to public health. Health effects from exposure to these metals included short-term symptoms such as irritation to the eyes, nose, throat, and lungs.

Potential Impacts of the Hazard (Natechs)

Natural disasters, including earthquake, flood, and fire also pose risks to public health and the environment. For example, following the Northridge Earthquake, California State University (CSU) Northridge laboratories and chemical storage rooms experienced multiple chemical spills. Such incidents, triggered by a natural disaster, pose a significant risk to students, faculty, staff, and first responders. At a minimum, all CSU campuses with a science lab (including CSU – Sacramento) is at risk of potential impact from a natural-technological (combined impact) event.

In a severe flood event, floodwaters are often contaminated with hazardous materials posing a threat to public and animal health, groundwater, and other parts of the environment. These hazardous materials may be released from damaged or flooded underground tank sites (e.g., gas stations or chemical storage facilities), propane tanks, manure or human waste handling facilities, fertilizer and pesticide storage, agricultural sites, and household hazardous waste.

In a fire event, (such as the October 2017 Northern California firestorms which destroyed approximately 6,000 residences) entire neighborhoods can be burned to the ground. Hazardous material release creates public health concerns which can delay the initial steps of fire recovery, including reopening burned areas to residents and initiating debris removal activities. The post-fire “toxic sweep” poses a risk of coming into contact with toxic substances due to the presence of synthetic and hazardous materials.

Probability of Future Occurrence of the Hazard

The probability of occurrence for a hazmat event on the CSU – Sacramento campus can be viewed in two different ways: the history of occurrence serves as a sound predictor of future probability assuming current risk and vulnerability factors remain somewhat constant. For the purposes of the current estimate, no current data clearly indicates otherwise. As such, the probability of occurrence is Low to Moderate - the campus has not experienced a hazmat event on campus, but 2 train derailments took place near the campus. As such, the risk of occurrence on or near campus is beyond campus control and is multiplied. In addition, nearby hazardous materials and infrastructure further increase vulnerability and probability of a campus-related event. Moreover, hazmat occurrences are largely based on human error, and any changes in risk and vulnerability factors such as a decreased vigilance in materials oversight and handling practices or changes in the amount of chemicals or exposure will likely increase the probability on campus.

Vulnerability to the Hazard

Hazardous materials pose a risk to the CSU – Sacramento campus. As identified by the campus planning committee and on the hazmat map, the following vulnerabilities are present on campus: chemicals are present in science and research labs. In addition, a rail line transporting chemicals runs along the western and southern borders of campus and several hazardous waste sites are very close to the campus footprint. Gases and
chemicals or hazardous waste, if spilled or released, could severely impact human health and campus operations.

Although it is quite difficult to produce a quantitative measure of vulnerability because (unlike natural hazards) the probability of occurrence is dependent on human error, which itself is variable based upon a fluctuating set of interrelated factors, some of which lack prediction or control, given the complexity of how all natural and built environments and hazmat risks factors interrelate at the local or campus level, it is prudent to assume for planning purposes that the campus’ vulnerability is a sub-set of the larger community’s vulnerability. As such, the CSU – Sacramento leadership maintains vigilance to mitigate the campus’ vulnerabilities identified above at a minimum.

Estimate of Potential Losses

As discussed previously, it is difficult if not impossible to produce an accurate quantitative measure of vulnerability because of the variable nature of a hazardous materials spill. For example, the release of a toxic airborne chemical in a populated area has severe impact potential, whereas the impact potential of a small chemical spill in a remote or rural area is most likely limited to remediation of soil. And, in both cases, the probability of occurrence is dependent on human error, which itself is variable based upon a fluctuating set of interrelated factors, some of which lack prediction or control. In all cases, different types and amounts of hazardous materials interact with fluctuating combinations of human error to produce different event outcomes with variable impact costs.

Vulnerability Assessment Conclusions

It is well understood that with regards to hazmat vulnerability, each campus and its surrounding community (including CSU – Sacramento) operates through a complex and dynamic interaction between industrial and commercial inputs and outputs and the natural and built environment. Such activity produces hazardous materials that move through the environment along both convergent and divergent routes and across all levels of land-use from site to campus to city and county and beyond. It is also clear from a review of the Sacramento County hazard mitigation plan and Cal OES’ records of hazardous material spills, that such events occur with great frequency and varying degrees of severity across jurisdictions statewide. As such, in assessing the vulnerability of the CSU – Sacramento campus, campus-level risks and vulnerabilities are not discreet or isolated but can become exacerbated or augmented through connections to broader community-level hazmat risks and vulnerabilities.

Finally, in order to draw conclusions on vulnerability, it should be noted that any identified vulnerabilities at the campus level and/or community level are circumscribed and potentially reduced by targeted policy and program interventions. Numerous policies and programs have been established in recent years in response to California’s widespread and complex and integrated hazardous materials risks - California established the Unified Program which consolidates and integrates the administrative requirements, permits, inspections, and enforcement activities of the following environmental and

Identified Data Limitations

The CSU – Sacramento planning committee has provided information on campus-level hazmat materials and risks. Data limitations pertain to a comprehensive understanding of human activity and error related to materials control over the long term.

*Landslide*

Description of the Hazard

A landslide is a down-slope movement of soil, rock, or other debris, and can also be referred to as a mass movement or slope failure. These geological hazards can range in size from a few feet to over a mile in length and width and, when heavy and rapidly moving, can cause serious damage and loss of life.

Landslides are classified based on the type of material and type of movement involved. They can range from slow-moving earth flows to fast-moving debris flows, though many large slope failures involve more than one type of movement. The primary natural triggers of slope failures are water, seismic activity, and volcanic activity. Slope saturation by water can occur from intense rainfall, snowmelt, changes in ground-water levels, and surface-water level changes along coastlines. In winter months, El Nino storms or other high rainfall events may saturate soils and trigger slope failure.

Deep-Seated Landslides

Deep-seated landslides, ranging in depth from ten to several hundred feet, occur as a result of geologic and hydraulic changes, such as earthquakes or increased levels of groundwater. These landslides can move slowly or quickly and can cause extensive property damage, but rarely result in loss of life.

Debris Flows Related to Shallow Landslides

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Shallow landslides may mobilize into rapidly moving debris flows and typically occur after sudden saturation of the ground. These types of debris flows are typically more dangerous because they move rapidly, causing both property damage and loss of life.

Debris flows may also occur as a result of post-fire conditions, where wildfires have left barren ground exposed to heavy rainfall. Intense rainfall, generally greater than .5 inch per hour, has the potential to trigger a post-fire debris flow. These landslides may impact lives and properties within the deposition zone and can result in downstream flooding. Post-fire debris flows often occur during the fall and winter following major summer fires.

Location of the Hazard

The susceptibility of an area to landslides depends on several variables, including magnitude of slope gradients, water content, ground cover, presence of erosion, and slope material and structure. However, landslides are most prevalent in terrain with weak material and steep slopes, and the highest risk is found in areas with high rainfall or high earthquake potential. Slope failures are also most likely to occur in areas where they have occurred in the past. In California, the most landslide-prone areas are found along the coast and in the northern Franciscan Formation.

General landslide vulnerability can be estimated from the distribution of weak rocks and steep slopes as seen in Figure 18-14. Based on Figure 18-14 (below), the CSU Sacramento campus is located in an area with a very low degree of susceptibility to landslide.

Figure 18-15: Deep-seated Landslide Susceptibility Surrounding CSU Sacramento

Based on the Figure below, the CSU-Sacramento campus is not located in or near any landslide susceptibility zones.

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Extent of the Hazard

The extent of landslide hazards in Sacramento County is limited to a small strip along the eastern boundary; landslides are not likely to occur in Sacramento. However, the indirect impacts of landslides in the region may cover a larger geographical extent. Based on the campus’ location distant from any landslide zones, and no history of occurrences on or near the campus, the planning committee ranks the extent of the hazard as **Low**.

History of the Hazard

FEMA has declared seven major disasters in Sacramento County involving landslides, mudslides, or mud flows since 1983. The campus has no history of landslides.

Potential Impacts of the Hazard

CSU Sacramento may be impacted by the disruption of services as a result of landslides in the region. Landslides can result in physical damage to buildings and property and have the potential to significantly effect infrastructure. As a landslide moves, it distresses structural foundations by settlement, cracking, and tilting. Fast-moving flows can remove entire structures in one instance, while other types of flows can cause damage gradually.
Transportation and utility infrastructure are particularly vulnerable to landslides, since the failure of any component can disrupt service over a large area. The loss of power and communication and disruption of transportation can have cascading effects throughout an area, including impaired disposal of sewage, contamination of water supplies, and the release of flammable fuels.\textsuperscript{12} Transportation routes are also often expensive to clean up, and prolonged obstruction can disrupt the movement of people and goods for long periods of time.

**Probability of Future Occurrence of the Hazard**

Slope failures are often triggered by other natural hazards such as heavy rainfall and earthquakes, so landslide frequency is often related to the frequency of these other hazards. As climate change impacts the frequency and intensity of triggers such as rain events, fires, and coastal erosion, landslides may generally occur more often. Historically, landslides have occurred rarely in Sacramento and therefore are not likely to occur in the future. Based on these factors, and the location of the campus far away from landslide zones, the probability of future occurrence is **Unlikely**.

**Vulnerability to the Hazard**

The severity and magnitude of future landslides is negligible in Sacramento. The vulnerability of the built environment to landslides depends on exposure and is more likely to incur damage as a result of proximity, rather than inferior structural design. The structures most vulnerable to landslides are buildings and utility/transportation lifelines, which can be impacted by either impact or ground deformation. Utilities and transportation infrastructure are particularly vulnerable, due to their geographic extent and susceptibility to physical distress. Any population proximal to a landslide when it occurs is vulnerable to its impacts. That said, the CSU Sacramento campus exhibits very few, if any building and infrastructure vulnerabilities due to its location; therefore, its landslide vulnerability is limited to secondary effects of a landslide such as a power outage or transportation disruption. **Estimate of Potential Losses**

There are no current models for estimating potential losses from a landslide directly impacting the campus.

Although the economic impact of landslide damage can exceed that of the direct repair costs, there are currently no applicable methods for estimating indirect costs related to CSU Sacramento.

**Vulnerability Assessment Conclusions**

Community exposure to landslides varies depending on their physical locations – whether in flat plains or on steep hillsides – and on their dependence on critical infrastructure located in landslide hazard zones.

Landslides are not likely to impact the campus, though indirect impacts to campus transportation and utilities are possible. Utility outages can impact health, particularly for vulnerable populations, and can cause interruptions in operations. Interruptions may
impact student and employee’s ability to travel to campus and the delivery of classes and events.

Identified Data Limitations

The ability to predict future landslides at the CSU Sacramento campus is limited. However, the USGS estimates that climate change-induced shifts in weather will increase the frequency of post-wildfire landslides, which are expected to occur almost every year in California.

Power Outage

Description of the Hazard

Sacramento is the capital city of the state of California. It is also the seat and largest city of Sacramento County. It is also the home of CSU Sacramento (Sacramento State).

Most aspects of modern life, and almost all aspects of urban life, rely on the availability of reliable utilities, such as electricity, water, and natural gas. An interruption in the supply or distribution of these commodities can leave highly populated areas like Sacramento without basic services, such as electricity or sanitation. These interruptions can be cascading effects from other hazard events, such as windstorms, floods, wildfires and earthquakes, or they can be caused by intentional disruptions of transmission lines.

A power outage event can interrupt day-to-day operations of the Sacramento State University campus, like in-person classes, impede or limit digital, telephonic or radio communications, create traffic jams around the busy avenues and boulevards surrounding the campus, close the student health center, and close restaurants around campus and outside the campus. Additionally, thousands of Sacramento State student residents in on-campus housing would also be affected by a power outage on campus and in the area.

Additionally, a severe outage to Sacramento would directly affect the campus and the community.

Electric power disruptions and outages fall into two categories: intentional and unintentional.

The four types of intentional disruptions are:

- Planned: Some disruptions are intentional and can be scheduled based on maintenance or upgrading needs.
- Unscheduled: Some intentional disruptions must be done "on the spot" in response to an emergency.
- Demand-Side Management: Some customers (i.e., on the demand side) have entered into an agreement with their utility provider to curtail their demand for electricity during periods of peak system loads.
Load Shedding: When the power system is under extreme stress due to heavy demand and/or failure of critical components, it is sometimes necessary to intentionally interrupt the service to selected customers to prevent the entire system from collapsing. These intentional interruptions result in rolling blackouts.

Unintentional or unplanned disruptions are outages that come with essentially no advance notice or warning. This type of disruption is the most problematic. The following are categories of unplanned disruptions:

- Accident by the utility, utility contractor, or others.
- Malfunction or equipment failure.
- Equipment overload (utility company or customer).
- Reduced capability (equipment that cannot operate within its design criteria).
- Tree contact other than from storms.
- Vandalism or intentional damage.
- Weather, including lightning, wind, earthquake, flood, and broken tree limbs taking down power lines.
- Wildfire that damages transmission lines.

Location of the Hazard

Although power outages can take place within a certain area, as a hazard, it has the potential to occur and affect the entire planning area equally.

Extent of the Hazard

In order to anticipate outage conditions and reduce impacts, campus facility managers and others keep track of conditions and data provided by the media, municipal utilities and the California Independent System Operator (CAISO). CAISO is tasked with managing the power distribution grid that supplies most of California, except in areas served by municipal utilities, and is thus the entity that coordinates statewide flow of electrical supply. CAISO uses a series of stage alerts to the media based on system conditions. The alerts are:

- Stage 1 - reserve margin falls below 7 percent.
- Stage 2 - reserve margin falls below 5 percent.
- Stage 3 - reserve margin falls below 1.5 percent.
Rotating blackouts become a possibility when Stage 3 is reached.

A power outage could affect the entire area of the campus, including the Sacramento State athletic fields, classrooms resident halls, administrative offices, virtual, telephonic and radio communications, leading to loss of lighting in campus parking structures, and creating a cascading hazard for commuters as they depart from or arrive to campus in the evening. Additionally, the university is located within proximity of highly utilized thoroughfares for the transportation of goods to throughout California, within one of the busiest areas of the Silicon Valley.

Given the prevalence of rolling blackouts and other power outages in California, the campus maintains safety precautions, situational awareness, access to emergency power generators and other protocols for managing campus power outages. However, given that recorded outages have taken place on campus, the planning committee ranks the extent of the power outage hazard as Moderate.

History of the Hazard

Sacramento State did not report experiencing any power outages due to PSPS but has experienced outages due to mechanical failure, human error, accidents, and other utility provider related power outages. Sacramento State did not report any power outages in the recent years at Sacramento State but did advise that the university is expanding their mitigation efforts by replacing sub-stations and upgrading outdated systems that may potentially exacerbate the probability of a power outage.

Potential Impacts of the Hazard

Instructors, campus residents, staff, and administration rely on electricity for basic survival and operations. During a widespread power failure, it may take days to restore operations. Electrical power may be the only cooling source for many individuals around the campus and its community, and long-term outages can potentially put people’s health and life at risk. Disruptions in the supply of heating fuel may put people and property at risk during extremely cold weather if it relies on electric generation or heating mechanisms instead of gas. Additionally, many medical devices, communications devices, and security rely on power to maintain their functions.

Climate Change and Energy Shortage

Climate change is expected to bring more frequent and intense natural disasters. These changes have created a variability at a rate that makes historical data a poor predictor of future climate. For example, the warmest years on record in California occurred in 2014, 2015, and 2016. The 2016-2017 year broke the record as the wettest ever recorded in the northern Sierra Nevada Mountains.

Changes in temperatures, precipitation patterns, extreme events, and sea-level rise have the potential to decrease the efficiency of thermal power plants and substations, decrease the capacity of transmission lines, render hydropower less reliable, spur an increase in electricity demand, and put energy infrastructure at risk of flooding.
With climate warming, higher costs from increased demand for cooling in the summer are expected to outweigh the decreases in heating costs in the cooler seasons. Hotter temperatures in California will mean more energy (typically measured in “cooling-degree days”) needed to cool homes and businesses both during heat waves and on a daily basis, during the daytime peak of the diurnal temperature cycle. During future heat waves, historically cooler coastal cities (e.g., San Francisco and Los Angeles) are projected to experience greater relative increases in temperature, such that areas that never before relied on air conditioning will experience new cooling demands.

Secondary impacts of energy shortages are most often felt by vulnerable populations. For example, those who rely on electric power for life-saving medical equipment, such as respirators, are extremely vulnerable to power outages. Also, during periods of extreme heat emergencies, the elderly and the very young are more vulnerable to the loss of cooling systems requiring power sources.

Probability of Future Occurrence of the Hazard

The probability of California experiencing a power outage can be difficult to quantify but is a hazard that occurs annually during the same seasonal periods of temperature variance throughout the calendar year. The City of Sacramento and Sacramento County experience such outages. As such, the probability ranking for the Sacramento area is Likely. Since the CSU Sacramento campus has also recorded power outage events, it is prudent to assign this same ranking for the campus.

Climate models suggest summer global temperatures are likely to increase while changes between temperature extremes would be more pronounced. As such, it is expected that power outages will occur more frequently in the future.

Vulnerability to the Hazard

Based on the data available, and in consideration of the increasing effects of climate change, the campus remains vulnerable to power outages in terms of impacts to people, power infrastructure and campus operations. Nonetheless, as discussed campus leadership works to reduce vulnerabilities through consistent use of safety and operational protocols and emergency power sources to ensure it is able to mitigate an interruption to electrical power.

Estimate of Potential Losses

The data provided by Sacramento State does not report any value for potential losses due to power outage.

Vulnerability Assessment Conclusions

Elevators, entry ways, air filtration systems and lighting provide the campus community with the necessary infrastructure and systems to function and navigate through the campus and to maintain a safe campus environment and visibility during nighttime hours. The primary concern for campus leadership is that a loss of power can lead to potential hazards to students, faculty, and staff at Sacramento State. Vulnerable
populations (especially students with physical disabilities) may be the most heavily affected by loss of power, as they rely on elevators, entry ways with automatic doors, and locks and lights; a power outage would impede a disabled student’s ability to travel and utilize the campus and its structures safely.

The use of communication devices, billing, records, and electrical tools may also become unusable due to a loss of electricity. Many records and billing items may have to revert to “by-hand” procedures and paper copies may have to be kept continuing operations. Additionally, classrooms may not be usable if lighting equipment is not functioning impacting a semester or quarter’s progress for the academic year.

Identified Data Limitations

Sacramento State did not report any monetary or life losses due to a power outage. Also, the campus did not report any incidents involving a power outage directly affecting the campus community and operations.

**Volcano (Associated Air Quality)**

**Description of the Hazard**

The US Geological Service defines volcanoes as “openings or vents where lava, tephra (small rocks), and steam erupt on to the Earth’s surface. Through a series of cracks within and beneath the volcano, the vent connects to one or more linked storage areas of molten or partially molten rock (magma). This connection to fresh magma allows the volcano to erupt over and over again in the same location.”

A volcanic eruption occurs when magma, lighter than surrounding rock, is driven upwards by its buoyancy and by pressure from the dissolved gases contained within it. Gases are released from magma as it reaches the surface and pressure decreases. Magma can be erupted in several ways and violent eruptions typically cause tiny pieces of tephra (ash) to be carried away by the wind. This ash is hard, does not dissolve in water, is extremely abrasive and mildly corrosive, and conducts electricity when wet. The gases released in an eruption include carbon dioxide, sulfur dioxide, hydrogen sulfide, and hydrogen halides. Depending on their concentration, these are potentially hazardous to people, animals, agriculture, and property.

**Location of the Hazard**

There are eight volcanic areas located throughout California. Seven of these - Medicine Lake Volcano, Mount Shasta, Lassen Volcanic Center, Clear Lake Volcanic Field, Long

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Valley Volcanic Region, Coso Volcanic Field, and Salton Buttes – are considered active volcanoes. No portion of CSU Sacramento or Sacramento County is located within a volcano hazard zone.

**Extent of the Hazard**

Volcanic hazards are most severe within a few miles of the volcano vent and the severity generally decreases with distance. Ash impact zones can range from tens to hundreds of miles from the vent source. The US Geological Survey has estimated zones surrounding active volcanoes wherein 2 inches or more of ashfall following an eruption is possible. While CSU Sacramento does not fall within an estimated ashfall zone, lighter dustings of ash outside of those areas may directly or indirectly impact the campus. As such, the planning committee ranks the extent of the hazard for the campus as Low.

**History of the Hazard**

No historical eruption events in California have affected the campus. Over the last 1,000 years, there have been at least 12 eruptions in California.\(^{11}\) The most recent volcanic eruption in California occurred at Lassen Peak about 100 years ago, when a major explosion delivered windborne ash over 275 miles away.\(^ {12}\)

**Potential Impacts of the Hazard**

The specific impacts vary widely and depend on which type of volcano erupts, the style of explosion, the volume of lava, the eruption duration, and the local water conditions. As CSU Sacramento is not proximal to an active volcano, only the potential impacts of ashfall and gases have been detailed. While both these hazards can be widespread, their most severe impacts are generally seen closer to the volcanic source.

Although ashfall is typically a nonlethal volcanic hazard, it is the most widespread and disruptive. Falling ash can damage crops, electronics, and machinery. It can also impact human health by irritating the respiratory tract, eyes, and skin. The particles may enter drinking water and structures and may cause structure failure if it is thick and heavy enough. Even a fine layer of ash can disrupt utilities. A portion of California’s major electric transmission lines, aerial telecommunication lifelines, transportation corridors, and water storage and conveyance lie within the state’s volcano hazard zones. Impacts to any of these can impact operations at CSU Sacramento.

The potential impacts of gases released during volcanic eruptions are as follows:

- Carbon dioxide typically becomes diluted very quickly and is not life threatening. However, it can become trapped in higher concentrations in low-lying areas and has the potential to be fatal.
- Sulfur dioxide can cause acid rain and air pollution downwind of a volcano.
- Hydrogen sulfide can cause irritation of the upper respiratory tract. At high concentrations it can cause unconsciousness and death.
• Hydrogen halides can coat ash particles and, once deposited, poison drinking water, agricultural crops, and grazing land.

Probability of Future Occurrence of the Hazard

The US Geological Survey, based on the record of volcanic activity in California, estimates that the probability of another small- to moderate-sized eruption in the next thirty years is about 16 percent. As such, the annual probability of future occurrence for the campus is ranked by the committee as Unlikely.

Vulnerability to the Hazard

Populations living near volcanoes are the most vulnerable to eruptions and lava flows. However, volcanic ash can travel and affect populations miles away. The location and thickness of ash in any given area is a function of the severity of the eruption and wind speed and direction. For CSU Sacramento, there is low vulnerability to the immediate impacts of volcanic eruptions due to the limited area affected and remote potential of an eruption. In the event of a widespread ashfall event, the elderly, infants, and populations with existing respiratory disease will be at higher risk.

Estimate of Potential Losses

Impacts to critical infrastructure, agriculture, and property from ashfall have the potential to cause widespread disruption, damage, and economic loss throughout the state. In the event of a widespread ashfall event, impacts will be immediate.

Current modeling is not precise enough to allow for an assessment of potential losses from ashfall to structures or infrastructure on or surrounding the campus.

Vulnerability Assessment Conclusions

CSU Sacramento is unlikely to experience the direct impacts of a volcanic event. While the campus may be indirectly impacted by ashfall elsewhere in the state, direct ashfall impacts are generally unlikely but possible in a widespread event. However, the likelihood of any volcanic eruption in the state impacting the campus is very low.

Identified Data Limitations

Not all active volcanoes in California have been zoned for hazards by the US Geological Survey. This, together with the infrequent occurrence of volcanic explosions and number of factors determining type and extent of impacts, make the quantification of potential loss difficult.

Wildfire

Description of the Hazard
While wildfires are a natural part of California’s ecosystem, wildfires in California represent a hazard that presents one of the greatest probabilities of destruction along with a demonstrated history of catastrophic fire events in recent years. The destructive fire seasons of 2017 to 2020 illustrated the destructive forces fire presents to communities across the state. Wildfires may result in the structural loss, infrastructure loss, dangerous air quality, environmental damages, economic impacts, injuries, and loss of life. In many communities throughout California, wildfire presents greatest risk to human life and property.

Wildfires have been defined as any free burning vegetation fire that initiates from an unplanned ignition, whether natural or human caused demanding fire suppression actions to contain. These fires are prone to become uncontrolled, spreading through vegetative fuels rapidly exposing people and structures to harm. Wildfires present a significant risk to communities across the state, as evidenced by increasing trends of structural losses from wildland fires. This risk is elevated in areas where development and community growth has intersected, also known as the wildland-urban interface (WUI). In the interface setting, development itself can provide additional fuel for large fires. Recent fires have also demonstrated the ability of fire to consume populated areas in extreme conditions.

California’s Mediterranean climate in combination with its geography and vast population create a combination of factors that promotes an optimal environment for large fire growth and consequences. As there is great diversity of geographic characteristics across the state, the risks and potential consequences of wildfire must be assessed locally. The physical location, weather patterns, local fuel types and volume, extent of the WUI, topography, and additional factors will factor differently from part of the state to another.

The behavior of wildfires in California is significantly influenced by three distinct geographic factors. These factors will help shape the size, direction of spread, rate of combustion, fire intensity, and ability to pre-heat fuels. The physical factors contributing to wildfire behavior include:

- Topography – The rate in which wildfires spread increases with greater slopes in topography. The greater the slope will result in more pre-heating of fuel above the advancing fire. The direction that a slope faces will also influence fire behavior as south facing slopes receive greater solar radiation and thus drier vegetation that is more susceptible to combustion. Ridgetops often denote the end of fire spread as fire has greater difficulty spreading downhill.
- Weather – Weather factors substantially in influencing the behavior of wildfires. Wind, temperature, humidity, lightning, and lack of precipitation all contribute to a fire’s ability or inability to spread and intensify. California routinely experiences conditions in which these factors are in alignment to contribute to extreme fire

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78 State of California Hazard Mitigation Plan, September 2018
behavior during the summer and fall seasons. High winds, low humidity, and high temperatures provide an environment promoting extreme fire activity.

- **Fuels** – Certain types of vegetation are increasingly prone to igniting and promote more intense burning. Areas with greater “fuel loading” (amount of fuel present in terms of weight of fuel per unit of area) increases the amount of fuel to fuel a fire. Greater volumes of dead or dry vegetation compared to live plants is a critical factor. Vegetation during drought conditions will experience decrease in moisture content increasing the conditions for combustion. Fuels close proximity to one another allows for rapid spread through contact or radiant exposures.

A risk assessment for wildfires should be implemented within a geospatial context focusing on the specific location features and incorporates the three components of the wildfire risk triangle – likelihood, intensity, and susceptibility.

**Location of the Hazard**

Substantial portions of the State of California are exceptionally vulnerable to wildfire activity or reside in a wildland-urban interface (WUI) area due to the vast open spaces, rangelands, forests and other lands with high susceptibility to fire occurring throughout the state. Sacramento is located in the heart of the Sacramento Valley between the southern Sierra Nevada Mountains and Coastal Ranges. In general, areas considered to be within Fire Hazard Severity Zones defined by the Fire and Resource Assessment Program (FRAP) within the California Department of Forestry and Fire Protection (CalFire) occur 12 miles to the east and 32 miles to the west of Sacramento. These areas surrounding the valley are topographically diverse, contain heavier vegetative fuels, and often have residential development interspersed. The land in the Sacramento Valley where the CSU Sacramento campus is located, is largely urban, suburban, or otherwise developed and lies a long distance from any fire hazard severity zones.

The CSU Sacramento campus is located in the eastern portion of the City of Sacramento. The area immediately surrounding the campus is predominately developed with residential and commercial land uses. The American River Parkway is immediately adjacent to the campus containing light to moderate fuels but is narrow and contains a line of trees and brush along the river-bed immediately next to the campus. Extensive agricultural and open fields exist surrounding the city. The campus is located 4 miles east of downtown Sacramento. High Fire Hazard Severity Zones are found along the length of the foothills to the Sierra Nevada Mountains and Coastal Ranges.

However, the CSU Sacramento campus is located in the Central Valley surrounded by the mountains and extensive areas of fire hazards. These mountain ranges host three national forests with extensive history of large fire development. The fires that burn in these areas have the potential to develop vast quantities of smoke that can fill the valley in the right weather conditions. The geography of the Central Valley creates a topography that captures air pollutants including smoke within the surrounding mountains and the development of inversion layers. The CSU Sacramento campus is located in a region in
which is vulnerable to wildfire smoke that can saturate the air around the campus even from substantial distances.

Figure 18-16: Fire Hazard Severity Zones, Sacramento, CA

Extent of the Hazard

The area immediately surrounding the CSU Sacramento campus is not in proximity to fire hazard zones designated as a High Fire Hazard Severity Zones. However, the County is surrounded by areas that are considered to be of high fire threat that would produce vast quantities of smoke and particulates into the air. Based on the above factors, the planning committee ranks the extent of the hazard for the campus as **Low to Moderate**.

The National Fire Danger Rating System (NFDRS) is the current system in use for rating and classifying the potential danger of fire. The NFDRS tracks the effects of previous weather events on both dead and live fuel loads and adjusts accordingly based on future

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or predicted weather conditions. These complex relationships and equations are computed, and the outputs are expressed in terms that users can quickly and easily understand. The current NFDRS is used by all federal and most state agencies to assess fire danger conditions.

The following table depicts the NFDRS, from the US Forest Service’s Wildland Fire Assessment System.

Table 18-25: National Fire Danger Rating System⁸⁰

<table>
<thead>
<tr>
<th>Rating</th>
<th>Basic Description</th>
<th>Detailed Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>CLASS 1: Low</td>
<td>Fires not easily started</td>
<td>Fuels do not ignite readily from small firebrands. Fires in open or cured grassland may burn freely a few hours after rain, but wood fires spread slowly by creeping or smoldering and burn in irregular fingers. There is little danger of spotting.</td>
</tr>
<tr>
<td>Danger (L)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>COLOR CODE:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Green</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CLASS 2:</td>
<td>Fires start easily and spread at a moderate rate</td>
<td>Fires can start from most accidental causes. Fires in open cured grassland will burn briskly and spread rapidly on windy days. Woods fires spread slowly to moderately fast. The average fire is of moderate intensity, although heavy concentrations of fuel -- especially draped fuel -- may burn hot. Short-distance spotting may occur but is not persistent. Fires are not likely to become serious and control is relatively easy.</td>
</tr>
<tr>
<td>Moderate Danger (M)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>COLOR CODE:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Blue</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CLASS 3:</td>
<td>Fires start easily and spread at a rapid rate</td>
<td>All fine dead fuels ignite readily, and fires start easily from most causes. Unattended brush and campfires are likely to escape. Fires spread rapidly and short-distance spotting is common. High intensity burning may develop on slopes or in concentrations of fine fuel. Fires may become serious and their control difficult, unless they are hit hard and fast while small.</td>
</tr>
<tr>
<td>High Danger (H)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>COLOR CODE:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yellow</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CLASS 4:</td>
<td>Fires start very easily and spread at a very fast rate</td>
<td>Fires start easily from all causes and immediately after ignition, spread rapidly and increase quickly in intensity. Spot fires are a constant danger. Fires burning in light fuels may quickly develop high-intensity</td>
</tr>
<tr>
<td>Very High Danger (VH)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>COLOR CODE: Orange</th>
<th>characteristics - such as long-distance spotting - and fire whirlwinds when they burn into heavier fuels. Direct attack at the head of such fires is rarely possible after they have been burning more than a few minutes.</th>
</tr>
</thead>
<tbody>
<tr>
<td>CLASS 5: Extreme (E) COLOR CODE: Red</td>
<td>Fires under extreme conditions start quickly, spread furiously, and burn intensely. All fires are potentially serious. Development into high intensity burning will usually be faster and occur from smaller fires than in the Very High Danger class (4). Direct attack is rarely possible and may be dangerous, except immediately after ignition. Fires that develop headway in heavy slash or in conifer stands may be unmanageable while the extreme burning condition lasts. Under these conditions, the only effective and safe control action is on the flanks, until the weather changes or the fuel supply lessens.</td>
</tr>
</tbody>
</table>

Due to the impacts of wildfires on public health, agencies across the nation have adopted the use of the Air Quality Index (AQI) to communicate and provide a consistent approach to air quality measurements and categorization. The AQI primarily focuses on the health effects caused by pollutants in the air such as smoke. The goal of the AQI is to provide advisories to assist the public in determining when to reduce exposures to inhalation of air pollution as pollution levels rise.

Figure 18-17: Air Quality Index for Ozone and Particulate Pollution

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History of the Hazard

The State of California has a long history of chronic and destructive wildfires throughout the state. On average, 8,300 wildfires have caused burnt 928,245 acres across the state over the 20-year period between 2000 and 2020. The Sacramento Region also has a long history of wildfire activity primarily in the foothills and open rangelands. Wildfires occurring in the Sacramento Region have resulted in thousands of acres burned and substantial damages.

CSU Sacramento does not have a history of wildfire activity occurring within proximity to the campus. However, the campus has experienced multiple days of poor air quality due to fires burning in throughout northern California. The 2017, 2018, and 2020 fire seasons in particular illustrated the increase in wildfire generated smoke saturating the air of communities throughout the state including Sacramento. CSU Sacramento personnel reported the ongoing development of policies and procedures to address the response to poor air quality days.

Table 18-26: Historic Large-Scale Fires Near CSU Sacramento

<table>
<thead>
<tr>
<th>Date</th>
<th>Fire</th>
<th>Location</th>
<th>Declaration</th>
<th>Damages</th>
</tr>
</thead>
<tbody>
<tr>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
</tr>
</tbody>
</table>

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82 California Department of Forestry and Fire Protection, Stats and Events, https://www.fire.ca.gov/stats-events/

83 Sacramento County Local Hazard Mitigation Plan, October 2016
Potential Impacts of the Hazard

The location of the CSU Sacramento campus surrounded by areas of urban development removed from areas with a fire hazard places a minimal direct threat from wildfire to the campus. The potential impacts to wildfire exist with members of the campus community who reside or work in these fire hazard zones.

Potential impacts to the campus community resulting from wildfires include:

- Injuries or loss of life
- Campus property destruction or damage
- Residential property destruction or damage
- Commercial property destruction or damage
- Loss of property contents
- Infrastructure damage
- Damaged or destroyed lifelines/supply routes
- Damaged or destroyed utilities
- Damaged or destroyed critical facilities supporting campus emergency support needs
- Loss of community economic base
- Employment losses
- Loss to ground supporting vegetation on hillsides resulting in erosion or landslides in future precipitation events
- Agricultural (crops and livestock) damages or destruction
- Environmental damage
- Societal and community impacts
- Damage to organizations and facilities providing support services to vulnerable populations
- Greater evacuation challenges for those most vulnerable
- Psychological impacts of impacted populations
- Disruptions to education delivery to community

Potential impacts resulting from wildfire generated smoke include:

- Dangerous levels of air pollution
- Human Health Effects
  - Similar health impacts to pets
- Air conditioning systems overwhelmed
• Greater demands on air filtration systems
• Greater demands on healthcare systems
• Reduced outdoor work productivity
• Closures of academic session

Additionally, there remains a number of secondary impacts from wildfires that could affect the campus community. Residential communities along the Wildland Urban Interface may experience extensive damage or destruction in areas the campus community members call home. Utilities feeding areas of Sacramento County including the campus may be damaged resulting in power outages. Fire related damage in the watersheds will likely cause future landslides, degradation to plants supporting hillsides, and impact the hydroelectric power capabilities. Fires may present threats to areas of recreation, research, scenic value, and wildlife that are a part of the culture of the campus community.

Probability of Future Occurrence of the Hazard

Based on the wildfire threat potential in the area surrounding the CSU Sacramento campus, including the distance to Fire Hazard Severity Zones and density of residential and commercial development, the probability of wildfire related damage is considered Unlikely.

Based on the wildfire threat potential in the area surrounding the Sacramento region, including the volume of areas in elevated Fire Hazard Severity Zones surrounding the Sacramento Valley, the probability of wildfire generated smoke impacts to air quality is considered Possible.

Vulnerability to the Hazard

The CSU Sacramento campus is not likely to be subject to direct impact from wildfire due to the campus location in an urban area of Sacramento. The vulnerabilities to the effects of wildfire would largely lie within the campus community who may reside or work in locations that are exposed to the Fire Hazard Severity Zones outside of Sacramento. Wildfires occurring in other areas of the region may result in the displacement of large numbers of people or the generation of smoke. These effects may spill onto the campus.

Fire directly threatening the campus would likely take the form of localized fires involving single structures or small areas. Fires along the American River Parkway have potential to present fire exposure to the campus but limited potential to produce conditions that would allow for fire spread onto the campus. Smaller vegetation fires are remotely possible surrounding the campus in the urban forest or fields surrounding the city. These incidents would likely have little impact to the campus.

The primary basis of vulnerability is based on the population affected and the built environment exposed. In general, newer construction will be more fire resistant than
older buildings as building and fire codes and construction technology have improved. Density of buildings and proximity of fuels to buildings or equipment at risk of combustion would additionally influence the fire’s ability to spread to structures.

Some areas of particular vulnerability on the campus includes:

- Students and staff engaging in outdoor activities when the air is determined to be unhealthy are vulnerable to adverse health effects.
- Buildings with ineffective HVAC or do not have HVAC will cause limitations in filtering of air during smoke filled days.
- Power outages or brownouts during days with high levels of smoke will limit shelter in place options during heat events in summer.

The greater concerns regarding vulnerabilities to wildfire on CSU Sacramento are related to the smoke that fires in the area would produce. The recent summer seasons have clearly demonstrated the reality of large wildfires producing enough smoke to fill the Sacramento Valley even from substantial distances away. These recent fires have displayed how the effects of this smoke impact the general population and especially vulnerable populations. CSU Sacramento students, faculty, and staff both on campus and off campus face these same vulnerabilities related to smoke filled air.

Smoke generated from large wildfires pose a threat in terms of diminished air quality that would be exposed to the population within the area of smoke distribution. Individuals with existing health problems such as respiratory or cardiac illnesses are increasingly vulnerable to wildfire generated smoke. Staff who work in roles requiring outdoor activity will be increasingly exposed during days where the air quality index is considered unhealthy or worse. Student athletes participating in outdoor sports and engaging in aerobic activities are increasingly vulnerable to the effects of wildfire.

The vulnerability to members of the campus community in which wildfire generated smoke on the CSU Sacramento campus will vary depending on when the air quality was to reach unhealthy levels. The risk to the campus population will be lessened during periods when classes are not in session or during periods of breaks. Conversely, during the days and hours that classes are in session and staff are at their workplaces, the human vulnerability increases. However, in region-wide events this vulnerability may be shared with the homes and workplaces of members of the campus community and their families.

Vulnerable populations will likely face disproportionate health safety issues from smoke filled air, experience increased stresses, may require the need to remain away from the campus enclosed at home, and may find difficulty in accessing equipment or supplies to aid in a specific need.

**Estimate of Potential Losses**

Estimates of potential losses will be influenced by a variety of factors. Costs would also be likely to include mitigation or repairs of HVAC systems, sealing of doors and windows,
and other methods of keeping smoke from entering buildings. Secondary costs would include lost academic days during campus closures, lost staff on campus productivity, and health and medical interventions for affected members of the campus community.

The maximum total replacement costs due to wildfire are unknown, as estimated campus facility and structure costs were not available for CSU Sacramento.

Table 18-27: Wildfire Hazard Potential (WHP) Zone Estimated Losses

<table>
<thead>
<tr>
<th>WHP Zone</th>
<th>No of Buildings</th>
<th>Maximum Replacement Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Extreme</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Very High</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>High</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Moderate</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Low</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Very Low</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Non-Burnable</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>No Building Value Data Provided*</td>
<td>64</td>
<td>Unknown</td>
</tr>
</tbody>
</table>

*Buildings with no value defined are also included in the respective Zones they are found in.

Vulnerability Assessment Conclusions

The occurrence of wildfires has been a frequent event in Sacramento County; however, wildfire incidents do not pose a direct risk to the CSU Sacramento campus. The location of the CSU Sacramento campus surrounded by densely developed residential, commercial, and industrial land uses mitigates any vulnerabilities of wildfire hazards to the campus community or facilities. Any direct threat posed by wildfire would likely be generated via the American River Parkway, however the parkway proximal to the campus is lacking dense vegetation.

Communities located within or near the Wildland Urban Interface may be subject to damaging fires. These same communities may be home to members of the campus community. The students, faculty, and staff of CSU Sacramento who live or work in these hazard areas may experience vulnerabilities to the direct exposure to wildfire not likely at the campus. These effects may create tremendous challenges that could impact their ability to maintain engagement with university academic or professional activities. The potential for large-scale wildfires in the region further generates the added potential for a number of cascading effects such as disruptions to the local economy, utility failures, disruptions to providing for the needs of the community, and development of public health hazards.

Additionally, the topography of northern California surrounded by mountains allows for smoke filled air to linger in the Sacramento Valley with the potential for unhealthy air quality depending on wind conditions. Fires in surrounding mountains generating tremendous quantities of smoke present tremendous health related vulnerabilities to
members of the campus community. The campus community exposed to these unhealthy air conditions are vulnerable to a variety of potential health related effects.

**Identified Data Limitations**

Data limitations include missing campus structural replacement costs, and lack of both a complete inventory of building construction types and mitigation efforts to lessen the impact due to fire activity. HAZUS generated analysis is focused on the broader community level versus fine-tuning the analysis to the micro-level for facilities such as a university campus.

**Severe Weather (Wind, Tornado, Hail, Lightning)**

**Description of the Hazard**

Severe weather can be described as a variety of weather or climate events that are beyond or near the ends of the range of observed weather patterns and behavior. These events can include high or extreme winds, storms, lightning, hail, tornadoes, heat waves, unusually cold temperatures, extreme rainfall, and flooding. According to the Intergovernmental Panel on Climate Change (IPCC), to be classified as severe (or extreme), the occurrence of each value of a climate or weather variable (e.g., wind, hail, lightning, tornado, etc.) must be “above (or below) a threshold value near the upper (or lower) ends of the range of observed values of the variable.”

Severe weather in California can be generated by local, regional, and/or global weather and climate influences. From the individual thunderstorm to the Santa Ana wind event to the strong El Niño, damaging weather elements that are produced by and accompany severe weather and climate phenomena (e.g., damaging winds, hail, lightning, and tornadoes) occur throughout California and the California State University (CSU) system.

**Global Scale Influences on Severe Weather in California: El Niño, La Niña, and ENSO**

The El Niño-Southern Oscillation (ENSO) is a recurring climate pattern involving changes in the temperature of waters in the central and eastern tropical Pacific Ocean. On periods

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ranging from about three (3) to seven (7) years, the surface waters across a large swath of
the tropical Pacific Ocean warm or cool by anywhere from 1°C to 3°C, compared to
normal. This oscillating warming and cooling pattern, referred to as the ENSO cycle,
directly affects rainfall distribution in the tropics and can have a strong influence on
weather across the United States and other parts of the world.

El Niño and La Niña are extreme phases of the ENSO cycle, with a third phase occurring
between them called the Neutral phase. The El Niño phase is characterized by unusually
warm ocean temperatures and weaker-than-normal east winds in the Equatorial Pacific,
while the La Niña phase is characterized by unusually cold ocean temperatures and
stronger-than-normal east winds in the Equatorial Pacific. Both extreme ENSO phases
lead to significant differences from the average ocean temperatures, winds, surface
pressure, and rainfall across parts of the tropical Pacific. The Neutral phase indicates that
conditions are near their long-term average.

The extreme ENSO phases affect the frequency and intensity of weather events across
the world, including in California. On average, areas across California experience
exceptionally stormy winters with increased precipitation under El Niño conditions, but
experience less stormy and drier winters under La Niña conditions. This variability in
storminess and precipitation brought on by El Niño and La Niña events affects the both
the frequency and intensity of severe weather conditions experienced by all CSU
campuses, including CSU Sacramento.

Regional Climate Influences on Severe Weather across California

Most of the weather in California is influenced by the wet-winter/ dry-summer
Mediterranean climate pattern. In the summer months, Pacific storm tracks are deflected
north due to the position of the Pacific High (i.e., a large-scale atmospheric circulation
over the Northeast Pacific Ocean), preventing Pacific storms from reaching California. As
a result, most summer storms are generated due to the incursion of moist air from the
Gulf of Mexico or the Gulf of California, and occur as scattered, locally heavy showers in
the desert and mountain regions of the state. In the winter months, the Pacific High
decreases in intensity and moves south, permitting powerful Pacific storms to move into
and across the state; these storms can produce extreme winds, heavy rains (including

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86 Retrieved on 07.18.2021 from https://www.weather.gov/mhx/ensowhat
88 Retrieved on 07.17.2021 from https://www.climate.gov/news-features/understanding-climate/el-ni%C3%B1o-and-la-ni%C3%B1a-frequently-asked-questions
89 Retrieved on 07.16.2021 from https://www.pmel.noaa.gov/elnino/what-is-el-nino
“atmospheric river” events), and widespread coastal and inland flooding. (Please see the Flood Hazard profile in this document for information on Floods.) As a result, storm events accompanied by precipitation in California are far more frequent in the winter months than they are in the summer months.91

While the Mediterranean climate pattern influences the seasonal frequency, intensity, geographic spread, and type of some severe weather events CSU campuses experience (including CSU Sacramento), other severe weather phenomena may occur in California at any time of the year. For example, near the coast and over the Central Valley, there appears to be no defined seasonality to thunderstorms, and these storms are usually light and infrequent. Thunderstorms are more intense and more frequent in the intermediate and higher elevations of the Sierra Nevada, and occur with greater frequency during the summer months.92

**Types of Storms in California**

The 2018 California State Hazard Mitigation Plan (SHMP) defines a storm as a violent atmospheric disturbance occurring over land and/or water that is distinguished by its strength, characteristics, and the scale of the resulting damage.93 The SHMP also lists the following types of storms that produce hazardous conditions and potential damage throughout the state of California.94 These storms affect (in varying degrees) all CSU campuses, including CSU Sacramento.

- **Thunderstorm:** A rain-bearing cloud that also produces lightning. Thunderstorms can produce some of nature’s most destructive and deadly weather including tornadoes, hail, strong winds, lightning and flooding.95 Thunderstorms are caused by an atmospheric imbalance from warm unstable air rising rapidly into the atmosphere. Lightning, which occurs during all thunderstorms, can strike anywhere.96 Thunderstorms can produce some of nature’s most destructive and deadly weather including tornadoes, hail, strong winds, lightning and flooding.97

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91 Retrieved on 07.17.2021 from https://wrcc.dri.edu/Climate/narrative_ca.php
92 Retrieved on 07.17.2021 from https://wrcc.dri.edu/Climate/narrative_ca.php
The National Oceanic and Atmospheric Administration (NOAA) defines a severe thunderstorm as any storm that produces one or more of the following elements: Damaging winds or speeds of 58 mph (50 knots) or greater, hail 1 inch in diameter or larger, and/or a tornado.\(^98\)\(^99\)

- **Hailstorm**: a type of storm that precipitates round chunks of ice. Hailstorms usually occur during regular thunderstorms.\(^100\)
- **Wind storm**: marked by high wind with little or no precipitation.\(^101\)
- **Winter storm**: A storm that can produce a combination of freezing rain, sleet, heavy snow, and/or strong winds.\(^102\)
- **Coastal storm**: large wind-driven waves and/or storm surge that strike the coastal zone.\(^103\)
- **Ice storm**: Ice storms are one of the most dangerous forms of winter storms. When surface temperatures are below freezing, but a thick layer of above-freezing air remains aloft, rain can fall into the freezing layer and freeze upon impact into a glaze of ice. In general, 8 millimeters (0.31 inch) of accumulation is all that is required, especially in combination with breezy conditions, to start downing power lines as well as tree limbs. Ice storms also make unheated road surfaces too slick to drive on. Ice storms can vary in time range from hours to days and can cripple small towns and large urban centers alike.\(^104\)
- **Snowstorm**: A heavy fall of snow accumulating at a rate of more than 5 centimeters (2 inches) per hour that lasts several hours. Snowstorms, especially

\(^{98}\) Retrieved on 07.15.2021 from https://www.noaa.gov/explainers/severe-storms

\(^{99}\) Retrieved on 07.15.2021 from https://www.weather.gov/safety/thunderstorm


ones with a high liquid equivalent and breezy conditions, can down tree limbs, cut off power, and paralyze travel over a large region.\textsuperscript{105}

**Severe Weather Hazard Elements: Wind Hazards, Hail, and Lightning**

This hazard profile concentrates on the following types of severe weather hazards: wind hazards (including tornadoes), hail, and lightning. These hazards are produced by a variety of weather phenomena, including thunderstorms, coastal storms, winter storms, and topographically-enhanced downslope winds. While storm and downslope wind hazards are responsible for severe weather events across the CSU system, only the wind, tornado, hail, and lightning elements generated by these hazards are covered in this profile. (Storm-related hazards such as flooding and extreme temperatures are covered in other sections of this document.)

**Wind Hazards**

Wind is the horizontal movement of air past any given point. Wind begins with differences in air pressures; pressure that is higher at one point than another sets up a force, pushing the high towards the low pressure.\textsuperscript{106} Wind gusts are defined as “rapid fluctuations in the wind speed with a variation of 10 knots or more between peaks and lulls.”\textsuperscript{107}

Wind hazards in California take several forms: High Wind, Strong Winds, Thunderstorm Winds, Mountain-Valley (Downslope) Winds, and Tornadoes. These hazards are encountered across California, and have the potential to cause harm to or loss of life and/or property throughout California and the CSU system (including CSU Sacramento).

**High Winds, Strong Winds, and Thunderstorm Winds**

The National Weather Service reports three (3) types of wind events that occur areas over land: High Winds, Strong Winds, and Thunderstorm Winds. Collectively, these reports are used to determine the frequency with which wind hazard events have affected areas across the U.S., including California.

**High Winds**

High winds are defined as sustained non-convective winds of 35 knots (40 mph) or greater lasting for 1 hour or longer, or gusts of 50 knots (58 mph) or greater for any


\textsuperscript{107} Retrieved on 07.15.2021 from https://forecast.weather.gov/glossary.php?word=wind%20gust
duration (or otherwise locally/regionally defined). In some mountainous areas, the above numerical values are 43 knots (50 mph) and 65 knots (75 mph), respectively.\textsuperscript{108}

**Strong Winds**

Strong winds are defined as non-convective winds gusting less than 50 knots (58 mph), or sustained winds less than 35 knots (40 mph), resulting in a fatality, injury, or damage.\textsuperscript{109}

**Thunderstorm Winds**

Thunderstorm winds are winds that arise from thunderstorm convection (occurring within 30 minutes of lightning being observed or detected), with speeds of at least 50 knots (58 mph). They can also be winds of any speed (non-severe thunderstorm winds below 50 knots (58 mph)) producing a fatality, injury, or damage.\textsuperscript{110}

Please note: **Straight-line wind** is a term used to define any thunderstorm wind that is not associated with rotation. It is used mainly to differentiate from the rotational winds found in tornado-producing storms.\textsuperscript{111} However, it is not a term used in the NCEI Storm Events Database, and therefore cannot be used to determine severe weather history of or potential impacts to CSU campuses.

**Tornadoes**

A tornado is an extreme severe weather wind hazard. A tornado is a rapidly rotating column of air extending from a thunderstorm to the surface of the Earth.\textsuperscript{112} This column extends between cloud and the Earth’s surface. The damage from tornadoes comes from the strong winds they contain and the flying debris they create. It is generally believed that rotational wind speeds can be as high as 300 mph in the most violent tornadoes.\textsuperscript{113} On a local scale, tornadoes are the most violent and most destructive of all atmospheric phenomena.\textsuperscript{114}

**Mountain-Valley (Downslope) Wind Systems: Santa Ana, Diablo, and Sundowner Winds.**

**Santa Ana Winds.** A type of wind hazard that is peculiar to Southern California is called a **Santa Ana Wind.** Santa Ana winds are strong, topographically-enhanced, extremely dry downslope winds that originate inland and affect coastal southern California and northern


\textsuperscript{111} Retrieved on 07.15.2021 from https://www.nssl.noaa.gov/education/svrwx101/wind/types/

\textsuperscript{112} Retrieved on 07.15.2021 from https://www.earthnetworks.com/tornado/

\textsuperscript{113} Retrieved on 07.15.2021 from https://www.nssl.noaa.gov/education/svrwx101/tornadoes/faq/

\textsuperscript{114} Retrieved on 07.15.2021 from https://www.weather.gov/bgm/severedefinitions
Baja California (Mexico). They occur when air from a region of high pressure over the dry, desert region of the southwestern U.S. flows westward towards low pressure located off the California coast. This creates dry winds that flow east to west through the mountain passages in Southern California. These winds have a strong seasonal component; they are most common during the cooler months of the year, occurring from September through May. Santa Ana winds typically feel warm (or even hot) because as the cool desert air moves down the side of the mountain, it is compressed, which causes the temperature of the air to rise. If strong enough, Santa Ana winds can cause major property damage, and may present difficulties for airborne and seagoing transportation. They also may increase wildfire risk because of the dryness of the winds and the speed at which they can spread a flame across the landscape. (Note: The Wildfire hazard is profiled elsewhere in this document.)

Figure below illustrates the mechanisms involved in the generation of Santa Ana winds across Southern California.

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**Diablo Winds.** The Diablo wind is another type of topographically-enhanced downslope wind phenomenon that occurs in the North-Central areas of California. Diablo winds are offshore wind events that flow northeasterly over Northern California’s Coast Ranges, often creating high wind speeds downwind of major canyons and over ridges, and extreme fire danger for the San Francisco Bay Area. Diablo winds are driven by a surface pressure gradient that forms in response to an inverted pressure trough that develops over California.\textsuperscript{118}

**Sundowner Winds.** Sundowner winds are significant and potentially damaging downslope wind and warming events that periodically occur along a short segment of the southern California coast in the vicinity of Santa Barbara, CA. The unique topography of this coastal region promotes the development of Sundowner wind events: over a length of about 100 km, the coastline is oriented approximately west–east, with the adjoining

\textsuperscript{117} Retrieved on 07.14.2021 from https://twitter.com/nwslosangeles/status/933049473034579968

\textsuperscript{118} Retrieved on 07.13.2021 from https://www.fireweather.org/diablo-winds
narrow coastal plain bounded by a steeply rising (to elevations greater than 1200 m) and coast-parallel mountain range. Called Sundowner winds because they often begin in the late afternoon or early evening, their onset is typically associated with a rapid rise in temperature and decrease in relative humidity, and the winds tend to blow from the north from the Santa Ynez Mountains to the coast of Santa Barbara County, California. During the more intense Sundowner wind events, wind speeds can be of gale force 39-54 miles per hour or higher, and can even reach hurricane force (≥ 74 miles per hour) in the most extreme cases. Temperatures over the coastal plain, and even at the coast itself, can rise significantly above 37.8°C (100°F). Seasonally, Sundowner winds peak in March, April, and May, with a minimum during summer and a secondary peak in winter that often corresponds with Santa Ana winds. In addition to causing a dramatic change from the more typical marine-influenced local weather conditions, Sundowner wind episodes have produced significant wind-related property and agricultural damage, as well as conditions of extreme fire danger.119 120 121

**Hail**

Hail is a form of precipitation consisting of solid ice that forms inside thunderstorm updrafts.122 It is roughly round in shape and at least 0.2’ in diameter. Hail develops in the upper atmosphere as ice crystals that are bounced about by high velocity updraft winds; the ice crystals accumulate frozen droplets and fall after developing enough weight. The size of hailstones varies and is a direct consequence of the severity and size of the storm that produces them – the higher the temperatures at the Earth’s surface, the greater the strength of the updrafts and the amount of time hailstones are suspended, and therefore the greater the size of the hailstone.123

**Lightning**

Lightning is an electrical discharge produced by a thunderstorm. Lightning rapidly heats the air in its immediate vicinity to about 50,000°F - about five times the temperature of the surface of the sun. This compresses the surrounding air and creates a supersonic shock wave, which decays to an acoustic wave that is heard as thunder.124

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The discharge may occur within or between clouds, between the cloud and air, between a cloud and the ground, or between the ground and a cloud.\textsuperscript{125} Lightning that is produced from thunderstorms in which precipitation evaporates before reaching the ground is called “dry lightning.”

**Location of the Hazard**

Severe weather is a non-spatial hazard, and can occur anywhere in the CSU system, including at the CSU Sacramento main campus and at off-campus facilities owned by the school. No one area of the campus – or of the surrounding community – is subject to experiencing severe weather more than any other area.

There is geographic variability among the different types of mountain and valley wind events (as a sub-category of the severe weather hazard). Santa Ana winds occur in Southern California, Diablo winds occur in North-Central California, and Sundowner winds occur almost exclusively in Santa Barbara County, California.

**Extent of the Hazard**

Severe weather hazards are non-spatial hazards that potentially affect all CSU Sacramento campus areas equally. However, the smallest geographic unit of measurement for almost all official severe weather event data is at the county level. Because the severe weather data used do not exist at the campus level, it is assumed that the same (or similar) severe weather risks to CSU Sacramento reflect those of the surrounding community and County. As a result, all assets and people at CSU Sacramento are at risk from the effects of severe weather and can expect to experience at least some (or the complete range of) endemic severe weather hazards. In consideration of the campus’ design, layout, and operations, the severe weather history and degree of severity in the Sacramento area, and the history and degree of severity of each severe weather sub-type identified by the extent scales (below), the campus planning committee ranks the overall extent of the Severe Weather hazard as **MILD**. See each sub-hazard below for the planning committee’s sub-type extent ranking.

**Wind Hazard: Non-Rotational**

The Beaufort Scale is an empirical measure that relates wind speed to observed conditions at sea or on land. Its full name is the Beaufort wind force scale.\textsuperscript{126} First developed in 1805, it is still used today to estimate wind strengths.\textsuperscript{127}


\textsuperscript{126} Retrieved on 07.15.2021 from https://www.rmets.org/resource/beaufort-scale

\textsuperscript{127} Retrieved on 07.15.2021 from https://www.weather.gov/mfl/beaufort
Table 18-28: Beaufort Wind Force Scale\textsuperscript{128}

<table>
<thead>
<tr>
<th>Force</th>
<th>Speed (mph)</th>
<th>Speed (knots)</th>
<th>Description</th>
<th>Specifications for use at sea</th>
<th>Specifications for use on land</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0-1</td>
<td>0-1</td>
<td>Calm</td>
<td>Sea like a mirror.</td>
<td>Calm; smoke rises vertically.</td>
</tr>
<tr>
<td>1</td>
<td>1-3</td>
<td>1-3</td>
<td>Light Air</td>
<td>Ripples with the appearance of scales are formed, but without foam crests.</td>
<td>Direction of wind shown by smoke drift, but not by wind vanes.</td>
</tr>
<tr>
<td>2</td>
<td>4-7</td>
<td>4-6</td>
<td>Light Breeze</td>
<td>Small wavelets, still short, but more pronounced. Crests have a glassy appearance and do not break.</td>
<td>Wind felt on face; leaves rustle; ordinary vanes moved by wind.</td>
</tr>
<tr>
<td>3</td>
<td>8-12</td>
<td>7-10</td>
<td>Gentle Breeze</td>
<td>Large wavelets. Crests begin to break. Foam of glassy appearance. Perhaps scattered white horses.</td>
<td>Leaves and small twigs in constant motion; wind extends light flag.</td>
</tr>
<tr>
<td>4</td>
<td>13-18</td>
<td>11-16</td>
<td>Moderate Breeze</td>
<td>Small waves, becoming larger; fairly frequent white horses.</td>
<td>Raises dust and loose paper; small branches are moved.</td>
</tr>
<tr>
<td>5</td>
<td>19-24</td>
<td>17-21</td>
<td>Fresh Breeze</td>
<td>Moderate waves, taking a more pronounced long form; many white horses are formed.</td>
<td>Small trees in leaf begin to sway; crested wavelets form on inland waters.</td>
</tr>
<tr>
<td>6</td>
<td>25-31</td>
<td>22-27</td>
<td>Strong Breeze</td>
<td>Large waves begin to form; the white foam crests are more extensive everywhere.</td>
<td>Large branches in motion; whistling heard in telegraph wires; umbrellas used with difficulty.</td>
</tr>
</tbody>
</table>

\textsuperscript{128} Retrieved on 07.15.2021 from https://www.weather.gov/mfl/beaufort
<table>
<thead>
<tr>
<th>Time</th>
<th>Wind Force</th>
<th>Beaufort Scale</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>7</td>
<td>32-38</td>
<td>28-33</td>
<td>Near Gale</td>
</tr>
<tr>
<td>8</td>
<td>39-46</td>
<td>34-40</td>
<td>Gale</td>
</tr>
<tr>
<td>9</td>
<td>47-54</td>
<td>41-47</td>
<td>Severe Gale</td>
</tr>
<tr>
<td>10</td>
<td>55-63</td>
<td>48-55</td>
<td>Storm</td>
</tr>
<tr>
<td>11</td>
<td>64-72</td>
<td>56-63</td>
<td>Violent Storm</td>
</tr>
<tr>
<td>12</td>
<td>73+</td>
<td>64+</td>
<td>Hurricane</td>
</tr>
</tbody>
</table>
Based on those extent ranking factors identified (above), the planning committee ranks the extent of non-rotational wind hazards as **MODERATE**.

**Extent: Tornado**

Tornadoes have their own severity/extent scale. Until 2007, tornadoes were measured and described according to the Fujita Scale.\(^\text{129}\)

In February 2007, use of the Fujita Scale was discontinued. In its place, the Enhanced Fujita (EF) Scale is used. The Enhanced Fujita scale considers how most structures are designed and is thought to be a much more accurate representation of the surface wind speeds in the most violent tornadoes. Like the original Fujita scale, the Enhanced Fujita scale is a set of wind estimates (not measurements) based on damage.

It is important to note the date that a tornado occurred. Tornadoes that occurred prior to February, 2007 are classified using the original Fujita scale and will not be converted to the Enhanced Fujita Scale.

Table below illustrates the Fujita Scale in use prior to February 2007.

Table 18-29: Fujita Tornado Scale (Pre-February 2007)\(^\text{130}\)

<table>
<thead>
<tr>
<th>F-Scale Number</th>
<th>Intensity Phrase</th>
<th>Wind Speed</th>
<th>Type of Damage</th>
</tr>
</thead>
<tbody>
<tr>
<td>F0</td>
<td>Gale tornado</td>
<td>40-72 mph</td>
<td>Some damage to chimneys; breaks branches off trees; pushes over shallow-rooted trees; damages sign boards.</td>
</tr>
<tr>
<td>F1</td>
<td>Moderate tornado</td>
<td>73-112 mph</td>
<td>The lower limit is the beginning of hurricane wind speed; peels surface off roofs; mobile homes pushed off foundations or overturned; moving autos pushed off the roads; attached garages may be destroyed.</td>
</tr>
<tr>
<td>F2</td>
<td>Significant tornado</td>
<td>113-157 mph</td>
<td>Considerable damage. Roofs torn off frame houses; mobile homes demolished; boxcars pushed over;</td>
</tr>
</tbody>
</table>

d
Table below illustrates the Enhanced Fujita (EF) Scale, currently in use. Tornadoes that have occurred since February, 2007 are classified using the Enhanced Fujita Scale.

<table>
<thead>
<tr>
<th>Scale</th>
<th>Type of Tornado</th>
<th>Speed Range</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>F3</td>
<td>Severe tornado</td>
<td>158-206 mph</td>
<td>Roof and some walls torn off well-constructed houses; trains overturned; most trees in forest uprooted.</td>
</tr>
<tr>
<td>F4</td>
<td>Devastating tornado</td>
<td>207-260 mph</td>
<td>Well-constructed houses leveled; structures with weak foundations blown off some distance; cars thrown and large missiles generated.</td>
</tr>
<tr>
<td>F5</td>
<td>Incredible tornado</td>
<td>261-318 mph</td>
<td>Strong frame houses lifted off foundations and carried considerable distances to disintegrate; automobile sized missiles fly through the air in excess of 100 meters; trees debarked; steel reinforced concrete structures badly damaged.</td>
</tr>
<tr>
<td>F6</td>
<td>Inconceivable tornado</td>
<td>319-379 mph</td>
<td>These winds are very unlikely. The small area of damage they might produce would probably not be recognizable along with the mess produced by F4 and F5 wind that would surround the F6 winds. Missiles, such as cars and refrigerators would do serious secondary damage that could not be directly identified as F6 damage. If this level is ever achieved, evidence for it might only be found in some manner of ground swirl pattern, for it may never be identifiable through engineering studies.</td>
</tr>
</tbody>
</table>
Table 18-30: Enhanced Fujita Scale (February 2007 and Later) \(^{131}\)

<table>
<thead>
<tr>
<th>Enhanced Fujita Category</th>
<th>Wind Speed</th>
<th>Potential Damage</th>
</tr>
</thead>
<tbody>
<tr>
<td>EF0</td>
<td>65-85 mph</td>
<td>Light damage. Peels surface off some roofs; some damage to gutters or siding; branches broken off trees; shallow-rooted trees pushed over.</td>
</tr>
<tr>
<td>EF1</td>
<td>86-110 mph</td>
<td>Moderate damage. Roofs severely stripped; mobile homes overturned or badly damaged; loss of exterior doors; windows and other glass broken.</td>
</tr>
<tr>
<td>EF2</td>
<td>111-135 mph</td>
<td>Considerable damage. Roofs torn off well-constructed houses; foundations of frame homes shifted; mobile homes completely destroyed; large trees snapped or uprooted; light-object missiles generated; cars lifted off ground.</td>
</tr>
<tr>
<td>EF3</td>
<td>136-165 mph</td>
<td>Severe damage. Entire stories of well-constructed houses destroyed; severe damage to large buildings such as shopping malls; trains overturned; trees debarked; heavy cars lifted off the ground and thrown; structures with weak foundations blown away some distance.</td>
</tr>
<tr>
<td>EF4</td>
<td>166-200 mph</td>
<td>Devastating damage. Well-constructed houses and whole frame houses completely leveled; cars thrown and small missiles generated.</td>
</tr>
<tr>
<td>EF5</td>
<td>&gt;200 mph</td>
<td>Incredible damage. Strong frame houses leveled off foundations and swept away; automobile-sized missiles fly through the air in excess of 100 m (107 yd); high-rise buildings have significant structural deformation; incredible phenomena will occur.</td>
</tr>
</tbody>
</table>

Based on the extent ranking factors identified (above), the planning committee ranks the extent of tornados as **LOW**.

**Extent: Hail**

The National Oceanic and Atmospheric Administration and the Tornado and Storm Research Organization (TORRO) have combined efforts to create the Hailstorm Intensity Scale. Table below provides details of this scale.

Table 18-31: Combined NOAA/TORRO Hailstorm Intensity Scale\(^{132}\)

<table>
<thead>
<tr>
<th>Size Code</th>
<th>Intensity Category</th>
<th>Typical Hail Diameter</th>
<th>Approximate Size</th>
<th>Typical Damage Impacts</th>
</tr>
</thead>
<tbody>
<tr>
<td>H0</td>
<td>Hard Hail</td>
<td>Up to 0.33”</td>
<td>Pea</td>
<td>No damage</td>
</tr>
<tr>
<td>H1</td>
<td>Potentially Damaging</td>
<td>0.33” – 0.60”</td>
<td>Marble or Mothball</td>
<td>Slight damage to plants and crops</td>
</tr>
<tr>
<td>H2</td>
<td>Potentially Damaging</td>
<td>0.60” – 0.80”</td>
<td>Dime or grape</td>
<td>Significant damage to fruit, crops, and vegetation</td>
</tr>
<tr>
<td>H3</td>
<td>Severe</td>
<td>0.80” – 1.20”</td>
<td>Nickel to Quarter</td>
<td>Severe damage to fruit and crops, damage to glass and plastic structures, paint and wood scored</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Extent Level</th>
<th>Damage Type</th>
<th>Size Range</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>H4 Severe</td>
<td>Half Dollar to Ping Pong Ball</td>
<td>1.20” – 1.60”</td>
<td>Widespread glass damage, vehicle body damage</td>
</tr>
<tr>
<td>H5 Destructive</td>
<td>Silver Dollar to Golf Ball</td>
<td>1.60” – 2.0”</td>
<td>Wholesale destruction of glass, damage to tiled roofs, significant risk of injuries</td>
</tr>
<tr>
<td>H6 Destructive</td>
<td>Lime or Egg</td>
<td>2.0” – 2.4”</td>
<td>Aircraft body dented; brick walls pitted</td>
</tr>
<tr>
<td>H7 Very Destructive</td>
<td>Tennis Ball</td>
<td>2.4” – 3.0”</td>
<td>Severe roof damage, risk of serious injuries</td>
</tr>
<tr>
<td>H8 Very Destructive</td>
<td>Baseball to Orange</td>
<td>3.0” – 3.5”</td>
<td>Severe damage to aircraft body</td>
</tr>
<tr>
<td>H9 Super Hailstorms</td>
<td>Grapefruit</td>
<td>3.5” – 4.0”</td>
<td>Extensive structural damage, risk of severe or fatal injuries to persons caught in the open</td>
</tr>
</tbody>
</table>

Based on those extent ranking factors identified (above), the planning committee ranks the extent of the hail hazard as **LOW**.
**Extent: Lightning**

The National Weather Service (NWS) uses a Lightning Activity Level (LAL) scale to indicate the frequency and character of cloud-to-ground (C/G) lightning. The scale uses a range of 1 – 6, with 6 being the high end of the scale. Table below provides details of the LAL scale.

Table 18-32: Lightning Activity Level (LAL) Scale

<table>
<thead>
<tr>
<th>Rank</th>
<th>Cloud and Storm Development</th>
<th>Areal Coverage</th>
<th>Counts C/G per 5 Minutes</th>
<th>Counts C/G per 15 Minutes</th>
<th>Average C/G per Minute</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>No Thunderstorms</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>2</td>
<td>Cumulus clouds are common but only a few reaches the towering stage. A single thunderstorm must be confirmed in the rating area. The clouds mostly produce virga, but light rain will occasionally reach ground. Lightning is very infrequent.</td>
<td>&lt;15%</td>
<td>1-5</td>
<td>1-8</td>
<td>&lt;1</td>
</tr>
<tr>
<td>3</td>
<td>Cumulus clouds are common. Swelling and towering cumulus cover less than 2/10 of the sky. Thunderstorms are few, but 2 to 3 occur within the observation area. Light to moderate rain will reach the ground, and lightning is infrequent.</td>
<td>15% to 24%</td>
<td>6-10</td>
<td>9-15</td>
<td>1-2</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Rank</th>
<th>Cloud and Storm Development</th>
<th>Areal Coverage</th>
<th>Counts C/G per 5 Minutes</th>
<th>Counts C/G per 15 Minutes</th>
<th>Average C/G per Minute</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>Swelling cumulus and towering cumulus cover 2-3/10 of the sky. Thunderstorms are scattered but more than three must occur within the observation area. Moderate rain is commonly produced, and lightning is frequent.</td>
<td>25% to 50%</td>
<td>11-15</td>
<td>16-25</td>
<td>2-3</td>
</tr>
<tr>
<td>5</td>
<td>Towering cumulus and thunderstorms are numerous. They cover more than 3/10 and occasionally obscure the sky. Rain is moderate to heavy, and lightning is frequent and intense.</td>
<td>&gt;50%</td>
<td>&gt;15</td>
<td>&gt;25</td>
<td>&gt;3</td>
</tr>
<tr>
<td>6</td>
<td>Dry lightning outbreak. (LAL of 3 or greater with majority of storms producing little or no rainfall.)</td>
<td>&gt;15%</td>
<td>None</td>
<td>None</td>
<td>None</td>
</tr>
</tbody>
</table>

Based on those extent ranking factors identified (above), the planning committee ranks the extent of the lightning hazard as LOW.

**Extent: Thunderstorms that Generate Wind, Tornado, Hail, and Lightning Hazard Events**

Thunderstorms are not explicitly identified as a severe weather category for this hazard profile. However, they are responsible for most tornado, lightning, and hail hazard events – as well as a significant number of wind hazard events – across California and the CSU system. While individual thunderstorms affect relatively small areas, there are many instances in which thunderstorms can cluster together and/or travel in a line over long distances, producing significant damage over large geographic areas.

A thunderstorm is classified as “severe” when certain meteorological parameters within the thunderstorm are reached (i.e., damaging winds or speeds of 58 mph (50 knots) or greater, hail 1 inch in diameter or larger, and/or a tornado). However, there is currently no
established, objective severity scale for thunderstorms.\textsuperscript{134}  \textsuperscript{135} That said, according to the \textit{Glossary of Meteorology} published by the American Meteorological Society (AMS), a thunderstorm is reported as \textit{light, medium, or heavy} according to following five (5) characteristics:

- the nature of the lightning and thunder;
- the type and intensity of the precipitation, if any;
- the speed and gustiness of the wind;
- the appearance of the clouds; and
- the effect upon surface temperature.\textsuperscript{136}

A thunderstorm may also be classified by the nature of the overall weather situation in which the thunderstorm is produced, including:

- \textbf{Airmass Thunderstorm}: A thunderstorm produced by local convection within an unstable air mass;\textsuperscript{137}
- \textbf{Frontal Thunderstorm}: An individual thunderstorm the initiation of which results from rising motion associated with a front, or a thunderstorm within a convective system generated and organized by frontal rising motion;\textsuperscript{138} or
- \textbf{Squall-line Thunderstorm}: An individual thunderstorm included within a squall line (i.e., a continuous or broken line of active deep moist convection frequently associated with thunder).\textsuperscript{139}  \textsuperscript{140}

Based on the extent ranking factors identified (above) in relation to campus layout and operations, and past event low degree of severity, the planning committee ranks the extent of the thunderstorm hazard as \textbf{LOW}.

\textsuperscript{134} Retrieved on 07.15.2021 from https://www.noaa.gov/explainers/severe-storms
\textsuperscript{135} Retrieved on 07.15.2021 from https://www.weather.gov/safety/thunderstorm
History of the Hazard

Severe weather hazards have been an annual occurrence in Sacramento County and on the CSU Sacramento campus. Historical data for these hazards are presented below.

Historical Storm Data Collection: NCEI Storm Events Database

Historical information regarding severe weather hazards can be found using The National Centers for Environmental Information (NCEI) Storm Events Database. The Storm Events Database contains searchable, archived National Weather Service (NWS) storm data from January 1950 to April 2021, as entered by NOAA’s National Weather Service (NWS). Due to changes in the data collection and processing procedures over time, there are unique periods of record available depending on the event type.¹⁴¹ For example, from 1950 through 1954, only tornado events were recorded; from 1955 through 1995, only tornado, thunderstorm wind, and hail events were introduced into the database; from 1996 to present, 45 additional event types are recorded, including high wind, strong wind, and lightning events.¹⁴² To obtain the most accurate portrayal of severe weather event frequency, searches of the Storm Events Database are conducted using data collected since 01/01/1996. As a reminder, all official severe weather event data is at the county level. Severe weather data do not exist at the campus level. That said, it may be the case that the campus to some degree experiences the severe weather events reported for the surrounding community and County.

Wind Hazards (excluding Tornadoes)

Information obtained from the NCEI Storm Event Database website shows the number of events (or occurrences) of wind hazard events in Sacramento County since 1996.¹⁴³ Here, wind hazard events include all “High Wind,” “Strong Wind,” and “Thunderstorm Wind” storm reports.¹⁴⁴

- **High Wind:** at least 42 events, or approximately 1.66 events per year¹⁴⁵


¹⁴³ National Climatic Data Center. Storm Events Database. Retrieved 07.19.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28Z%29+High+Wind&eventType=%28Z%29+Strong+Wind&eventType=%28C%29+Thunderstorm+Wind&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=SACRAMENTO%3A67&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA


¹⁴⁵ Retrieved on 07.19.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28Z%29+High+Wind&beginDate_mm=01
• **Strong Wind**: at least 30 events, or 1.18 events per year

• **Thunderstorm Wind**: at least 9 events, or approximately 0.36 events per year

• **All Wind Hazard events** (excluding Tornadoes): at least 75 events, or approximately 2.96 events per year. (Note: This was determined by conducting a simultaneous search of the component wind hazards of high wind, strong wind and thunderstorm wind.)

Overall, in Sacramento County, there have been at least 75 wind hazard events since 1996, excluding tornadoes. That translates to an approximate average historical frequency of occurrence of 2.96 wind hazard events per year.

Please note: Differences between the sums of individual component severe weather hazard event Database searches (i.e., 81 events) and simultaneous Database searches of all severe weather hazard events (i.e., 75 events) may be due to the following factors: (1) multiple event types are in the same record (e.g., "Thunderstorm Wind/Hail" or "Hail/Tornado;" and/or (2) severe weather hazard events such as “Thunderstorm Wind” or “Hail” that are reported for Sacramento County have actually taken place hundreds of

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146 Retrieved on 07.19.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28Z%29+Strong+Wind&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=SACRAMENTO%3A67&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA

147 Retrieved on 07.19.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Thunderstorm+Wind&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=SACRAMENTO%3A67&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA

148 Retrieved on 07.19.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28Z%29+High+Wind&eventType=%28Z%29+Strong+Wind&eventType=%28C%29+Thunderstorm+Wind&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=SACRAMENTO%3A67&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA

149 National Climatic Data Center. Storm Events Database. Retrieved 07.19.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28Z%29+High+Wind&eventType=%28Z%29+Strong+Wind&eventType=%28C%29+Thunderstorm+Wind&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=SACRAMENTO%3A67&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA
miles away, but are erroneously recorded as events that have occurred in the County. When such a discrepancy arises, the more conservative aggregate hazard wind event value (i.e., 75 events) is used to determine the historical frequency of occurrence for the severe weather hazard. The origin of this discrepancy is unknown at this time.

**Historical Wind Hazard Losses for Sacramento County since 1996**

According to the NCEI Storm Events Database, the wind hazard events that Sacramento County has experienced since 1996 have been costly. There have been 3 deaths and 2 injuries, and property and crop damage estimates have totaled approximately $12,988,000 and $39,000, respectively.151

**Tornado Wind Hazards**

Information from the NCEI Storm Events Database indicates that since 1996, there have been 10 reported events of tornadoes in Sacramento County, which translates to approximately 0.39 tornado events per year.152

The vast majority of tornado reports in Sacramento County since 1996 have been of tornadoes with a severity rating of F0/EF0. Only one (1) of the tornadoes reported in has been rated F1/EF1 or higher (it was an EF1 tornado that occurred in 2012); that translates to approximately 0.04 events of F1/EF1 tornadoes have occurred per year in Sacramento County.153

**Historical Tornado Hazard Losses for Sacramento County since 1996**

According to the NCEI Storm Events Database, the tornado hazard events that Sacramento County has experienced since 1996 have been costly. While there have been

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151 Retrieved on 07.19.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28Z%29+High+Wind&eventType=%28Z%29+Strong+Wind&eventType=%28C%29+Thunderstorm+Wind&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=SACRAMENTO%3A67&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA

152 Retrieved on 07.19.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Tornado&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=SACRAMENTO%3A67&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA

153 Retrieved on 07.19.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?tornfilter=1&sort=DT&statefips=6%2CCALIFORNIA&county=SACRAMENTO%3A67&eventType=%28C%29+Tornado&beginDate_yyyy=1996&beginDate_mm=01&beginDate_dd=01&endDate_yyyy=2021&endDate_mm=04&endDate_dd=30
no deaths, injuries, or crop damage, property damage estimates have totaled approximately $730,000.\textsuperscript{154} (Note: The one (1) F1/EF1 tornado that occurred in Sacramento County in 2012 caused no deaths, injuries, property losses, or crop losses.)

**Hail**

Information from the NCEI Storm Events Database indicates that since 1996, there have been 8 reported events of hail in Sacramento County, which translates to approximately 0.32 hail events per year.\textsuperscript{155} (Note: The NCEI Storm Event Database search results for hail indicate that there has been a total of nine (9) reports of hail since 1996. However, one (1) entry is for a hail event in San Diego County, hundreds of miles away from Sacramento County. The origin of this error is unknown at this time.)

**Historical Hail Hazard Losses for Sacramento County since 1996**

According to the NCEI Storm Events Database, the hail hazard events that Sacramento County has experienced since 1996 have been costly. While there have been no deaths, injuries, or crop damages reported, property damage estimates have totaled approximately $111,030.\textsuperscript{156} (Note: The San Diego County hail event that was included erroneously in the search results for hail hazard events in Sacramento County accounted for all injuries (i.e., 5) and crop damage estimates (i.e., $300,000) presented in the search results.)

**Lightning**

Information from the NCEI Storm Events Database indicates that since 1996, there has been one (1) reported event of lightning in Sacramento County, which translates to approximately 0.04 lightning events per year.\textsuperscript{157}
**Historical Lightning Hazard Losses for Sacramento County since 1996**

According to the NCEI Storm Events Database, the lightning hazard events that Sacramento County has experienced since 1996 have been costly. While there have been no deaths, injuries, or crop damages reported, property damage estimates have totaled approximately $150,000.158

**All Severe Weather Hazard Events Recorded by the NCEI Storm Events Database**

Information obtained from the NCEI Storm Events Database indicates that there have been 94 occurrences of the severe weather hazard in Sacramento County. This translates to 3.71 severe weather hazard occurrences per year.159

Please note: Differences between the sums of individual component severe weather hazard event Database searches (i.e., 101 events) and simultaneous Database searches of all severe weather hazard events (i.e., 94 events) may be due to the following factors: (1) multiple event types are in the same record (e.g., "Thunderstorm Wind/Hail" or "Hail/Tornado;" and/or (2) severe weather hazard events such as “Thunderstorm Wind” or “Hail” that are reported for Sacramento County have actually taken place hundreds of miles away, but are erroneously recorded as events that have occurred in the County.160 When such a discrepancy arises, the more conservative aggregate hazard wind event value (i.e., 94 events) is used to determine the historical frequency of occurrence for the severe weather hazard. The origin of this discrepancy is unknown at this time.

**Historical, Aggregated Severe Hazard Losses for Sacramento County since 1996**

According to the NCEI Storm Events Database, the severe weather events that Sacramento County has experienced since 1996 have been costly. There have been 3

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158 Retrieved on 07.20.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Lightning&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=SACRAMENTO%3A67&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA

159 Retrieved on 07.19.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Hail&eventType=%28Z%29+High+Wind&eventType=%28C%29+Lightning&eventType=%28Z%29+Strong+Wind&eventType=%28C%29+Thunderstorm+Wind&eventType=%28C%29+Tornado&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=SACRAMENTO%3A67&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA

deaths and 2 injuries, and property and crop damage estimates have totaled approximately $13,979,000 and $39,000, respectively.\textsuperscript{161} It is important to note that for all Sacramento County severe weather hazard events recorded on the Storm Events Database, 100\% of all deaths, injuries, and crop losses, and approximately 93\% of all property losses, have been caused by wind hazard events alone.

Wind Hazards Not Included in the NCEI Storm Events Database

Santa Ana Winds

Santa Ana wind events occur at least twice per month from October through April.\textsuperscript{162} From 1948 to 2012, total of 2056 events on the 65-year record were recorded in the Southern California region, yielding an average of \textbf{32 occurrences per year}. Typical Santa Ana wind events last 1–2 days and represent 27\% of the occurrences, with events lasting up to 6 days accounting for 90\% of all occurrences. The remaining 10\% are made up almost entirely of events lasting between 7 and 12 days.\textsuperscript{163} \textsuperscript{164}

Figure below shows the mean monthly frequency per season of Santa Ana Wind events detected from 1948 to 2012. Extreme Santa Ana wind events are shown in dark red, and are defined as those events that are above the 90th percentile of all events on record.

\textsuperscript{161} Retrieved on 07.19.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Hail&eventType=%28Z%29+HighWind&eventType=%28C%29+Lightning&eventType=%28Z%29+StrongWind&eventType=%28C%29+Thunderstorm+Wind&eventType=%28C%29+Tornado&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=SACRAMENTO%3A67&hailfilter=0.00&tornado&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=SACRAMENTO%3A67&hailfilter=0.00&to


**Diablo Winds**

Diablo wind events occur approximately **2.5 events per year**. These events are most frequent during the fall and early winter seasons, with the highest frequency of events occurring in October. As a result, the highest risk of Diablo-wind-related damage is in the fall and early winter.\(^{167}\)

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Figure below shows the monthly frequency of Diablo winds (along with average live fuel moisture content). The Diablo Wind data are derived from a 17-year climatology of San Francisco Bay Area regional surface weather stations.\textsuperscript{168}

Figure 18-20: Monthly Frequency of Diablo Winds and Average Live Fuel Moisture Content (Dashed Line)\textsuperscript{169}

\textbf{Sundowner Winds}

Strong sundowner wind events occur approximately \textbf{2-3 times per year.} These events can create sharp temperature rises, local gale force winds, and significant weather-related problems. Rare, “explosive” types of sundowner wind events occur about 6 times per century that present dangerous weather situations, generating extremely strong and hot winds that can reach gale force or higher speeds.\textsuperscript{170}

\textbf{Historical Frequency of All Severe Weather Hazards}

\footnotesize
168 Retrieved on 07.15.2021 from https://www.fireweather.org/diablo-winds


Table below shows the average historical frequency of severe weather hazard events for Sacramento County since 1996.

Table 18-33: Severe Weather Hazard Event

Frequencies for Sacramento County since 1996.

<table>
<thead>
<tr>
<th>Severe Weather Hazard Category</th>
<th>Average Number of Hazard Events Per Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wind (Includes High, Strong and Thunderstorm Winds ONLY)</td>
<td>2.96</td>
</tr>
<tr>
<td>Tornado</td>
<td>0.39</td>
</tr>
<tr>
<td>Hail</td>
<td>0.32</td>
</tr>
<tr>
<td>Lightning</td>
<td>0.04</td>
</tr>
<tr>
<td>Diablo Wind</td>
<td>2.5</td>
</tr>
<tr>
<td>Santa Ana Wind</td>
<td>32</td>
</tr>
<tr>
<td>Sundowner Wind</td>
<td>2 to 3</td>
</tr>
</tbody>
</table>

* Note: The Santa Ana and Sundowner wind hazards are not present in Sacramento County. They are included here for information purposes only.

Potential Impacts of the Hazard

The significance (or priority) of a hazard’s potential impacts is based primarily on the frequency and resulting damage caused by the hazard, including deaths/injuries and property, crop, and economic damage. All assets and people within CSU Sacramento campus areas are at risk from the effects of severe weather hazards.

**Wind Hazards (Including Tornadoes)**

Wind hazard events have the potential to impact people, property, and operations on campuses across the CSU system. People caught in the open during an extreme wind event are exposed to high winds and debris, and could be injured or killed.

The habitability of buildings can be compromised (by damaging roofs, windows, or other weak points in the building envelope), leading to long-term operational issues for the campus. As with most university campuses, space is always at a premium at the CSU
Sacramento campus, and the loss of any currently utilized space due to building or structural damage would likely disrupt operations and the University’s mission.

Extreme wind events can result in power failure, which would impact the operation of the campus. Fallen tree limbs and other potential transportation hazards may also cause disruption to the surrounding community and limit ingress/egress to the campus. According to the 2016 Sacramento Countywide LHMP, wind hazards (including tornadoes) are considered to be low significance, and therefore to have a minimal potential impact on the County and (by extension) CSU Sacramento.171

**Hail**

Hail typically impacts property by damaging structures, cars, and utilities as it falls. Dents in cars, broken glass, and holes in roofs are common impacts of hail. Injuries to people from hail are less common, though they can happen, as hail is a hard object falling in an unpredictable manner at a fairly high rate of speed. According to the 2016 Sacramento Countywide LHMP, hail hazards are considered to be of medium significance, and therefore have a moderate potential impact on the County and (by extension) CSU Sacramento.172

**Lightning**

Lightning strikes the United States about 20-25 million times a year.173 Although most lightning occurs in the summer months, people can be struck at any time of year. Since 1990, lightning has killed an average of 39 people each year in the United States, and hundreds more have been injured.174 Property losses due to lightning have been very costly across the U.S. For example, from 2005 through 2020, U.S. homeowner’s insurance claim payouts for lightning losses totaled approximately $15,334,600,000, or $958,412,500 worth of payouts per year.175 (Commercial claim payouts for lightning losses for the U.S. were not available.)


175 Retrieved on 07.21.2021 from https://www.iii.org/table-archive/20504
According to the 2016 Sacramento Countywide LHMP, lightning hazards are considered to be of medium significance, and therefore have a moderate potential impact on the County and (by extension) CSU Sacramento.\textsuperscript{176}

### Probability of Future Occurrence of the Hazard

Areas throughout California, including all California State University (CSU) campuses, experience severe weather events every year, and future occurrences of such events are projected to increase in both their frequency and intensity. The 2016 Sacramento Countywide Local Hazard Mitigation Plan (LHMP) states that there is a near 100\% chance that each of the severe weather hazards profiled above for Sacramento County (i.e., wind, tornado, hail and lightning) will occur in the future.\textsuperscript{177} Also, according to the NCEI Storm Events Database, some of these same severe weather hazards have occurred in Sacramento County at least once per year. Furthermore, while the severe weather hazard is a non-spatial hazard that affects all areas of the CSU Sacramento campus equally, the smallest geographic unit of measurement for almost all official severe weather event data is at the county level. Because the severe weather data used in this assessment do not exist at the campus level, it is assumed that the severe weather probabilities for the CSU Sacramento campus reflect those of the surrounding community and County identified in the Table below.

Based on the data available from both the Sacramento Countywide LHMP and the NCEI Storm Events Database, the severe weather hazard is expected to occur on (or otherwise impact) the CSU Sacramento campus at least once on an annual basis. Therefore, the probability of future occurrence of the severe weather hazard for CSU Sacramento is \textbf{HIGHLY LIKELY}. See Table below for probabilities of future occurrence for component severe weather hazards for the county and the campus.

Table 18-34: Severe Weather Hazard Probabilities of Future Occurrence for Sacramento County and CSU Sacramento.

<table>
<thead>
<tr>
<th>Severe Weather Hazard Category</th>
<th>Average Number of Hazard Events Per Year</th>
<th>Probability of Future Occurrence</th>
</tr>
</thead>
</table>


Vulnerability to the Hazard

People, structures, and assets on CSU Sacramento campus are all vulnerable to the impacts associated with severe weather. Infrastructure can be damaged or destroyed by hail, wind, tornadoes, thunderstorms, and lightning, which can result in service interruptions and outages. Structures can be damaged or destroyed by hail, wind, tornadoes, thunderstorms, and lightning. People can be injured or killed by lightning, flying debris, hail, or extreme wind events. The CSU Sacramento campus also has vehicles, as well as off-campus conference and recreational facilities, that are all vulnerable to a severe weather event.

Estimate of Potential Losses

Severe weather is a non-spatial hazard that affects the entire CSU Sacramento campus. Each of the hazards associated with severe weather can result in losses throughout the planning area.

All structures within the CSU Sacramento campus are at risk from severe weather. There are approximately 64 buildings on the main campus that could be damaged by wind, hail, and/or lightning. If even a fraction of these assets were to be damaged, the resulting estimated losses would still be in the millions of dollars. Unfortunately, the total replacement costs due to severe weather hazard are unknown, as estimated campus facility and structure values for CSU Sacramento were not available. Moreover, an analysis of projected dollar losses to campus buildings from severe weather as a percentage of building replacement costs is also not currently available, though CSU leadership may pursue such data in the future.
The population at the CSU Sacramento campus varies throughout the day. As of Fall, 2019, CSU Sacramento had 31,156 students and 3,228 faculty and staff. All are at risk from severe weather events, with 34,384 being directly vulnerable in this scenario.

Vulnerability Assessment Conclusions

Severe weather presents a variety of hazards to the CSU Sacramento campus. People, assets, infrastructure, and vehicles can all be damaged by this hazard, and losses can quickly begin to rise. In the aggregate, severe weather is a frequently occurring hazard (mostly in the form of wind hazard events) that presents a variety of risks to CSU Sacramento.

It is evident that the CSU Sacramento campus has vulnerabilities to and risks from severe weather hazard incidents, and that pre-event planning, communication, and mitigation efforts should be implemented. Public education and outreach regarding areas of shelter that could be used by campus populations during severe weather events is considered by campus leadership to be one viable mitigation option. The campus planning committee will continue to look for feasible and cost-effective options for the mitigation of severe weather risks going forward.

Identified Data Limitations

Numerous federal agencies maintain a variety of records regarding losses associated with hazards. Unfortunately, no single source is considered to offer a definitive accounting of all losses. The Federal Emergency Management Agency (FEMA) maintains records on federal expenditures associated with declared major disasters. The US Army Corps of Engineers (USACE) and the Natural Resources Conservation Service (NRCS) collect data on losses during the course of some of their ongoing projects and studies. Additionally, the National Oceanic and Atmospheric Administration’s (NOAA) National Centers for Environmental Information (NCEI) collects and maintains data about natural hazards in summary format, as well as occurrences, dates, injuries, deaths, and estimated costs for individual storm events. Many of these databases and other data collection services, including the NCEI, have inherent data limitations when searching for information at a scale as small as a single campus.

The best available data and records have been used throughout this section. Where no data or records exist or could be located, that deficiency is noted.


18.4 Social Resilience Assessment

Overview

While every person is vulnerable to risk, individuals from diverse populations such as those with access and functional needs are disproportionally more vulnerable and may be at a higher risk to harm in a disaster event. In addition to physical vulnerabilities, the intersectionality between physical hazard risks and population social vulnerabilities must be considered to holistically address overall campus risk.

As inclusivity is a high priority for CSU, addressing campus risk and resilience must be done through the lens of inclusion and equity. Addressing social vulnerability is an increasingly critical requirement of state and national doctrines and described in Section 4.4 of the HVRA Base Plan. Every individual of the campus’s richly diverse population group needs to have the capacity, skills, and knowledge in order to understand, access, and participate in risk reduction and disaster response in ways that are meaningful to their own unique situation. In a campus community, having strong social support networks and active involvement in community disaster responses may negatively or positively impact these opportunities and reduce the resilience-building process. This section offers a glimpse into the CSU Sacramento campus’s unique social construct, population demographics, strengths and concerns and presents a high-level assessment of the resilience, coping capacities and potential social vulnerabilities of students, staff and faculty. The research variables that were asked are often considered sensitive subjects, and few are traditionally included in emergency management/hazard mitigation planning.

This social resilience assessment of college campuses is the first of its kind in the nation. The research methodology unfolded as the interviews with campuses progressed. The assessment data presented are not definitive or authoritative. The answers, analysis, and suggested trends are strictly indicators for potential social risk. They do not represent an accurate data capture as limitations on the data gathering process influenced an ability to provide accuracy. This assessment provides indications of increased risk, not accuracy of response or a true reflection of the situation of the campus. The information presented is to be considered in the context of the more detailed system-wide CSU social vulnerability assessment that is included in the baseline HVRA.

Campus-Identified Populations of Concern

During the campus interview, the following responses were provided when asked, “In considering the diverse population group(s) amongst student body, faculty and staff, which are of the most concern in your emergency management planning?”
Table 18-35: High level summary of campus populations of concern

<table>
<thead>
<tr>
<th>Question</th>
<th>Campus Response</th>
</tr>
</thead>
</table>
| Which population groups amongst the student body, faculty, and staff, are of the most concern for physical and social vulnerabilities in emergency management planning? | Foreign language speakers
|                                                                         | Commuter students                                    |
| Which population groups are most difficult to reach in an event?         | Deaf employees (deaf studies professors)              |
| Which population groups have little/limited support networks if impacted by an event? | DACA students                                        |

Resilience Variables Related to Campus Emergency Management

The interviewees were asked to reflect on a set of 12 variables for the campus populations of student, faculty and staff: homelessness (*housing insecurity*), food security, health and wellness, disability/access and functional needs (AFN), racial equity, digital equity, communications, international students, immigrants/immigration status issues (*undocumented, DACA, etc.*), LGBTQI (Lesbian Gay Bisexual Transgender Questioning (or queer) Intersex), and transportation dependency. They were also offered an opportunity to add any other factor they wanted to include. The following two questions were asked:

- Is this factor a particular issue of concern for emergency management on your campus? Responses were summarized as **Very High, High, Medium, Low**
- Is this factor reflected in the emergency plans and processes for your campus? Responses were summarized as **Yes, No, In Progress, NA**
In order to provide a high-level qualitative response for the answers, the approach of averaging response was taken. If conflicting answers were expressed by the interviewees, the answer (code) was averaged out. A detailed explanation of the response averaging approach is included in the base HVRA.

Table 18-36: Campus-specific emergency management issues of concern and inclusion in emergency management plans and processes.

<table>
<thead>
<tr>
<th>Issue of Concern</th>
<th>Issue of Concern</th>
<th>Plans &amp; Processes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Homelessness (Housing Insecurity)</td>
<td>High</td>
<td>N/A</td>
</tr>
<tr>
<td>Food Security</td>
<td>Low</td>
<td>N/A</td>
</tr>
<tr>
<td>Health &amp; Wellness</td>
<td>Low</td>
<td>No</td>
</tr>
<tr>
<td>AFN</td>
<td>Medium</td>
<td>Yes</td>
</tr>
<tr>
<td>Digital Equity</td>
<td>Low</td>
<td>N/A</td>
</tr>
<tr>
<td>Comms.</td>
<td>Low</td>
<td>N/A</td>
</tr>
<tr>
<td>International Students / Immigrants / Immigration Status</td>
<td>Low</td>
<td>No</td>
</tr>
<tr>
<td>LGBTQI</td>
<td>Low</td>
<td>No</td>
</tr>
</tbody>
</table>

Qualitative Narrative: Campus Overview of Potential Resilience Vulnerabilities

The following are interview notes of interest:

- The most difficult to reach in an event are deaf studies professors whose offices have doorbells with lights. (Campus has a high of hearing-impaired population.)
- Those who have little support networks if impacted by an event are the Dreamers (DACA students) living off campus as a result of immigrations issues with their parents.
- High concern with the portion of students who are homeless and living out of their vehicles; they have no resources for them.
- Concern with evacuation due to fire because a lot of buildings are older and do not have evacuation chairs in stairwells.
- The new parking structure #5 was retrofitted with WIFI repeaters at all locations so students without internet at home can work from their cars.
- No issues with immigration status because they have incorporated information into the EOP

**Campus High Hazards and Potentially Vulnerable Populations**

This section provides a brief introduction to the link between socially vulnerable populations and a particular hazard type. While extensive research has been conducted on the impacts of hazards, not all linkages have been documented or published, and detail for finding them are beyond the scope of this assessment. It’s important to note, the intersectional nature of what makes an individual’s personal experience and resilience to an event is played out by unique factors for that individual or population. The nuanced social vulnerabilities often come from the social and physical environment in which a person is embedded.

In order to aid in further assessing campus resilience, below is a general description of the known impacts. From some hazards, the descriptions are robust, while others are only brief introductions.

**Table 18-37: CSU Sacramento *Highly Likely, Likely and Possible* Hazards**

<table>
<thead>
<tr>
<th>Hazard</th>
<th>Future Occurrence Probability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Communicable Disease</td>
<td>Highly Likely</td>
</tr>
<tr>
<td>Drought</td>
<td>Highly Likely</td>
</tr>
<tr>
<td>Earthquake</td>
<td>Possible</td>
</tr>
<tr>
<td>Erosion</td>
<td>Likely</td>
</tr>
<tr>
<td>Extreme Temperature</td>
<td>Highly Likely (Heat); Unlikely (Cold)</td>
</tr>
<tr>
<td>Flood</td>
<td>Possible</td>
</tr>
<tr>
<td>Hazardous Materials</td>
<td>Possible</td>
</tr>
<tr>
<td>Power Outage</td>
<td>Likely</td>
</tr>
<tr>
<td>Wildfire</td>
<td>Unlikely (Fire); Possible (Smoke)</td>
</tr>
</tbody>
</table>

**Drought**

The 2012-2016 drought had severe effects on two vulnerable sectors of our population: those in low-income brackets, and those, especially Native Americans, who rely on
subsistence fishing for their livelihoods.\textsuperscript{180} Water bills increased throughout the state. Due to rising water prices, for the working poor, many have paid four to five percent of their income for water. Since many CSU students are commuters, and many living with families, future drought impacts may potentially affect a percentage of non-resident students. NASA’s modeling shows that future droughts are likely to last longer and be more intense, even leading to “megadroughts” in the western states.\textsuperscript{181} Fresh water supplies are predicted to be full of extremes, with both droughts and extreme precipitation events being more severe. The interrelationship between drought and other hazard conditions may lead to a set of secondary impacts. Drought conditions lead to water quality issues due to loss of drinking water, increased fire danger that leads to drought-induced fires and elevated AQI levels, as well as extreme heat or prolonged heat events.

\textit{Earthquake}

Impacts on populations from earthquakes are complex, with long-term implications on social stability for all populations. In addition to the physical impact exposure during a no-notice earthquake event and the social and logistical challenges of a recovering community, an earthquake can have lasting impacts long afterwards due to post traumatic stress disorder (PTSD).

Socioeconomic vulnerabilities of populations at risk were analyzed in the hypothetical yet scientifically realistic earthquake sequence that is being used to better understand hazards for the San Francisco Bay region during and after a magnitude-7 earthquake (mainshock) on the Hayward Fault and its aftershocks. In this study, the at-risk populations located in areas of concentrated damage are anticipated to experience longer recovery trajectories, increased long term housing displacement, and transportation impacts due to dependencies on transit dependencies. When neighborhood schools close, families with school age children may move to other areas to keep their children in schools. Persons with access and functions needs are likely to be more dependent on access to functioning medical, social and personal health care services that would be overwhelmed by the event and therefore increasing their vulnerabilities. For the homeless populations, the loss of social community services and damages to shelters could add to protracted relocations. For the young and mobile populations who rent, the major disruption to housing, jobs and transit will also drive relocation. Widespread housing damage and preexisting housing market constraints will make it “extremely challenging” for the socially and economically vulnerable populations to find alternative housing near their home communities. Those who utilize interim and irregular housing


for months and years after a disaster are more vulnerable to physical, social, and mental disorders, including suicide, substance abuse, and physical and verbal abuse. Aftershocks and post disaster conditions delay population return and increase outmigration.\textsuperscript{182}

\textit{Erosion}

Risk from erosion relates to earthen and infrastructural losses. The degree of vulnerability to these events and their impacts depends on human behavior and the traditional social factors such as situational awareness, prior knowledge of hazards, social capital and decision-making capabilities, as well as increased vulnerability due to social factors, such as racial and economic disparities.

\textit{Extreme Temps}

People susceptible to respiratory ailments (asthma, lower and upper respiratory disease) disproportionately suffer from the effects of fire, smoke, air pollutions, allergens, heat and PSPS. Those with limited income or without resources are affected disproportionately due to the inability to provide safe shelter, air conditioning, cooling, air purification, medical care, and quality foods, and are also least able to obtain information related to climate risks and adaptation strategies.

\textit{Heat}

Heatstroke, cardiovascular disease, respiratory disease and cerebrovascular disease are related to extreme heat events. Increased number of heat waves creates heat-related physical stress on populations and is exacerbated in the metropolitan areas where greater amounts of heat-absorbing surfaces (e.g., asphalt and concrete) trap heat and emit higher temperatures throughout the night.

The heat also extends the geographic range and the distribution of disease-carrying insects and pests. Health professionals are concerned that California’s warming climate will allow species to acclimate. Such vectors include such pests as ticks that carry Lyme disease, and mosquitos that transmit Zika, dengue fever, West Nile, plague and tularemia. Some others, such as chikungunya, Chagas disease, and Rift Valley fever virus, are threats as well.

Some communities of color and some low-income, homeless, and immigrant populations are more exposed to heat waves, as these groups often reside in urban areas affected by heat island effects. In addition, these populations are likely to have limited adaptive capacity due to a lack of adequately insulated housing, inability to afford or to use air conditioning, inadequate access to public shelters such as cooling centers, and

inadequate access to both routine and emergency health care. These social, economic, and health risk factors give rise to the observed increase in deaths and disease from extreme heat in some immigrant and impoverished communities.

Heat stroke, the most serious heat-related illness, occurs when the body is unable to control its temperature. Body temperature rises rapidly, the sweating mechanism fails, and the body cannot cool down. In extreme causes, heat stroke can cause confusion and unconsciousness, so the victim is unable to seek treatment without assistance.

There are several groups of people who are uniquely vulnerable to the effects of extreme heat, such as infants and children, older adults aged 65 and up, athletes and outdoor workers, low-income households, and individuals with certain chronic medical conditions.

When dealing with an extreme heat event, the most common impacts are those generally felt by the people living in the targeted area. For people in particular, heat can kill when the body is pushed beyond its limits. Most heat disorders occur because the victim has been overexposed to heat. As discussed, the major human risks associated with extreme heat include dehydration, sunburn, fatigue, heat exhaustion, heat stroke, and in severe cases, death.

Some portions of the population are more at risk to the effects of extreme heat. The very young, the elderly, and certain groups with chronic medical conditions (such as asthma or other pulmonary illnesses, heart disease, poor blood circulation, neurological illnesses, and obesity) are generally more vulnerable to the effects of extreme heat, and are more likely to suffer illness or death as a result.

This is especially true if exposure is extended for a period of time and preventative measures are not taken immediately. Distributional implications of impacts, and even less on distributional implications of adaptation actions.” 183

**Flood**

Risk from floods relates to community risk, exposure and infrastructural losses. The degree of vulnerability to these events and their impacts depends on human behavior and the traditional social factors such as situational awareness, prior knowledge of hazards, social capital and decision-making capabilities. The exposure of humans to floods continues to increase, driven by changes in hydrology and land use. The adverse impacts on socially vulnerable populations are amplified because a disproportionately high number live in flood-prone areas. Research has shown that places of social vulnerabilities are places characterized by housing and racial disparities, such as mobile home parks, structural fragility and poverty, and higher percentages of populations such

as Black and Native Americans, and others with shared histories of discrimination, marginalization and exclusion. ¹⁸⁴

Health impacts from flooding are well recognized due to the extensive history of flooding in California and around the nation. The impacts range from waterborne illnesses from contaminated waters, respiratory illnesses that impact the lungs, throat, and airways from airborne particles, mold on flooded buildings that can trigger asthma, allergies and other illnesses—all which are particularly impactful to older, younger and individuals with pre-existing health condition. Foodborne illnesses can increase if there are issues with power outages or sewer overflows. Individuals with increased mental health concerns can be impacted by the stress or anxiety from the impacts of the flood. Poor quality housing can increase vulnerability to many flood risks, including flood inundation, power outages, mold growth, rodent vectors, and serious health impacts. For those with limited finances, flood inundation and impacts to infrastructure or farmlands may lead to extensive income losses.

The poorest residents suffer disproportionately to flood situations, especially those who have been less able to fund homeowner’s insurance to protect against flood losses. Loss of life is not unusual in flooding situations, as is loss of property, livestock, pets, workplaces, and tourist industries. There is a strong interrelationship between water events and other hazards. Flooding, storms and water quality are related to each other. Drought conditions can exacerbate floods as the surface soils are hardened and not as ready to allow surface water absorption. Extreme heat events can cause snowmelt, inundating waterways and causing flood and water quality issues. Flooding and storm events can have impacts on public health, environmental health, agricultural health and economic system health. Mental health issues are reported for all people who have experience flood losses, including anxiety, fear, anger, anger, sadness and grief. ¹⁸⁵ Additionally, waterborne disease outbreaks are reported weeks after the flood events. Mold contamination leads to indoor air issues. Damp indoor environments lead to increased prevalence of asthma, and also upper and lower respiratory symptoms.

These issues may influence the diverse CSU populations, both on and off campus, in a number of ways long after a flood event, or the related hazards impacts, has concluded.

**Hazardous Materials**

The severity of a hazardous materials release depends upon the type of material released, the amount of the release, and the proximity to populations or environmentally sensitive areas such as wetlands or waterways. The release of materials can lead to injuries or


evacuation of nearby residents. Wind direction at the time of the release can also have a bearing on the severity (as well as the location and extent) of a hazardous materials release.

The primary threat from the hazardous materials incident hazard is to the structures located along transmission lines and transportation routes or near facilities that use or store hazardous materials. Minor incidents would likely cause no damage and little disruption, assuming they could be contained quickly. Major incidents could have fatal and disastrous consequences. The severity of a hazardous material release relates primarily to its impact on human safety and welfare and on the threat to the environment. Threats to human safety and welfare include:

- Poisoning of water or food sources and/or supply
- Presence of toxic fumes or explosive conditions
- Damage to personal property
- Need for the evacuation of people
- Interference with public or commercial transportation

Environmental risks are not uniformly distributed across groups of people. Age, poverty, and minority status place some groups at a disproportionately high risk for environmental disease. Poor access to health information and health care means less health promotion, less risk avoidance, a less healthy diet, and more adverse conditions that increase susceptibility to exposure. Delayed recognition of exposure, diagnosis, and treatment allows effects to accumulate.

**Power Outage/Public Safety Power Shutoffs (PSPS)**

Loss of power creates economic hardship to a region experiencing regular PSPS events, such as those experienced throughout the state over the recent years. Many businesses close, including gas stations, grocery stores, and local retail establishments. These impacts may deeply impact students dependent on support jobs, as well impacting family members of campus staff and faculty. PSPS increases risks to the public due to inability to use medical devices, spoilage of food and medicines, and disruption to infrastructure, such as supply of clean water and electricity used to run home medical equipment, such as lift chairs and ventilators.

**Wildfire**

Increased wildfire threat occurs especially in the end of fall, when conditions are driest, but before the winter rains have come; an east-to-west wind gusts exacerbate fire risk. Wildfire threats have the concomitant threat of Public Safety Power Shutoffs (PSPS). And,

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186 https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3222496/

in the case of an actual wildfire, danger exists both from fire and from the smoke. Recent wildfires have demonstrated that some demographics are disproportionately affected. Native Americans are six times more likely to be affected than white people. Blacks and Hispanic people are 50 percent more vulnerable. These values take into account the likelihood of a community being affected and the greater difficulty of that community to recover. These statistics reflect the lack of access to resources to pay for insurance, to rebuild and recover, to implement fire safety measures, and to access other resources. Price gouging after a fire (such as documented in Sonoma County after the 2017 Tubbs Fire) further exacerbates the disparity. Furthermore, the disabled and the elderly are at particular risk from extreme wildfire conditions, as they are often not as able to effectively evacuate. Of the 85 people who died in the Camp Fire in Butte in 2018, 62 of them were at least 65 years old.

Smoke from wildfires creates a significant public health threat. Especially vulnerable are individuals who have heart or lung issues, such heart disease, lung disease or asthma. Those most vulnerable include the medically fragile, elderly and children. Air Quality Indexes track the level of the following: particulate matter, surface levels of ozone, carbon monoxide, sulfur dioxide, and nitrogen dioxide. All of these can cause respiratory distress and harm lungs.

The California Department of Public Health reports the increased public health risks, and risk indicators that include: heat-related ED visits, populations living in wildfire areas, adults with multiple chronic conditions, populations living in poverty, race/ethnicity, outdoor workers, public transit access, air conditioner ownership and tree canopy.

Hazard Mitigation and Emergency Management Planning

The goal of this high-level assessment is to provide a starting point to encourage further exploring campus social risks and vulnerabilities, as well as to inform and to enhance holistic emergency management and hazard mitigation decision


making, planning processes and future adaptive risk management strategies. By including the social resilience factors, mitigation investments may move beyond standardized planning and regulations, structure and infrastructure projects, and natural systems protections to embrace a more expanded, customized emergency operations plan and an education and outreach program unique to the campus.

A more robust social resilience inquiry is strongly encouraged to develop an accurate picture, based on methodical and scientific research-based data. Such an effort would be envisioned through both nuanced discussions with a variety of campus stakeholders and the invitation of nontraditional stakeholders to join in a collaborative resilience partnership. Such a forward-leaning effort would be directly in keeping with CSU’s commitment to inclusion and equity in risk reduction.
Section 19
California State University, San Bernardino

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19.1 University Profile

University History

California State University, San Bernardino (CSU San Bernardino) was founded in 1960 as San Bernardino-Riverside State College. The school earned its university status in 1984, officially becoming CSU San Bernardino. Today, the school includes five colleges and is classed as a Master's College and University by the Carnegie Institute. It is a federally recognized Hispanic-Serving Institution and was selected by the Carnegie Foundation for Distinctive Community Engagement. In 2020, the National Security Agency chose CSU San Bernardino to help lead its cybersecurity workforce development initiative and named the school’s Cybersecurity Center as the Community National Center for Cybersecurity Education.

CSU San Bernardino is designated as a Hispanic-Serving Institution (HSI).

University Governance

The campus president is the chief executive officer who oversees the administration of the entire university. The president manages campus operations and fundraising, sets campus priorities, and oversees the hiring and support of staff and faculty. The president also maintains a close working relationship with the CSU’s systemwide office, reporting to the chancellor and participating in the systemwide Executive Council.

The provost is the chief academic officer of the university, overseeing all academic affairs and programs of the university. The provost reports directly to the president.

The Faculty Senate of CSU San Bernardino includes elected faculty representing each of the five colleges, as well as a voting counselor, librarian, lecturer, and student representatives. The president and provost are active ex-officio members of the Senate. The Senate includes over 50 standing, special, college, and department committees. Meanwhile, both the Staff Council and Associated Students, Incorporated are made up of representatives who participate in shared governance.

CSU San Bernardino is developing a Shared Governance Steering Committee, which will include representatives of the Associated Students, Faculty Senate, Staff Council, and the Administration. The future goals of this Committee will be to create partnerships with the community, integrate input from all stakeholders, and share accountability. The school is in the process of finalizing the CSUSCB Statement on Shared Governance.

University Mission

"Create a dynamic learning environment through premiere programs and services that promote student success, enhance the learning experience, and engage students intentionally with communities”.

In support of this mission, CSU San Bernardino has a vision to advance communities and regions by connecting them with students focused on social justice and integrity. The
Core values driving these goals center around social justice, sustainability, inclusivity, and transparency.

University Location

The 441-acre CSU San Bernardino campus is located in northern San Bernardino, framed by the San Bernardino Mountains. San Bernardino, a city of approximately 215,000, is located between the Cajon and San Gorgonio passes, positioning it as an intermodal logistics hub. The city is located approximately 60 miles east of Los Angeles and 60 miles northeast of the Pacific Ocean.

University Population

CSU San Bernardino typically enrolls approximately 20,000 students per semester. In fall 2020, the 19,404-student population was overwhelmingly made up of undergraduate degree seekers with an average age of 22. Hispanic students made up 66% of all students, with White students making up the second most populous group at 12%. 81% all students are first-generation, and 58% are considered low-income. The student population is also overwhelmingly female.

In addition to the student population, the University is home to approximately 950 faculty and staff.

19.2 Interim Final Rule for Hazard Vulnerability and Risk Assessment

Requirement §201.6(c)(2): The plan shall include a risk assessment that provides the factual basis for activities proposed in the strategy to reduce losses from identified hazards. Local risk assessments must provide sufficient information to enable the jurisdiction to identify and prioritize appropriate mitigation actions to reduce losses from identified hazards.

Requirement §201.6(c)(2)(i): [The risk assessment shall include a] description of the type...location and extent of all natural hazards that can affect the jurisdiction. The plan shall include information on previous occurrences of hazard events and on the probability of future hazard events.

Requirement §201.6(c)(2)(ii): [The risk assessment shall include a] description of the jurisdiction’s vulnerability to the hazards described in paragraph (c)(2)(i) of this section. This description shall include an overall summary of each hazard and its impact on the community.

Requirement §201.6(c)(2)(ii): [The risk assessment must also address National Flood Insurance Program (NFIP) insured structures that have been repetitively damaged floods.

Requirement §201.6(c)(2)(ii)(A): The plan should describe vulnerability in terms of the types and numbers of existing and future buildings, infrastructure, and critical facilities
located in the identified hazard area.

**Requirement §201.6(c)(2)(ii)(B):** The plan should describe vulnerability in terms of an estimate of the potential dollar losses to vulnerable structures identified in paragraph (c)(2)(ii)(A) of this section and a description of the methodology used to prepare the estimate.

**Requirement §201.6(c)(2)(ii)(C):** The plan should describe vulnerability in terms of providing a general description of land uses and development trends within the community so that mitigation options can be considered in future land use decisions.

**Requirement §201.6(c)(2)(iii):** For multi-jurisdictional plans, the risk assessment must assess each jurisdiction’s risks where they vary from the risks facing the entire planning area.

### 19.3 Hazard Identification and Risk Assessment

**Overview of California State University, San Bernardino History of Hazards**

Numerous federal agencies maintain a variety of records regarding losses associated with hazards. Unfortunately, no single source is considered to offer a definitive accounting of all losses. The Federal Emergency Management Agency (FEMA) maintains records on federal expenditures associated with declared major disasters. The US Army Corps of Engineers (USACE) and the Natural Resources Conservation Service (NRCS) collect data on losses during the course of some of their ongoing projects and studies. Additionally, the National Oceanic and Atmospheric Administration’s (NOAA) National Centers for Environmental Information (NCEI) database collects and maintains data about natural hazards in summary format. The data includes occurrences, dates, injuries, deaths, and estimated costs. Many of these databases and other data collection services, including the NCEI, have inherent data limitations when searching for information at a university scale.

The best available data and records were used throughout this assessment.

**Hazard Identification**

As part of the initial hazard identification process, the Campus Assessment Team considered potential hazards with the most chance to significantly affect the planning area. The hazards include those that have occurred in the past and may occur in the future. A variety of sources were used to develop the list of hazards considered including national, regional, and local sources such as emergency operations plans, FEMA’s *How-To Series*, websites, published documents, databases, and maps, as well as discussion among the Campus Assessment Team members.

In the initial phase of the planning process, the Campus Assessment Team considered 14 hazards and the risks they create for the University and its material assets, population,
and operations. The hazards initially considered, and the determinations as to the treatment of those hazards, are shown in Table 19-1 (following).

Table 19-1: Hazard Identification Determinations

<table>
<thead>
<tr>
<th>Hazard</th>
<th>Determination (Yes/No)</th>
<th>Reason for Determination</th>
<th>Future Occurrence Probability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Communicable Disease</td>
<td>Yes</td>
<td>Hazard of concern for campus</td>
<td>Highly Likely</td>
</tr>
<tr>
<td>Dam and Levee Failure</td>
<td>Yes</td>
<td>Hazard of concern for campus</td>
<td>Unlikely</td>
</tr>
<tr>
<td>Drought</td>
<td>Yes</td>
<td>Hazard of concern for campus</td>
<td>Highly Likely</td>
</tr>
<tr>
<td>Earthquake</td>
<td>Yes</td>
<td>Hazard of concern for campus</td>
<td>Possible</td>
</tr>
<tr>
<td>Erosion</td>
<td>Yes</td>
<td>Hazard of concern for campus</td>
<td>Likely</td>
</tr>
<tr>
<td>Extreme Temperature</td>
<td>Yes</td>
<td>Hazard of concern for campus</td>
<td>Possible (Heat); Unlikely (Cold)</td>
</tr>
<tr>
<td>Flood</td>
<td>Yes</td>
<td>Hazard of concern for campus</td>
<td>Unlikely</td>
</tr>
<tr>
<td>Hazardous Materials</td>
<td>Yes</td>
<td>Hazard of concern for campus</td>
<td>Possible</td>
</tr>
<tr>
<td>Landslide</td>
<td>Yes</td>
<td>Hazard of concern for campus</td>
<td>Likely</td>
</tr>
<tr>
<td>Power Outage</td>
<td>Yes</td>
<td>Hazard of concern for campus</td>
<td>Likely</td>
</tr>
<tr>
<td>Sea Level Rise</td>
<td>No</td>
<td>Not a hazard of concern for campus</td>
<td>N/A</td>
</tr>
<tr>
<td>Tsunami</td>
<td>No</td>
<td>Not a hazard of concern for campus</td>
<td>N/A</td>
</tr>
<tr>
<td>Volcano</td>
<td>Yes</td>
<td>Hazard of concern for campus</td>
<td>Unlikely</td>
</tr>
<tr>
<td>Wildfire</td>
<td>Yes</td>
<td>Hazard of concern for campus</td>
<td>Likely (Fire); Possible (Smoke)</td>
</tr>
</tbody>
</table>

**Future Occurrence Probability**

In order to determine the probability of future occurrences of each hazard profiled, the following scale was developed:
- Highly Likely- 76%-100% that the hazard would occur annually.
- Likely- 50%-75% that the hazard would occur annually.
- Possible- 11%-49% that the hazard would occur each annually.
- Unlikely- 0%-10% that the hazard would occur each annually.
Communicable Disease

Description of the Hazard

Communicable diseases are illnesses that occur due to infectious agents or their toxic products and are infectious due to their potential of transmission from one person or species to another by a replicating agent. They may be transmitted from a reservoir to a susceptible host either directly as from an infected person or animal or indirectly through the agency of an intermediate plant or animal host, vector, or the inanimate environment. Communicable diseases are clinically evident illness resulting from the presence of pathogenic microbial agents, including pathogenic viruses, pathogenic bacteria, fungi, protozoa, multi-cellular parasites, and aberrant proteins known as prions. The degree of spread of a communicable disease depends on both the ability of an organism to enter, survive and multiply in the host and the comparative ease with which the disease is transmitted to other hosts.

Some ways in which communicable diseases spread are by:

- Travel through the air, such as tuberculosis, measles, or COVID-19;
- Physical contact with an infected person, such as through touch (staphylococcus), sexual intercourse (gonorrhea, HIV), fecal/oral transmission (hepatitis A), or droplets (influenza, TB, COVID-19);
- Contact with a contaminated surface or object (Norwalk virus), food (salmonella, E. coli), blood (HIV, hepatitis B), or water (cholera); and
- Bites from insects or animals capable of transmitting the disease (mosquito: malaria and yellow fever; flea: plague)

Collectively, the twenty-three (23) campuses and Chancellor’s Office of the California State University (CSU) system have identified nine (9) communicable disease hazards that have had significant impacts on their respective student, faculty, and staff populations. Of these communicable diseases, COVID-19 is considered to be the most prominent and widespread agent across all CSU campuses. (See Table 19-2 below.)


Table 19-2: Communicable Diseases at Identified CSU Campuses

<table>
<thead>
<tr>
<th>Collective List of Communicable Diseases Identified by All CSU Campuses</th>
<th>Number of CSU Campuses (Including Chancellor’s Office) Identifying Communicable Disease Having Significant Impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>COVID-19 (SARS-CoV-2)</td>
<td>24</td>
</tr>
<tr>
<td>Meningitis</td>
<td>7</td>
</tr>
<tr>
<td>Measles</td>
<td>6</td>
</tr>
<tr>
<td>Influenza (Including H1N1/Swine Flu)</td>
<td>6</td>
</tr>
<tr>
<td>Tuberculosis</td>
<td>5</td>
</tr>
<tr>
<td>Norovirus</td>
<td>4</td>
</tr>
<tr>
<td>Mumps</td>
<td>2</td>
</tr>
<tr>
<td>E. Coli</td>
<td>2</td>
</tr>
<tr>
<td>Sexually Transmitted Diseases (STDs)</td>
<td>2</td>
</tr>
</tbody>
</table>

(Source: Interviews with CSU campus staff at CSU campuses and at CSU Chancellor’s Office.)

With the exception of COVID-19, there is variability among CSU campuses regarding which communicable diseases have had the greatest impact on individual campus communities. Table 19-3 shows the communicable disease hazards that have had the greatest impact on each CSU campus.

Table 19-3: Communicable Disease Hazards at CSU Campuses with Greatest Impact

<table>
<thead>
<tr>
<th>CSU Campus</th>
<th>Identified Communicable Disease Hazards with the Greatest Impact on CSU Campus</th>
</tr>
</thead>
<tbody>
<tr>
<td>CSU Bakersfield</td>
<td>COVID-19, Meningitis</td>
</tr>
<tr>
<td>CSU Channel Islands</td>
<td>COVID-19, Measles</td>
</tr>
<tr>
<td>Chico State</td>
<td>COVID-19, Tuberculosis</td>
</tr>
<tr>
<td>CSU Dominguez Hills</td>
<td>COVID-19</td>
</tr>
<tr>
<td>Cal State East Bay</td>
<td>COVID-19, Meningitis</td>
</tr>
<tr>
<td>Fresno State</td>
<td>COVID-19, Meningitis, Tuberculosis</td>
</tr>
<tr>
<td>Cal State Fullerton</td>
<td>COVID-19, Influenza</td>
</tr>
<tr>
<td>Humboldt State</td>
<td>COVID-19, Measles, Norovirus, Influenza, STDs</td>
</tr>
<tr>
<td>Cal State Long Beach</td>
<td>COVID-19</td>
</tr>
<tr>
<td>Institution</td>
<td>Communicable Disease</td>
</tr>
<tr>
<td>-----------------------------</td>
<td>-----------------------</td>
</tr>
<tr>
<td>Cal State LA</td>
<td>COVID-19, E. coli, Measles</td>
</tr>
<tr>
<td>Cal Maritime</td>
<td>COVID-19</td>
</tr>
<tr>
<td>CSU Monterey Bay</td>
<td>COVID-19</td>
</tr>
<tr>
<td>CSUN (Northridge)</td>
<td>COVID-19, Measles</td>
</tr>
<tr>
<td>Cal Poly Pomona</td>
<td>COVID-19, Influenza (Swine Flu - H1N1)</td>
</tr>
<tr>
<td>Sacramento State</td>
<td>COVID-19</td>
</tr>
<tr>
<td>Cal State San Bernardino</td>
<td>COVID-19, Tuberculosis</td>
</tr>
<tr>
<td>San Diego State</td>
<td>COVID-19, Meningitis, Mumps</td>
</tr>
<tr>
<td>San Francisco State</td>
<td>COVID-19</td>
</tr>
<tr>
<td>San José State</td>
<td>COVID-19, H1N1</td>
</tr>
<tr>
<td>Cal Poly San Luis Obispo</td>
<td>COVID-19, Meningitis, Norovirus</td>
</tr>
<tr>
<td>CSU San Marcos</td>
<td>COVID-19</td>
</tr>
<tr>
<td>Sonoma State</td>
<td>COVID-19, H1N1, Norovirus</td>
</tr>
<tr>
<td>Stanislaus State</td>
<td>COVID-19, Tuberculosis</td>
</tr>
<tr>
<td>Office of the Chancellor</td>
<td>COVID-19</td>
</tr>
<tr>
<td>CSU System-Wide</td>
<td>COVID-19, Meningitis, Measles, Tuberculosis, Influenza-Swine Flu-H1N1, Mumps, Norovirus, E. coli, STDs</td>
</tr>
</tbody>
</table>

(Source: Interviews with CSU campus staff at CSU campuses and at CSU Chancellor’s Office.)

**Descriptions of Identified Communicable Disease Hazards at CSU San Bernardino**

CSU San Bernardino has identified two (2) communicable disease hazards that have had the greatest impact on campus – COVID-19 and Tuberculosis. The following are brief descriptions of the communicable disease hazards at CSU San Bernardino.

**COVID-19 (SARS-CoV-2)**

Coronaviruses are a family of viruses that can cause illnesses such as the common cold, severe acute respiratory syndrome (SARS) and Middle East respiratory syndrome (MERS). In 2019, a new coronavirus was identified as the cause of a disease outbreak that originated in China. This virus is now known as the **severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2)**. The disease it causes is called Coronavirus Disease 2019 (COVID-19). In March 2020, the World Health Organization (WHO) declared the COVID-19 outbreak a pandemic.
Signs and symptoms of coronavirus disease 2019 (i.e., COVID-19) may appear two to 14 days after exposure. Common signs and symptoms can include fever, cough, and tiredness. Early symptoms of COVID-19 may also include a loss of taste or smell.

The virus that causes COVID-19 spreads easily among people, and more continues to be discovered over time about how it spreads. Data has shown that the COVID-19 virus spreads mainly from person to person among those in close contact (within about 6 feet, or 2 meters). The virus is transmitted by respiratory droplets being released when someone with the virus coughs, sneezes, breathes, sings or talks. These droplets can be inhaled or land in the mouth, nose or eyes of a person nearby. In some situations, the COVID-19 virus can spread by a person being exposed to small droplets or aerosols that stay in the air for several minutes or hours (i.e., airborne transmission). It's not yet known how common it is for the virus to spread this way. The COVID-19 virus can also spread if a person touches a surface or object with the virus on it and then touches his or her mouth, nose or eyes; however, this is not considered to be a main way it spreads.

The severity of COVID-19 symptoms can range from very mild to severe. Some people may have only a few symptoms, and some people may have no symptoms at all. However, some people may experience worsened symptoms, such as worsened shortness of breath and pneumonia. People who are older have a higher risk of serious illness from COVID-19, and the risk increases with age. People who have existing medical conditions also may have a higher risk of serious illness from COVID-19. In some cases, the disease can cause severe medical complications and may even lead to death.  

**Tuberculosis**

Tuberculosis (TB) is a potentially serious infectious disease that mainly affects the lungs. Tuberculosis is caused by bacteria that spread from person to person through microscopic droplets released into the air. This can happen when someone with the untreated, active form of tuberculosis coughs, speaks, sneezes, spits, laughs or sings.

Although tuberculosis is contagious, it's not easy to catch. It is more likely for someone to get tuberculosis from a close family member or coworker than from a stranger. Most people with active TB who have had appropriate drug treatment for at least two weeks are no longer contagious.

Many strains of tuberculosis resist the drugs most used to treat the disease. People with active tuberculosis must take several types of medications for many months to eradicate the infection and prevent development of antibiotic resistance. 

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Location of the Hazard

Communicable diseases have the potential to affect the entire CSU San Bernardino (CSUSB) planning area equally. As a result, the communicable disease hazard can be found both at the CSU San Bernardino (CSUSB) main campus located in San Bernardino, CA (San Bernardino County), and at the CSUSB satellite campus in Palm Desert, CA (Riverside County). Because of the ubiquitous nature of many communicable diseases, students, faculty, staff at (and visitors to) both CSUSB locations are at risk of exposure to the communicable disease hazard.

CSU Student Housing Locations and Populations

Although CSU-campus-owned student housing opportunities have been severely limited due to the COVID-19 pandemic, this situation is temporary. Eventually, students will be allowed back on campus at full capacity, and many of these students will be living in campus-owned housing. When this occurs, over 53,000 students (i.e., just over 11% of the CSU total enrollment) will be at increased risk of exposure to communicable disease hazards, owing to the “close-quarters” living arrangements in student housing. For CSU San Bernardino, approximately 8% of its 20,311 enrolled students (or 1,625 students) reside in student housing.  

Extent of the Hazard

Various communicable diseases are categorized by the Center for Disease Control and Prevention (CDC) by levels of containment called Biosafety Levels (or BSLs). The higher the BSL, the greater the level of containment and level of effort necessary to prevent transmission of the disease, and therefore the greater the hazard. Biosafety Levels prescribe procedures and levels of containment for a particular microorganism or material (including research involving recombinant or synthetic nucleic acid molecules) and procedures associated with that containment. BSLs also consider primary barriers (e.g., biosafety cabinets), secondary barriers, facility design, air handling, laboratory security, etc. BSLs are graded from 1 to 4; as the BSL increases so does the relative risk of the agent/procedures as well the stringency of procedures and facility design.

Figure 19-1 describes the different BSLs, and provides examples of communicable diseases that would typically fall in to these classifications, as well as the typical protections that would be necessary to prevent transmission of each of the diseases.

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8 California State University. CSU Campus Match. Retrieved 04.30.2021 from: https://www2.calstate.edu/attend/campuses/campus-match/Pages/campus-match.aspx
The Extent of CSU San Bernardino Communicable Disease Hazards Except COVID-19:

Before the COVID-19 pandemic, there were cases of Tuberculosis at CSU San Bernardino. Tuberculosis would be classified at either the BSL-2 or BSL-3 containment level.  

The Extent of CSU San Bernardino COVID-19 Communicable Disease Hazard:

As a microorganism, the SARS-CoV-2 (COVID-19) virus requires a high level of containment. It is therefore classified at BSL-3. 

History of the Hazard

Most communicable disease data are maintained by at the state and at the county levels, and are not generally available at the municipal or campus levels, unless (a) the CSU campus falls under the jurisdiction of a city-level health department, or (b) a geographically specific outbreak occurs on campus or in the local community. The exception to this is the current COVID-19 pandemic, where both campus and County-level case data have been collected. As a result, it is important to provide COVID-19 case statistics for both CSU campuses and the counties where CSU campus assets are located.

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Table 19-5 shows county-level COVID-19 case data for San Bernardino County and Riverside County. County case data are updated on at least a weekly basis. No campus-level COVID-19 case data could be found for CSU Bernardino. (Please note that the COVID-19 case numbers here may not reflect the most recent updates.)

Table 19-4: Confirmed COVID-19 Statistics for San Bernardino and Riverside Counties (as of 03/22/2021)\(^{12}\)

<table>
<thead>
<tr>
<th>County</th>
<th>Cases</th>
<th>Deaths</th>
</tr>
</thead>
<tbody>
<tr>
<td>San Bernardino</td>
<td>289,846</td>
<td>3,692</td>
</tr>
<tr>
<td>Riverside</td>
<td>292,967</td>
<td>4,117</td>
</tr>
</tbody>
</table>

Potential Impacts of the Hazard

Communicable disease outbreaks and pandemics potentially have (and will continue to have) direct impact on life, health, and safety across the CSU system, including CSU – San Bernardino. The extent of this impact is contingent on the type of infection or contagion, the severity of the outbreak, and the speed at which it is transmitted. Property and infrastructure integrity may be affected if large portions of campus population contract communicable diseases at the same time and are therefore unable to perform maintenance, operations, and educational tasks. This would be particularly disruptive if those impacted are first responders or other essential personnel. Long-term outbreaks affecting large numbers of CSU San Bernardino students could result in cancelled classes, delayed matriculation, or other disruptions to the CSU System’s mission. This has already occurred with the current COVID-19 pandemic, and could occur again with more virulent strains of communicable diseases, including COVID-19.

Communicable disease hazards found across the CSU system (including CSU San Bernardino) vary both by level of containment (BSL) (described previously) and by level of individual/public health risk, or Risk Group (RG) level. While BSLs describe the procedures and required levels of containment in a laboratory setting, Risk Groups (RGs) reflect the potential effects of disease exposure on humans or animals. Like BSLs, RGs range from Level 1 (RG1) to Level 4 (RG4), with Level 1 (RG1) posing minimal risk to healthy individuals and public health and Level 4 (RG4) posing a very serious or extreme risks to individuals and public. BSLs generally correlate with Risk Group (RG) Levels (e.g., a RG2 agent is worked with at BSL-2), but there are exceptions (e.g., production volumes, high-risk procedures, etc.). \(^{13}\)


Table 19-5: WHO Risk Group Categorization

<table>
<thead>
<tr>
<th>Risk Group (RG)</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>RG1</td>
<td>Rarely associated with disease in healthy adult humans or animals and pose no-to-little public health risk (e.g., Saccharomyces cerevisiae, E. coli K-12 strain derivatives often used for recombinant/molecular biology, many environmental organisms)</td>
</tr>
<tr>
<td>RG2</td>
<td>Associated with mild to moderate disease for which preventative measures or post exposure treatments are often available; public health impact is limited (e.g., Streptococcus pyogenes, Salmonella, hepatitis B virus)</td>
</tr>
<tr>
<td>RG3</td>
<td>Associated with serious to lethal human disease for which preventative vaccines or post-exposure therapies may be scarce. Public health impact is limited-to-moderate (e.g., Mycobacterium tuberculosis, hantaviruses, West Nile virus, SARS)</td>
</tr>
<tr>
<td>RG4</td>
<td>Associated with serious to lethal human disease for which preventative vaccines or post exposure therapies are not usually available. Public health impact is high (e.g., Ebola virus, Marburg virus, smallpox virus, etc.)</td>
</tr>
</tbody>
</table>

Table 19-7 describes the four (4) Risk Group Levels (RGs), and provides examples of communicable diseases that would typically fall in to these classifications, and the typical protections that would be necessary to prevent transmission of the disease. It is important to note that all but two (2) communicable disease hazards identified by CSU campuses fall under either the lower-risk RG1 or RG2 categories. COVID-19 and tuberculosis are the two (2) communicable diseases fall under the higher-risk RG3 category. However, with the advent of the recently-developed COVID-19 vaccine, and with the expectation of an increasingly robust vaccine supply, it is possible that the RG level for COVID-19 could be lowered in the future, thereby reducing both the extent and the potential impact of COVID-19.

Table 19-6: Risk Group Levels (RGs) with Example Diseases and Recommended Precautions

<table>
<thead>
<tr>
<th>Level</th>
<th>Examples</th>
<th>Typical Protection to Prevent Transmission</th>
</tr>
</thead>
<tbody>
<tr>
<td>RG I</td>
<td>E. Coli</td>
<td>Precautions are minimal, most likely involving gloves and some sort of facial protection. Usually, contaminated materials are left in open (but separately indicated) waste receptacles. Decontamination procedures for this level are similar in most respects to modern precautions against everyday viruses (i.e.: washing one’s hands with anti-bacterial soap, washing all exposed surfaces of the lab with disinfectants, etc.).</td>
</tr>
<tr>
<td>RG 2</td>
<td>Chicken Pox, Hepatitis A, B, C, Lyme disease, Salmonella, Mumps, Measles, Malaria, Scrapie, Dengue Fever, HIV</td>
<td>These bacteria and viruses cause mild disease in humans or are difficult to contract via aerosol. Routine diagnostic work with clinical specimens can be done safely at BSL-2, using BSL-2 practices and procedures.</td>
</tr>
</tbody>
</table>

---

### RG 3

<table>
<thead>
<tr>
<th>Anthrax</th>
<th>West Nile Virus</th>
</tr>
</thead>
<tbody>
<tr>
<td>SARS Virus (Including COVID-19)</td>
<td>Tuberculosis</td>
</tr>
<tr>
<td>Typhus</td>
<td>Yellow Fever</td>
</tr>
<tr>
<td>Hantaviruses</td>
<td>Avian Flu</td>
</tr>
</tbody>
</table>

These bacteria and viruses cause severe to fatal disease in human, but vaccines or other treatments do exist to combat them. Laboratory personnel have specific training in handling pathogenic and potentially lethal agents and are supervised by competent scientists who are experienced in working with these agents. This is considered a neutral or warm zone.

### RG 4

<table>
<thead>
<tr>
<th>H5N1 (Bird Flu)</th>
<th>Dengue Hemorrhagic Fever</th>
</tr>
</thead>
<tbody>
<tr>
<td>Marburg Virus</td>
<td>Ebola Virus</td>
</tr>
<tr>
<td>Smallpox</td>
<td>Lassa Fever</td>
</tr>
<tr>
<td>Crimean-Congo Hemorrhagic Fever</td>
<td>Other Hemorrhagic Diseases</td>
</tr>
</tbody>
</table>

These viruses and bacteria cause severe to fatal disease in humans, for which vaccines or other treatments are *not* available. When dealing with biological hazards at this level the use of a Hazmat suit and a self-contained oxygen supply is mandatory. The entrance and exit of a BSL-4 lab will contain multiple showers, a vacuum room, an ultraviolet light room, autonomous detection system, and other safety precautions designed to destroy all traces of the biohazard. Multiple airlocks are employed and are electronically secured to prevent both doors opening at the same time. All air and water service going to and coming from a BSL-4 lab will undergo similar decontamination procedures to eliminate the possibility of an accidental release.

### Probability of Future Occurrence of the Hazard

There are significant data limitations regarding non-COVID-19 communicable disease cases, as the information thereof is outdated, anecdotal, and/or inadequate. As a result, it is not feasible to provide quantitative probabilities of future occurrence for non-COVID-19 communicable disease hazards. However, based on the limited data, it is feasible to present qualitative probabilities of future occurrence based on ranges of communicable disease frequency. Table 19-8 shows a probability scale of future occurrence for the nine (9) communicable disease hazards profiled in this assessment. This scale is divided into four (4) levels of probability:
Table 19-7: Likelihood of Future Hazard Occurrence

<table>
<thead>
<tr>
<th>Likelihood</th>
<th>Parameters for Determining Likelihood</th>
</tr>
</thead>
<tbody>
<tr>
<td>Highly Likely</td>
<td>76 – 100% probability that hazard will occur annually (high to very high frequency)</td>
</tr>
<tr>
<td>Likely</td>
<td>50 – 75% probability that hazard will occur annually (moderate to high frequency)</td>
</tr>
<tr>
<td>Possible</td>
<td>11 – 49% probability that hazard will occur annually (low to moderate frequency)</td>
</tr>
<tr>
<td>Unlikely</td>
<td>0 – 10% probability that hazard will occur annually (very low to low frequency)</td>
</tr>
</tbody>
</table>

Due to significant data limitations surrounding non-COVID communicable diseases, the probability of future occurrence of CSU-system-wide communicable disease is measured by the proportion of campuses that have identified a particular communicable disease as having an impact on the campus community. In this measure, the more frequent a communicable disease is seen as impactful CSU-wide, the greater the probability of future occurrence. Note: Each communicable disease’s probability of future occurrence ranking CSU-system-wide reflects the ranking at the individual CSU campus level unless noted otherwise.

Table 19-8: Probability of Future Occurrence of Communicable Disease Hazard for CSU System

<table>
<thead>
<tr>
<th>Collective List of Communicable Diseases Identified by All CSU Campuses</th>
<th>Number of CSU Campuses (Including Chancellor’s Office) Identifying Communicable Disease Having Significant Impact</th>
<th>Proportion of CSU Campuses Identifying Communicable Disease as Having Significant Impact System-Wide</th>
<th>CSU System-Wide Probability Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>COVID-19 (SARS-CoV-2)</td>
<td>24</td>
<td>1.00</td>
<td>Highly Likely</td>
</tr>
<tr>
<td>Meningitis</td>
<td>7</td>
<td>0.29</td>
<td>Possible</td>
</tr>
<tr>
<td>Measles</td>
<td>6</td>
<td>0.25</td>
<td>Possible</td>
</tr>
<tr>
<td>Influenza (Including H1N1/Swine Flu)</td>
<td>6</td>
<td>0.25</td>
<td>Possible</td>
</tr>
<tr>
<td>Tuberculosis</td>
<td>5</td>
<td>0.21</td>
<td>Possible</td>
</tr>
<tr>
<td>Norovirus</td>
<td>4</td>
<td>0.17</td>
<td>Possible</td>
</tr>
<tr>
<td>Mumps</td>
<td>2</td>
<td>0.08</td>
<td>Unlikely</td>
</tr>
<tr>
<td>E. Coli</td>
<td>2</td>
<td>0.08</td>
<td>Unlikely</td>
</tr>
</tbody>
</table>
Sexually Transmitted Diseases (STDs) | 2 | 0.08 | Unlikely

(Source: Interviews with staff at CSU campuses and at the CSU Chancellor’s Office.)

Vulnerability to the Hazard

Vulnerability to a communicable diseases hazard resides in the population of a given area – both human and animal – not in the infrastructure or physical assets. While CSU assets and infrastructure could be impacted indirectly by the communicable disease hazard, these impacts would be secondary to the impact that the communicable disease hazard would have on students, faculty, staff, and visitors at the CSU San Bernardino campus.

CSU campus settings are geographically diverse, with locations ranging from small towns to medium-sized cities to densely populated urban areas. Hundreds of thousands of people work, study, and/or pass through CSU campuses on any given day. (As of Fall 2019, the CSU- San Bernardino had 20,311 students and additional faculty and staff.) Each of these persons is vulnerable to communicable disease, particularly if it is a pathogen that individual has not been immunized against, or for which no immunization exists. Prolonged outbreaks could result in a loss of services, failure of infrastructure (from lack of operators or maintenance), and closure of facilities. This exact scenario has played out in the current COVID-19 pandemic on the CSU San Bernardino campus.

Estimate of Potential Losses

COVID-19 Pandemic Health Impact on CSU Campuses and Surrounding Communities

The most prescient metric for estimating losses from COVID-19 is loss of life. The nationwide campus-related COVID-19 death rate of 0.02% remains well below the average COVID-19 death rate in the U.S. However, due to data limitations, there is no information on CSU-campus-specific deaths by COVID-19 or by any other communicable diseases. In fact, COVID-19 is the only communicable disease for which case reports have been readily available for CSU campuses.

At some point in the future, CSU campuses will return to full capacity. Without adequate surveillance regarding campus access and student and employee interaction, CSU campuses (including CSU San Bernardino) are at risk of developing an extreme incidence of COVID-19, and may become “super-spreaders” for adjacent communities. The emergence of more virulent COVID-19 variants would only add to the potential for high

16 The California State University. Enrollment. Retrieved 05.03.2021 from: https://www2.calstate.edu/csu-system/about-the-csu/facts-about-the-csu/enrollment/Pages/default.aspx
17 The California State University. Employee Head Count by Campus. Retrieved 05.03.2021 from: https://www2.calstate.edu/csu-system/faculty-staff/employee-profile/csu-workforce/Pages/employee-headcount-by-campus.aspx
negative impacts on life safety, operations, and service delivery across the CSU system. (Other communicable diseases would also re-emerge, but with low to moderate negative impacts on life safety, operations, and service delivery.)

**Economic Impact of COVID-19 Pandemic on CSU Financial Health**

During the first few months of the COVID-19 pandemic in 2020, the CSU system suffered tremendous negative fiscal impacts. From March through July of 2020 alone, over $146 million worth of revenue losses were sustained across the CSU system due to refunds to students for parking, housing and dining service fees during Spring Semester, 2020. (See Figure 19-2 below for the economic impact to the campus). Several CSU campuses saw refund losses surpass $10 million. (See Figure 19-2.)

Figure 19-2: CSU COVID-19 Cost Tracking Showing Revenue Refund Losses and Increased Costs

<table>
<thead>
<tr>
<th>Department of Finance – BL 20-07 – COVID-19 Cost Tracking</th>
</tr>
</thead>
<tbody>
<tr>
<td>At 31 July 2020 (Dollars in Thousands)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Absorbable</th>
<th>Non-Absorbable</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Estimated Cost (within department operations)</td>
<td>Total Estimated Extraordinary Cost</td>
</tr>
<tr>
<td>3,461</td>
<td>8,597</td>
</tr>
<tr>
<td>3,035</td>
<td>30,828</td>
</tr>
<tr>
<td>47,521</td>
<td>146,149</td>
</tr>
<tr>
<td>194,079</td>
<td></td>
</tr>
</tbody>
</table>

| Campus | State Agency Code | Total Estimated Cost (within department operations) | Total Estimated Extraordinary Cost |
|--------|-------------------|----------------------------------------------------|
| Bakerfield | 6650 | - | 1,377 |
| Chancellor’s Office | 6620 | - | 27 |
| Channel Islands | 6890 | - | - |
| Chico | 6080 | - | 352 |
| Dominguez Hills | 4608 | 1 | 567 |
| East Bay | 6762 | - | 1,217 |
| Fresno | 6700 | - | 2,206 |
| Fullerton | 4730 | 30 | 4,935 |
| Humboldt | 6730 | - | 1,026 |
| Long Beach | 6740 | - | 2 |
| Los Angeles | 6750 | - | 1,480 |
| Maritime Academy | 4752 | - | 254 |
| Monterey Bay | 6766 | - | 1,476 |
| Northridge | 4760 | - | 17 |
| Pomona | 6770 | 3,909 | 21 |
| Sacramento | 6770 | - | 1,985 |
| San Bernardino | 6660 | - | 300 |
| San Diego | 6790 | 89 | 5,851 |
| San Francisco | 6800 | 5 | 3,283 |
| San Jose | 6810 | - | 3,615 |
| San Luis Obispo | 6820 | - | 810 |
| San Marcos | 6840 | - | 522 |
| Sonoma | 6830 | 470 | 340 |
| Stanislaus | 6670 | - | 1,020 |

**Mitigative Relief from Federal Assistance**

The $1.5 billion in total federal assistance sent to the CSU system will help relieve the losses of revenues from services like dorms, parking and dining services during a year of mainly empty campuses. (See Table 19-10.) However, because of staggering COVID-related revenue losses, the CSU system is planning for three (3) years of fiscal duress.


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Table 19-9: Total Federal Assistance to CSU for COVID-19 Related Losses, 2020 – 2021

<table>
<thead>
<tr>
<th>Institution</th>
<th>December 2020 Stimulus</th>
<th>CARES Act</th>
<th>APLU Projection of HEERF Total ARP Act Funding Allocation</th>
<th>Total Estimated Federal COVID Relief Funding</th>
</tr>
</thead>
<tbody>
<tr>
<td>California Polytechnic State University</td>
<td>$20,752,799</td>
<td>$14,725,000</td>
<td>$37,000,928</td>
<td>$72,478,727</td>
</tr>
<tr>
<td>California State Polytechnic University, Pomona</td>
<td>$48,614,353</td>
<td>$31,102,000</td>
<td>$86,044,649</td>
<td>$165,761,002</td>
</tr>
<tr>
<td>California State University Channel Islands</td>
<td>$14,288,099</td>
<td>$8,512,000</td>
<td>$24,915,170</td>
<td>$47,715,269</td>
</tr>
<tr>
<td>California State University Maritime Academy</td>
<td>$1,381,700</td>
<td>$1,204,000</td>
<td>$2,472,622</td>
<td>$5,058,322</td>
</tr>
<tr>
<td>California State University - Sacramento</td>
<td>$59,891,260</td>
<td>$35,643,000</td>
<td>$104,900,133</td>
<td>$200,434,393</td>
</tr>
<tr>
<td>California State University, Bakersfield</td>
<td>$22,855,632</td>
<td>$12,483,000</td>
<td>$40,285,565</td>
<td>$75,624,197</td>
</tr>
<tr>
<td>California State University, Chico</td>
<td>$31,603,856</td>
<td>$20,019,000</td>
<td>$55,754,538</td>
<td>$107,377,394</td>
</tr>
<tr>
<td>California State University, Dominguez Hills</td>
<td>$31,843,563</td>
<td>$18,312,000</td>
<td>$55,915,410</td>
<td>$106,070,973</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>University</th>
<th>Total Revenue</th>
<th>State Assistance</th>
<th>Match</th>
<th>Total Expenses</th>
</tr>
</thead>
<tbody>
<tr>
<td>California State University, East Bay</td>
<td>$24,243,652</td>
<td>$14,394,000</td>
<td>$42,929,208</td>
<td>$81,566,860</td>
</tr>
<tr>
<td>California State University, Fresno</td>
<td>$52,725,317</td>
<td>$32,557,000</td>
<td>$92,926,594</td>
<td>$178,208,911</td>
</tr>
<tr>
<td>California State University, Fullerton</td>
<td>$67,736,949</td>
<td>$41,088,000</td>
<td>$120,859,884</td>
<td>$229,684,833</td>
</tr>
<tr>
<td>California State University, Long Beach</td>
<td>$67,421,424</td>
<td>$41,202,000</td>
<td>$119,508,329</td>
<td>$228,131,753</td>
</tr>
<tr>
<td>California State University, Los Angeles</td>
<td>$61,905,561</td>
<td>$40,067,000</td>
<td>$108,543,672</td>
<td>$210,516,233</td>
</tr>
<tr>
<td>California State University, Monterey Bay</td>
<td>$13,455,716</td>
<td>$8,705,000</td>
<td>$23,922,768</td>
<td>$46,083,484</td>
</tr>
<tr>
<td>California State University, Northridge</td>
<td>$74,004,088</td>
<td>$47,458,000</td>
<td>$131,021,450</td>
<td>$252,483,538</td>
</tr>
<tr>
<td>California State University, San Bernardino</td>
<td>$42,438,131</td>
<td>$27,924,000</td>
<td>$74,982,459</td>
<td>$145,344,590</td>
</tr>
<tr>
<td>California State University, San Marcos</td>
<td>$26,602,684</td>
<td>$15,542,000</td>
<td>$46,496,808</td>
<td>$88,641,492</td>
</tr>
<tr>
<td>California State University, Stanislaus</td>
<td>$22,007,207</td>
<td>$12,928,000</td>
<td>$38,636,391</td>
<td>$73,571,598</td>
</tr>
<tr>
<td>Humboldt State University</td>
<td>$16,130,016</td>
<td>$11,146,000</td>
<td>$28,831,619</td>
<td>$56,107,635</td>
</tr>
<tr>
<td>San Diego State University</td>
<td>$45,914,127</td>
<td>$30,394,000</td>
<td>$80,592,385</td>
<td>$156,900,512</td>
</tr>
<tr>
<td>San Francisco State University</td>
<td>$47,404,409</td>
<td>$30,000,000</td>
<td>$83,075,470</td>
<td>$160,479,879</td>
</tr>
<tr>
<td>San Jose State University</td>
<td>$46,631,939</td>
<td>$30,977,000</td>
<td>$82,976,130</td>
<td>$160,585,069</td>
</tr>
<tr>
<td>Sonoma State University</td>
<td>$13,980,795</td>
<td>$9,153,000</td>
<td>$24,732,994</td>
<td>$47,866,789</td>
</tr>
</tbody>
</table>
Vulnerability Assessment Conclusions

Before the COVID-19 pandemic, populations at all CSU campuses and CSU-affiliated facilities were substantial. Collectively, as of Fall 2019, CSU campuses had 480,541 students and 53,763 faculty and staff. All were at risk from the communicable disease events, with 534,304 people being directly vulnerable. The COVID-19 pandemic has caused campus population numbers to plummet to a small fraction of full capacity.

At some point in the future, campus population numbers will return to their pre-pandemic levels, and students, faculty, and staff will again be vulnerable to the communicable disease hazard. If just 10% of the total CSU population were to become ill with a highly infective communicable disease like influenza or another strain of SARS, this would mean that approximately 53,430 people would be sick at the same time. This scenario would likely overwhelm available on-campus medical services could even overwhelm portions of the larger community’s medical resources – especially if there were large numbers of infected people with immune system compromises or other underlying health problems. Table 19-11 shows the “10% outbreak scenario” projections both for each CSU campus and for the entire CSU system.

See Table 19-11 below for the “10% outbreak scenario” projections both for each CSU campus and for the entire CSU system.

Table 19-10: Scenario of Communicable Disease Hazard Affecting 10% of the CSU Population

<table>
<thead>
<tr>
<th>CSU Campus</th>
<th>Approximate Enrollment Population (Fall 2019)</th>
<th>Approximate Total FT/PT Faculty/Staff Population (Fall 2019)</th>
<th>Total Combined Approximate Student and Faculty/Staff Population</th>
<th>10% Outbreak Scenario (Students and Faculty/Staff Combined)</th>
</tr>
</thead>
<tbody>
<tr>
<td>CSU Bakersfield</td>
<td>11,199</td>
<td>1,277</td>
<td>12,476</td>
<td>1,248</td>
</tr>
<tr>
<td>CSU Channel Islands</td>
<td>7,093</td>
<td>994</td>
<td>8,087</td>
<td>809</td>
</tr>
<tr>
<td>Chico State</td>
<td>17,019</td>
<td>1,969</td>
<td>18,988</td>
<td>1,899</td>
</tr>
<tr>
<td>CSU Dominguez Hills</td>
<td>17,027</td>
<td>1,761</td>
<td>18,788</td>
<td>1,879</td>
</tr>
</tbody>
</table>


<table>
<thead>
<tr>
<th>Institution</th>
<th>Freshmen</th>
<th>Juniors</th>
<th>Seniors</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cal State East Bay</td>
<td>14,705</td>
<td>1,764</td>
<td>16,469</td>
<td>1,647</td>
</tr>
<tr>
<td>Fresno State</td>
<td>24,139</td>
<td>2,534</td>
<td>26,673</td>
<td>2,667</td>
</tr>
<tr>
<td>Cal State Fullerton</td>
<td>39,868</td>
<td>3,736</td>
<td>43,604</td>
<td>4,360</td>
</tr>
<tr>
<td>Humboldt State</td>
<td>6,983</td>
<td>1,171</td>
<td>8,154</td>
<td>815</td>
</tr>
<tr>
<td>Cal State Long Beach</td>
<td>38,074</td>
<td>4,004</td>
<td>42,078</td>
<td>4,208</td>
</tr>
<tr>
<td>Cal State LA</td>
<td>26,361</td>
<td>2,821</td>
<td>29,182</td>
<td>2,918</td>
</tr>
<tr>
<td>Cal Maritime</td>
<td>911</td>
<td>329</td>
<td>1,240</td>
<td>124</td>
</tr>
<tr>
<td>CSU Monterey Bay</td>
<td>7,123</td>
<td>1,059</td>
<td>8,182</td>
<td>818</td>
</tr>
<tr>
<td>CSUN (Northridge)</td>
<td>38,391</td>
<td>3,832</td>
<td>42,223</td>
<td>4,222</td>
</tr>
<tr>
<td>Cal Poly Pomona</td>
<td>27,914</td>
<td>2,650</td>
<td>30,564</td>
<td>3,056</td>
</tr>
<tr>
<td>Sacramento State</td>
<td>31,156</td>
<td>3,228</td>
<td>34,384</td>
<td>3,438</td>
</tr>
<tr>
<td>Cal State San Bernardino</td>
<td>20,311</td>
<td>2,118</td>
<td>22,429</td>
<td>2,243</td>
</tr>
<tr>
<td>San Diego State</td>
<td>35,081</td>
<td>3,702</td>
<td>38,783</td>
<td>3,878</td>
</tr>
<tr>
<td>San Francisco State</td>
<td>28,880</td>
<td>3,401</td>
<td>32,281</td>
<td>3,228</td>
</tr>
<tr>
<td>San José State</td>
<td>33,282</td>
<td>3,568</td>
<td>36,850</td>
<td>3,685</td>
</tr>
<tr>
<td>Cal Poly San Luis Obispo</td>
<td>21,242</td>
<td>2,871</td>
<td>24,113</td>
<td>2,411</td>
</tr>
<tr>
<td>CSU San Marcos</td>
<td>14,519</td>
<td>1,687</td>
<td>16,206</td>
<td>1,621</td>
</tr>
<tr>
<td>Sonoma State</td>
<td>8,649</td>
<td>1,338</td>
<td>9,987</td>
<td>999</td>
</tr>
<tr>
<td>Stanislaus State</td>
<td>10,614</td>
<td>1,276</td>
<td>11,890</td>
<td>1,189</td>
</tr>
<tr>
<td>Office of the Chancellor</td>
<td>0</td>
<td>673</td>
<td>673</td>
<td>67</td>
</tr>
<tr>
<td><strong>CSU System-Wide</strong></td>
<td><strong>480,541</strong></td>
<td><strong>53,763</strong></td>
<td><strong>534,304</strong></td>
<td><strong>53,430</strong></td>
</tr>
</tbody>
</table>

*Note: Enrollment figures do not include non-specific CSU campus International Programs (455 students) or CALStateTEACH Program (933 students).*

While the case numbers of COVID-19 have been significantly lower (about 1% of the total CSU population) than those in the 10% scenario, the degree of virulence and resultant morbidity and mortality caused by COVID-19 have led to widespread campus shutdowns, educational disruption, and economic harm to the CSU system, including CSU San Bernardino. In short, the real-time COVID-19 communicable disease outbreak scenario has proven far more devastating than the 10% simulated scenario.
Identified Data Limitations

There is a wealth of technical information available for communicable disease. However, there is also limited non-COVID-19 communicable disease data available regarding risk or vulnerability of specific populations throughout the CSU. Much of the data that does exist is protected by privacy policies, and therefore cannot be obtained for more specific populations. As a result, performing a detailed quantitative assessment for this hazard is difficult.

Data that could be collected prior to the next update in order to improve this methodology includes:

- Data regarding infection rates at the campus level and for specific populations;
- Data regarding communicable disease case numbers and outcomes, by CSU campus;
- Data regarding projected population changes;
- Data regarding absenteeism; and
- Data regarding increased operating costs as a result of absenteeism (i.e., temporary shifting of duties resulting in business interruption).

Dam and Levee Failure

Description of the Hazard

A dam failure represents the structural collapse of a dam that stores water in a reservoir behind the dam. These failures are typically the result of structural age, damage to the structure caused by earthquake or flooding, inadequate discharge or spillway capacity, inadequate maintenance, improper construction materials, or extreme inflow of water into the reservoir. Prolonged precipitation may result in overtopping of the dam resulting in structural compromise. The tremendous energy generated by a sudden breach of the dam will have significant downstream effects. Flood damage resulting from dam failures potentially will result in economic losses, environmental damage, destruction of agriculture, and human casualties. This type of incident is extremely dangerous as it can occur rapidly, with no warning resulting in an inability to effectively evacuate threatened communities.

A levee failure is similar to dam failures as the result will be a breach causing flooding on the dry side of the levee. Levees are embankments whose primary purpose is to furnish flood protection from seasonal high water or divert the flow of water. Most levees in California are intended to withstand peak water levels generated by heavy precipitation or rapid snowmelt in a watershed. Other levees are designed to withstand fluctuating water levels on a continuous basis such as those in the California Delta exposed to tidal influences. Levees routinely extend for lengthy distances immediately protecting

communities. Levees can be found throughout the state but are most prominent in the Sacramento and San Joaquin Valleys.

Levee failures can vary from over toppings to small uncontrolled discharge to catastrophic failure. Areas downstream of the failure will be subject to inundation dependent on the volume of water released. These levee failures are also typically the result of structural age, damage to the structure caused by earthquake or flooding, slumping, seepage underneath the levee, high velocity flows eroding the levee, inadequate capacity, inadequate maintenance, improper construction materials, or extreme inflow of water into the system. Flood damage resulting from levee failures potentially will result in economic losses, environmental damage, destruction of agriculture, and human casualties.

A Dam or levee failure flooding will vary depending on a number of factors including the extent of the collapse or breach, the volume of water behind the structure, and the nature of the exposed downstream features. This unpredictable flooding presents a threat to life and property in addition to critical infrastructure. Lifelines and supply routes will likely be damaged or made impassible by flood erosion or standing water. Water quality and health concerns would likely be cascading effects of dam or levee failures.

Location of the Hazard

San Bernardino County is home to a variety of flood control facilities and levee systems mostly along the base of the various mountains and hills throughout the county. Levees have been constructed along flood control channels providing community protection, primarily along the Santa Ana River at the base of the San Bernardino Mountains. The CSU San Bernardino campus immediately adjacent to the dam and levee system at Devils Canyon.
There are a number of dam facilities along the base of the San Bernardino Mountains. The Devils Canyon Dike #1 Dam is immediately adjacent to the campus on the northwest side. The reservoir is not normally full and is made available to capture runoff from the Devils Canyon section of the San Bernardino Mountains. The CSU San Bernardino campus lies outside of dam inundation zones for this facility but major transportation routes south of the campus are within the inundation zone including Kendall Drive and University Parkway. The larger facilities include the Seven Oaks Dam located in San Bernardino County east of Highland on the Santa Ana River. This is a large reservoir with the potential holding capacity of 145,600-acre feet of water when full, however this lake is not normally a storage facility that routinely holds water instead used for flood control when needed. The Seven Oaks Dam does not have a direct impact on the campus but would affect the community supporting the campus.

Figure 19-4: Devils Canyon Dike #1 Dam Breach Inundation Map

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26 California Department of Water Resources, Dam Breach Inundation Map Publisher, https://fmds.water.ca.gov/webgis/?appid=dam_prototype_v2
Devils Canyon drains the eastern portion of the San Bernardino Mountains south of Crestline and Cedar Pines Park. The California Aqueduct additionally feeds into southern California near this location. There are a series of levees that extend from the dam facility that line the reservoir and extend around the northwestern corner of the campus. The levee forms the western and northern borders of the campus. The campus is located within a levee protected zone for Devils Canyon.
Extent of the Hazard

Dams are classified according to the hazard that they pose to life and property in the event of failure, rather than the likelihood of that failure.

- **High hazard potential dams** may result in loss of human life, and will likely result in economic, environmental, or lifeline losses.
- **Significant hazard potential dams** are not expected to result in loss of life, but are expected to cause economic, environmental, and lifeline losses.
- **Low hazard potential dams** are not expected to result in loss of life, and there is a low expectation of economic, environmental, or lifeline losses. What losses do occur are generally limited to the dam owner.

Dams classified as high hazard are required to have Emergency Action Plans (EAP). EAPS are formal documents that identify potential emergency conditions at the dam and specify preplanned actions to be followed in case of failure. An EAP is required for all high hazard dams and is recommended for all significant hazard dams.

Table 19-11: San Bernardino County Dams in Proximity to CSU San Bernardino

<table>
<thead>
<tr>
<th>River</th>
<th>Dam</th>
<th>Storage</th>
<th>Hazard Severity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Devils Canyon</td>
<td>Devils Canyon Dike #1</td>
<td>79af</td>
<td>High Hazard</td>
</tr>
</tbody>
</table>

The CSU San Bernardino campus lies outside of the inundation zone of the Devils Canyon Dike #1 Dam. However, the campus borders the reservoir facility. In the event of a catastrophic failure of the Devils Canyon Dike #1 Dam, the CSU San Bernardino campus is expected to remain out of the inundation area. The inundation area is expected to spread water down the discharge channel onto Kendall Dr and University Parkway, two of the primary access routes to the campus. These transportation corridors that lie within the dam inundation zone would compromise access to and from the campus affecting the ability to evacuate, gain access to emergency services, and receive supplies. The roadways expected to become inundated in a dam breach scenario would limit access to Interstate-215. Based on the above factors, the planning committee ranks the extent of the hazard as **Moderate**.

**Extent – Levee Failure**

Levees are used to contain potential water releases from the Devils Canyon Basins immediately adjacent to the campus. The CSU San Bernardino campus lies within the levee flood protected area. In the event any of these basins were filled at elevated levels and a failure of a levee were to occur, the community surrounding the campus would likely experience flood related damages. This specific hazard could alter the ability of the campus to maintain operations as damages would be extensive. Depending on the location of a breach, the campus community would be heavily affected with the loss of life and homes, access to campus would be limited, and student financial capacity to support ongoing education being diminished. Based on the above factors, the planning committee ranks the extent of the hazard as **Moderate**.

**History of the Hazard**

There are no records of dam or levee failures in areas that present a threat to the CSU San Bernardino campus. Additionally, there have been no occurrences of dam or levee

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failure threatening the Palm Desert Campus in Riverside County. San Bernardino County has not experienced dam or levee failures elsewhere in the County:

Table 19-12: San Bernardino County Dam/Levee Failures

<table>
<thead>
<tr>
<th>Date</th>
<th>Dam</th>
<th>Release</th>
<th>Damage</th>
</tr>
</thead>
<tbody>
<tr>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
</tr>
</tbody>
</table>

Potential Impacts of the Hazard

Dam Failure Impacts - Water that is released due to a dam that has failed generates tremendous energy and force causing a flood that will be catastrophic to life and property. Water levels from the failed dam could be significantly higher than those experienced in worst case scenario flood events. Areas closer to the failed dam will be more likely to experience complete devastation while other areas within the inundation zone will see varying levels of flood waters. The extent of the impacts of a failed dam would vary based on a number of factors such as the volume of water released, the base flow of the river, the time of the failure, the amount of warning provided, and the distance from the dam. Impacts resulting from a dam failure include:

- Loss of life
- Property destruction or damage
- Loss of property contents
- Infrastructure damage
- Flooded or destroyed lifelines/supply routes
- Damaged or destroyed utilities
- Loss of community economic base
- Employment losses
- Agricultural (crops and livestock) damages or destruction
- Environmental damage
- Floods generating threats to public health
- Flood generated debris

Levee Failure Impacts – A levee failure may result in substantial amounts of water to enter into developed areas protected by the levee. The force and volume of water that is generated by a levee failure may cause extensive structural damage in close proximity to the breach and effects of flooding spreading well beyond the point of the failure. The extent of the impacts would vary based on a number of factors such as the volume of water released, the time of the failure, the amount of warning provided, the location of the breach, elevation, and distance from the breach. Potential impacts resulting from a levee failure include:

- Loss of life
- Property destruction or damage
- Loss of property contents
- Infrastructure damage
- Public health hazards resulting from mold, mildew, and disease due to flood water
- Flooded or destroyed lifelines/supply routes
- Damaged or destroyed utilities
- Loss of community economic base
- Employment losses
- Agricultural (crops and livestock) damages or destruction
- Environmental damage
- Prolonged periods of necessary dewatering
- Disruptions to education delivery to community

**Probability of Future Occurrence of the Hazard**

San Bernardino County is determined to be at risk from dam and levee failure in various locations of the county. The location of the CSU San Bernardino campus in proximity to the Devils Canyon Dike (dam) demonstrates that the potential exists for future dam related issues. Portions of the neighborhoods surrounding the campus are within the dam inundation zone for the Devils Canyon Dike but flows towards the south and away from the campus. Access routes to and from the campus would be impacted by a collapse of this facility. The campus is bordered by the Devils Creek diversion levees along the west and northwest borders of the campus. The campus lies entirely within the levee protection zone. There are no official recurrence intervals that have been calculated for dam or levee failures. Based on historical experience and occurrences, the likelihood of this hazard is low.

The CSU San Bernardino, Palm Desert campus is not within proximity to any dams nor within any dam inundation zone. There are no identified levees in proximity to the Palm Desert campus and thus the campus is outside of any levee protected zone. The probability of future occurrence for both dam and levee failures is **Unlikely**.

**Vulnerability to the Hazard**

The CSU San Bernardino campus is subject to the potential effects of flooding resulting from compromised dams and levees. The effects of dam failure would likely be indirect affecting members of the campus community and regional transportation networks and services. Some flood control channels are lined by levees intended to protect the surrounding areas from rises in water level. In the case of dam failure, the amount of time to respond to the needs of the campus community prior to inundation will be limited.

The most significant challenge regarding dam failures is they generally result in catastrophic outcomes. Any breach along a levee is impossible to predict where a failure may occur. It is likely that response action will not be fully implemented until the incident situational intelligence provides adequate information as to compromised locations. These variables place all those working and living within the dam inundation and flood protection zones in vulnerable locations.
The distributed placement of levees, most near development may expose significant vulnerabilities to other areas of the region even if the campus is unaffected. There is potential the campus community will be affected as a breach may cause flooding and damages to the homes of students, faculty, and staff or to access/supply routes, utilities, or other critical services. The potential for flood damaged structures being left uninhabitable including campus residence halls will result in numerous displaced individuals and households. The lack of flood insurance will cause extreme financial burdens on those affected.

Vulnerability to a dam or levee failure on the CSU San Bernardino campus will vary depending on when the failure was to occur. The risk to the campus population will be lessened during periods when classes are not in session or during periods of breaks. Conversely, during the days and hours that classes are in session and staff are at their workplaces, the human vulnerability increases. However, in region-wide events this vulnerability may be shared with the homes and workplaces of members of the campus community and their families.

Certain campus populations will experience greater challenges to a post-flood / failure environment. Vulnerable populations will likely need to navigate through flood generated debris, face extreme health safety issues from flood waters, experience extreme stresses of a disaster, an inability to communicate to or gain access to support networks, and find difficulty in accessing equipment or supplies to aid in a specific need.

Estimate of Potential Losses

Estimates of potential losses will be influenced by a variety of factors. The volume and force of the water will determine the scale of damages affecting campus infrastructure, equipment, and other impacted features. The proximity to the failure and elevation above flood waters will affect the level of damage and individuals exposed. The time of the academic year, the day of week, and hour in which the failure was to occur will influence the number of people on campus and potential casualties. Losses will be generated by the physical damages, the loss of revenue, loss of academic research, loss of building contents, and community wide economic reductions.

Based on estimate replacement costs of facilities and structures on campus, the total replacement costs due to earthquake are $626,694,141. However, it is unlikely for a dam or levee failure event to cause catastrophic destruction at CSU San Bernardino.

Vulnerability Assessment Conclusions

While the occurrence of dam and levee failures have not been historically relevant near the CSU San Bernardino campuses, the potential for hazards related to the region’s levees and dams still exist. However, the presence of earthquake faults in proximity to the existing dam and levee structures presents a valid danger to downstream locations in the event of an earthquake. The consequences of a dam failure would generate catastrophic results to downstream communities. The potential for dam or levee failure further generates the added potential for a number of cascading effects such as disruptions to
the local economy, utility failures, disruptions to providing for the needs of the community, and development of public health hazards. These effects would be exacerbated by effects of seasonal flooding, ongoing heavy precipitation, or excessive run-off from the watershed contributing to the river system. The potential for widespread flooding and damage of structures due to the force of water has exponentially powerful impacts on particular populations among the campus community including those with access or functional needs, international students, the homeless, and students residing in the residence halls.

Identified Data Limitations

Data limitations include missing campus structural replacement costs, and an incomplete inventory of both building construction features and mitigation efforts to lessen the impact due to flood inundation.
**Drought**

Description of the Hazard

Drought is defined as a condition where moisture levels fall significantly below normal for an extended period of time over a large area that adversely affects plants, animal life, and humans. Drought is a gradual phenomenon. Although droughts are sometimes characterized as emergencies, they differ from typical emergency events. Most natural disasters, such as floods or forest fires, occur relatively rapidly and afford little time for preparing for disaster response. Droughts occur slowly, over a multi-year period, and it is often not obvious or easy to quantify when a drought begins and ends.

Throughout California, one dry year does not normally constitute a drought. California’s extensive system of water supply infrastructure (reservoirs, groundwater basins, and conveyance assets) mitigates the effect of short-term dry periods for most water users. Defining when a drought begins is a function of drought impacts to water users. Drought in one location may not constitute a drought for all water users, as some users in relative proximity may have a different water supply. For example, individual water suppliers may use a combination of sources such as rainfall/runoff, water in storage, or expected supply from a water wholesaler to define their water supply conditions.

Drought can be characterized as one or more of the four following types:

- **Meteorological drought** is defined on the basis of the degree of dryness (in comparison to some “normal” or average amount) and the duration of the dry period. A meteorological drought must be considered as region-specific since the atmospheric conditions that result in deficiencies of precipitation are highly variable from region to region.

- **Hydrological drought** is associated with the effects of periods of precipitation (including snowfall) shortfalls on surface or subsurface water supply (e.g., streamflow, reservoir and lake levels, ground water). The frequency and severity of hydrological drought is often defined on a watershed or river basin scale. Although all droughts originate with a deficiency of precipitation, hydrologists are more concerned with how this deficiency plays out through the hydrologic system. Hydrological droughts are usually out of phase with or lag the occurrence of meteorological and agricultural droughts. It takes longer for precipitation deficiencies to show up in components of the hydrological system such as soil moisture, streamflow, and ground water and reservoir levels. As a result, these impacts are out of phase with impacts in other economic sectors.

- **Agricultural drought** focus is on soil moisture deficiencies, differences between actual and potential evaporation, reduced ground water or reservoir levels, and so forth. Plant water demand depends on prevailing weather conditions, biological characteristics of the specific plant, its stage of growth, and the physical and biological properties of the soil.
• **Socioeconomic drought** refers to when physical water shortage begins to affect health, well-being, and quality of life of people, or when the drought starts to affect the supply and demand of an economic product that relies on water.

The drought issue in California is further compounded by water rights. The central challenge is how to prioritize water usage among a broad variety of contexts. It is for this reason that water is a commodity possessed and utilized under a variety of legal doctrines. As such, many competing sets of interests create a dynamic prioritization process between, for example, farming and federally protected fish habitats and water supply for municipal/public use (including usage for CSU San Bernardino) versus water usage for wildfire abatement or natural resource protection.

**Location of the Hazard**

Drought conditions have been identified throughout San Bernardino County and the city of San Bernardino where the campus is located. Drought is not a location-specific hazard and affects the entire planning area equally. Drought location is not isolated to the campus footprint but occurs as a geographic sub-set of drought conditions occurring at larger scales. From 2000-2020, drought conditions existed continuously in the state, with 80-100% of the state impacted for 12 of the last 20 years. ²⁸

**Extent of the Hazard**

Although drought impacts have not been reported specifically for the campus, given the historical occurrence of severe drought impacts throughout the city and county surrounding the planning area and the potential future impact exacerbated by climate change, the CSU Planning Committee recognizes that drought will continue to pose a high degree of risk to the state, potentially impacting crops, livestock, water resources, the natural environment at large, buildings and infrastructure (from land subsidence), and local economies. That said, although drought affects the entire CSU 23 campus planning area, the potential impacts are variable and specific to each campus/jurisdiction, depending on contextual factors such as the degree of assets and activities that shape drought vulnerability within each jurisdiction; currently, the extent of drought on campus is evaluated by the committee to be minimal.

In addition, land subsidence has occurred and will continue in areas where the groundwater basin has been subject to overdraft and long-term recharge is inadequate to maintain the water table elevation, leaving underground voids. Subsidence levels have been measured up to 30-feet in California with subsidence bowls covering hundreds of square miles. As such, drought-related subsidence may result in serious structural damage to buildings, roads, irrigation ditches, underground utilities, and pipelines. Though such effects have not been reported on campus, they remain issues of concern for the campus in the long term.

Although the campus planning team identifies the extent of the hazard as Low (qualitatively) which corresponds to D0 – D1 on the Extent scale (below), San Bernardino County has experienced more severe drought conditions for 15 of the past 20 years, including 5 years of D4 levels. As such, the campus planning team recognizes that while historic impacts shaping the extent of drought on campus have been minimal, the potential impacts are tied to trends across larger geographic areas, and, therefore, the committee recognizes that the extent of drought on campus has the potential to increase in the future.

The U.S. Drought Monitor developed tables of impacts reported during past droughts in California in order to depict the extent of drought risk for each level of drought on the U.S. These possible extent conditions for California complement the general impacts column of the U.S. Drought Monitor Classification Scheme.

Table 19-13: Impacts of Drought Levels as Determined by US Drought Monitor

<table>
<thead>
<tr>
<th>Category</th>
<th>Impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>D0</td>
<td>Soil is dry; irrigation delivery begins early</td>
</tr>
<tr>
<td></td>
<td>Dryland crop germination is stunted</td>
</tr>
<tr>
<td></td>
<td>Active fire season begins</td>
</tr>
<tr>
<td></td>
<td>Winter resort visitation is low; snowpack is minimal</td>
</tr>
<tr>
<td>D1</td>
<td>Dryland pasture growth is stunted; producers give supplemental feed to cattle</td>
</tr>
<tr>
<td></td>
<td>Landscaping and gardens need irrigation earlier; wildlife patterns begin to change</td>
</tr>
<tr>
<td></td>
<td>Stock ponds and creeks are lower than usual</td>
</tr>
<tr>
<td>D2</td>
<td>Grazing land is inadequate</td>
</tr>
<tr>
<td></td>
<td>Producers increase water efficiency methods and drought-resistant crops</td>
</tr>
<tr>
<td></td>
<td>Fire season is longer, with high burn intensity, dry fuels, and large fire spatial extent; more fire crews are on staff</td>
</tr>
<tr>
<td></td>
<td>Wine country tourism increases; lake- and river-based tourism declines; boat ramps close</td>
</tr>
<tr>
<td></td>
<td>Trees are stressed; plants increase reproductive mechanisms; wildlife diseases increase</td>
</tr>
<tr>
<td></td>
<td>Water temperature increases; programs to divert water to protect fish begin</td>
</tr>
<tr>
<td></td>
<td>River flows decrease; reservoir levels are low and banks are exposed</td>
</tr>
</tbody>
</table>

29 United States Drought Monitor. *Drought Classification*. Retrieved 05.04.2021 from: [https://droughtmonitor.unl.edu/About/AbouttheData/DroughtClassification.aspx](https://droughtmonitor.unl.edu/About/AbouttheData/DroughtClassification.aspx)
<table>
<thead>
<tr>
<th>D3</th>
<th>Livestock need expensive supplemental feed, cattle and horses are sold; little pasture remains, producers find it difficult to maintain organic meat requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fruit trees bud early; producers begin irrigating in the winter</td>
<td></td>
</tr>
<tr>
<td>Federal water is not adequate to meet irrigation contracts; extracting supplemental groundwater is expensive</td>
<td></td>
</tr>
<tr>
<td>Dairy operations close</td>
<td></td>
</tr>
<tr>
<td>Marijuana growers illegally tap water out of rivers</td>
<td></td>
</tr>
<tr>
<td>Fire season lasts year-round; fires occur in typically wet parts of state; burn bans are implemented</td>
<td></td>
</tr>
<tr>
<td>Ski and rafting business is low, mountain communities suffer</td>
<td></td>
</tr>
<tr>
<td>Orchard removal and well drilling company business increase; panning for gold increases</td>
<td></td>
</tr>
<tr>
<td>Low river levels impede fish migration and cause lower survival rates</td>
<td></td>
</tr>
<tr>
<td>Wildlife encroach on developed areas; little native food and water is available for bears, which hibernate less</td>
<td></td>
</tr>
<tr>
<td>Water sanitation is a concern, reservoir levels drop significantly, surface water is nearly dry, flows are very low; water theft occurs</td>
<td></td>
</tr>
<tr>
<td>Wells and aquifer levels decrease; homeowners drill new wells</td>
<td></td>
</tr>
<tr>
<td>Water conservation rebate programs increase; water use restrictions are implemented; water transfers increase</td>
<td></td>
</tr>
<tr>
<td>Water is inadequate for agriculture, wildlife, and urban needs; reservoirs are extremely low; hydropower is restricted</td>
<td></td>
</tr>
<tr>
<td>Fields are left fallow; orchards are removed; vegetable yields are low; honey harvest is small</td>
<td></td>
</tr>
<tr>
<td>Fire season is very costly; number of fires and area burned are extensive</td>
<td></td>
</tr>
<tr>
<td>Many recreational activities are affected</td>
<td></td>
</tr>
<tr>
<td>Fish rescue and relocation begins; pine beetle infestation occurs; forest mortality is high; wetlands dry up; survival of native plants and animals is low; fewer wildflowers bloom; wildlife death is widespread; algae blooms appear</td>
<td></td>
</tr>
<tr>
<td>Policy change; agriculture unemployment is high, food aid is needed</td>
<td></td>
</tr>
<tr>
<td>Poor air quality affects health; greenhouse gas emissions increase as hydropower production decreases; West Nile Virus outbreaks rise</td>
<td></td>
</tr>
<tr>
<td>Water shortages are widespread; surface water is depleted; federal irrigation water deliveries are extremely low; junior water rights are</td>
<td></td>
</tr>
</tbody>
</table>
History of the Hazard

Historically, drought has been so prevalent in California that its presence is almost continuous. According to the US Drought Monitor, Time Series data, San Bernardino County has experienced 7 periods of drought between 2000 and 2021 including a severe drought event from 2011 – 2019 that impacted the entire county encompassing the CSU - San Bernardino footprint.

Figure 19-6: Periods of Drought in San Bernardino County, California, 2000 – 2021

According to the National Drought Mitigation Center, over 3,500 reports and publications covering 370 drought-related events took place across the state (many of which were statewide events) between 2000-2020. In addition, the National Center for Environmental Information (NCEI) reports more than 500 events statewide during this same time period. These events produced a comprehensive range of impacts to water supply, regulations and allocations to businesses and municipalities, budgets and resources for firefighting, water law and policy, and physical impacts to built and natural environments. As such, data records of previous occurrences can be viewed as separate time and event demarcations for a hazard almost continuously in effect across the state with cascading impact potential.

Source: https://droughtreporter.unl.edu/advancedsearch.aspx
Source: https://www.ncdc.noaa.gov/stormevents

According to the Department of Water Resources, droughts exceeding three years are relatively common in Southern California, but relatively rare in Northern California - the

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region is the geographic source of much of the state’s developed water supply. The 1929-34 drought established the criteria commonly used in designing storage capacity and yield of large Northern California reservoirs. 

According to the US Drought Monitor’s time series data, from 2000-2021 (with the exception of a 2–3-month period in 2000 and 2011), some degree of drought conditions has been continuously in effect somewhere in California. In fact, 80% - 100% of the state has been subjected to drought conditions for 12 of the last 20 years, with the most severe drought being the 100% state-wide event from 2012-2017.

Figure 19-7: Periods of Drought in San Luis Obispo County, California, 2000 – 2021

Given the extent of the drought risk in California, the following drought event was selected as an exemplar due to its broad and significant impacts on the state and on the county surrounding the CSU - San Bernardino campus planning area:

2012 – 2017 – Drought produced severe impacts to water wells throughout the state of California, with a high number of wells running dry. Land subsidence due to increased groundwater pumping also occurred in numerous areas of the state such as the San Joaquin and Central Valleys. Crop damage was widespread as well. Water allotments were drastically reduced in many towns and water agencies, with extremely high costs for procuring water. In addition, job loss occurred with many families requiring food supply assistance, and water supply assistance provided to home-owners with dry wells. According to a report released by UC Davis Center for Watershed Sciences, the 2012-2017 period of the California drought cost the state’s agriculture industry about $1 billion in lost revenue, with a total statewide economic cost of the drought calculated to be $2.2 billion. The report says, ‘it is responsible for the greatest water loss ever seen in California agriculture - about one third less than normal’. The report calls the

groundwater situation in California "a slow-moving train wreck." Spring snowpack at Donner Summit reached record low levels in 2014, exceeded in 2015 by a remarkable April 1 snow-water-equivalent value of only 5% of average. Decreased precipitation since contributed to near-record low levels in the Shasta Reservoir. The ongoing drought has contributed to declines in crop values across the state. For example, crops including cotton, corn silage and barley (the field crop category) fell by 42 percent. 33

Potential Impacts of the Hazard

Drought impacts are wide-reaching and may be economic, environmental, and/or societal. This assessment of its impact recognizes that historic occurrences of drought throughout the planning area are a sub-set of larger and inter-connected local and regional droughts, and that the (related) historic impacts provide a sound basis for understanding potential (future) impacts.

Though no impacts have been recorded on campus, the most significant potential impact associated with drought across the CSU - San Bernardino campus planning area a potential reduction in water availability for the municipal area tied to each campus. Other impacts include crop loss and damage to trees and other natural resources (See Tree Mortality below). The footprint of CSU - San Bernardino to some extent includes these vulnerable resources based on the campus landscape (trees) and the presence (and footprint size) of any agricultural research crops and/or field stations.

As a secondary impact of drought, wildfire is directly attributable to dry atmospheric conditions. Wildfires almost always coincide with drought in California, though not limited to such. 34 However, the wildfire hazard is analyzed separately in this plan. (See Wildfire section below).

In reviewing the occurrences of drought for San Bernardino (city and county), the US Drought Monitor and the National Drought Mitigation Center report that tens of millions of trees died during the (2012-2017) state-wide drought disaster. Though data sources do not provide data for tree mortality specific to CSU - San Bernardino, the broad geographic extent of the impact makes it likely that tree mortality occurred to some degree on the campuses. Due to the lasting and ongoing effects of drought on the landscape, trees will continue to be impacted within the municipalities, counties and regions wherein lies the CSU campus system as long as drought conditions continue.

Given the absence of data, in order for the CSU Committee to assess the impact of tree mortality, it is useful to view it as a risk sub-set to the probability, location, extent, severity and duration of the drought hazard within each campus-located municipality, county and region. Regarding potential impacts, standing dead trees could fall, posing a risk to people, buildings, power lines, roads and other infrastructure. In addition, drought-impacted trees become susceptible to diseases and insect infestations (bark beetle)


further adding to the risk of tree mortality and related potential impacts. No data is currently available for tree mortality on campus, however, the CSU Planning Team will pursue data on this issue in the future.

As a potential tertiary impact, prolonged and repeated drought conditions over time can produce land subsidence and the risk of damage to building foundations and infrastructure on campus resulting from ground instability and collapse. Land subsidence is defined as the vertical sinking of the land over manmade or natural underground voids. Subsidence is often the direct result of groundwater over-extraction in response to drought conditions, as well as oil and gas extraction. Weight can accelerate the process of subsidence resulting from surface development and infrastructure such as roads and buildings, vibrations from construction blasting and heavy truck or train traffic. For example, the State Water Project’s 444-mile-long California Aqueduct has required repairs such as the raising of canal linings, bridges, and water control structures on the Aqueduct – in the Central Valley a five-mile reach of the Eastside Bypass was impacted by subsidence, and the Department of Water Resources estimated that it may cost in the range of $250 million to acquire flowage easements and levee improvements to restore the design capacity of the subsided area. 35

At present, drought related damage to campus buildings and infrastructure at CSU - San Bernardino has not been reported, but the potential for such impacts is possible. With regard to overall potential impact, water supply/availability for CSU - San Bernardino is ultimately tied to broader inter-dependent, and more intensive modes of water use at local and regional scales such as agriculture and ranching, wildfire protection, larger metropolitan/municipal usage, manufacturing and commerce, tourism, recreation, and wildlife preservation. During drought periods, the State of California’s regulated water allocations are modified and often reduced, which can result in reduced water availability for all usage contexts, including CSU - San Bernardino. A reduction of electric power generation and water quality deterioration are also potential impact factors.

Table 19-14: Summary of Drought Impacts on Water Resources 36

<table>
<thead>
<tr>
<th>Resource</th>
<th>Type of Impact</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sea Level</td>
<td>Direct</td>
<td>Sea level is rising and will likely impact coastal areas</td>
</tr>
<tr>
<td>Soil Moisture</td>
<td>Direct</td>
<td>Prolonged dry seasons can lead to decreases in soil moisture; drier vegetation</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Vegetation</th>
<th>Indirect</th>
<th>Longer and more intense fire season with increased extent of area burned</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stream Conditions</td>
<td>Direct</td>
<td>Increases in water temperature; potential effects on fish</td>
</tr>
<tr>
<td>Snowpack</td>
<td>Indirect</td>
<td>Increases in temperature will lead to decreases in snowpack</td>
</tr>
<tr>
<td>Runoff</td>
<td>Direct</td>
<td>Warmer temperatures are likely to lead to a shift in peak runoff from spring to winter and a likely decrease in summer base flow</td>
</tr>
<tr>
<td>Hydropower</td>
<td>Indirect</td>
<td>Decreased summer flows resulting from earlier snowmelt and a shift in peak runoff could affect hydropower generation during summer months</td>
</tr>
<tr>
<td>Precipitation</td>
<td>Direct</td>
<td>Warmer winter temperatures will result in a greater percentage of precipitation falling as rain rather than as snow</td>
</tr>
<tr>
<td>Groundwater</td>
<td>Indirect</td>
<td>Reduction in snowpack and extended periods of drought are likely to increase dependency on groundwater</td>
</tr>
</tbody>
</table>

**Probability of Future Occurrence of the Hazard**

**Highly Likely** — The US Drought Monitor’s time series data (2000-2020) indicates that some degree of drought has nearly a 100% probability of occurrence in the state in any given year. Given that CSU - San Bernardino lies within a frequently drought-impacted county and region (according to Time Series data), it is prudent to extend this Highly Likely probability of occurrence to the planning area even though historic occurrence and impacts are reported to be minimal.

**Vulnerability to the Hazard**

In California, rising temperatures are projected to increase the average lowest elevation at which snow falls, reducing water storage in the snowpack, particularly at those lower mountain elevations which are now on the margins of reliable snowpack accumulation. Higher spring temperatures will also result in earlier melting of the snowpack. The shift in snow melt to earlier in the season is critical for California’s water supply because flood control rules require that water be allowed to flow downstream and that water cannot be stored in reservoirs for use in the dry season. As such, state-level drought risk factors that have led to drought’s state-wide severity and extent, and potential impacts also create drought vulnerabilities at the level of the CSU - San Bernardino campus.
Moreover, climate change will likely adversely impact the vulnerability of watersheds and ecosystems in their ability to deliver important ecosystem services. These changes may limit the natural capacity of healthy forests to capture water and regulate stream flows. Sierra Nevada mountain winters and springs are warming, and on average, precipitation as snowfall relative to rain is decreasing. A warming climate with reduced snowpack will result in earlier snowmelt and will subsequently reduce downstream water availability during summer and early fall.

As such, the state and the CSU - San Bernardino planning area stakeholders potentially have less capacity to address future drought risks due to projected temperature increases and shortages in water; ground-water withdrawals have been occurring at a deficit rate of 1 – 2-million-acre feet per year, where the impacts of drought include decreased availability of water for agriculture and environmental uses. In forested and other vegetated areas, prolonged drought decreases the moisture content of forest fuels and increases the risk of high severity wildfires.

It should be pointed out that California is the single most productive agricultural state and its agricultural industry relies heavily on reservoir water supplied by snowmelt and rainfall runoff. Yearly variations in snowpack depths have implications for water availability as snowmelt from the winter snowpack feeds a network of reservoirs. Spring snowpack at Donner Summit reached record low levels in 2014, exceeded in 2015 by a remarkable April 1 snow-water-equivalent value of only 5% of average. Decreased precipitation since 2011 has contributed to near-record low levels in the Shasta Reservoir.

Vulnerability of Populations

Drought vulnerabilities for California’s population include agricultural sector job loss, secondary economic losses to local businesses and public recreational resources, increased cost to local and state government for large-scale water acquisition and delivery, and water rationing and water wells running dry for individuals and families. As drought is often accompanied by prolonged periods of extreme heat, negative health impacts such as dehydration can also occur, where children and elderly are most susceptible. Air quality often declines in times of drought which can affect those with respiratory ailments. These same vulnerability measures apply to the students, faculty and staff of the CSU – San Bernardino campus.

Property Vulnerability

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Drought vulnerabilities for property include crop loss, injury and death of livestock and pets, and damage to infrastructure, homes and other buildings resulting from the secondary drought impact of land subsidence. The related drought impacts of tree mortality and land subsidence pose risks to vulnerable critical infrastructure and property. These same vulnerability measures apply to the properties of the CSU - San Bernardino campus.

**Natural Environment Vulnerability**

Drought vulnerabilities for the natural environment are widespread throughout public and private lands within the state, including tree mortality, impacts to all flora and fauna, and destabilization (subsidence) of land along streams and rivers, and within watersheds.

With regard to the campus, currently, the primary vulnerabilities are drought impacted trees and landscaping (flora). And, the core issue shaping drought vulnerabilities throughout California is water supply and demand. Several factors play into the issue including groundwater basins, surface water run-off, public and agricultural demand, and surface water storage water sheds. A USGS led analysis was first conducted in 2010 through the Forest and Rangeland Assessment and ongoing through the USGS Forest and Rangeland Ecosystem Science Center to identify threats and assets where water supply would benefit from environmental management designed to protect or enhance water resources, the key effort which, in part, both defines and mitigates the severity of drought risk and vulnerabilities.

With regard to overall threat and asset findings shaping the potential severity of drought, the watersheds in the Sierra region contribute most greatly to the state’s water supply, but are under threat from climate change, wildfire and development. In addition, groundwater basins in the San Joaquin Valley and Sacramento Valley bioregions are an abundant resource that is heavily threatened by over pumping.

**Critical Facilities Vulnerabilities**

Drought vulnerabilities for CSU - San Bernardino’s critical facilities include water shortfalls for facility operations and critical functions, and potential structural destabilization and damage resulting from land subsidence.

**Estimate of Potential Losses**

An estimate of potential losses from drought has not been calculated for the campus or the CSU system as a whole. However, drought related losses to the City of San Bernardino and the surrounding region such as crop loss and cost increases for water resources have re-occurred over time. Please consult city and county level government, and/or state agricultural agencies for data on the financial impacts from drought.

**Vulnerability Assessment Conclusions**

The CSU Planning Committee understands that the high degree of vulnerability posed by drought will be exacerbated by greater climate variation in the future and therefore greater variation and uncertainty regarding the availability of water supplies which are
already under tremendous stress. In response to such vulnerability, state legislation passed in 2014 requires local governments to regulate pumping and recharge to better manage groundwater supplies, and groundwater-dependent regions are required to halt overdraft and bring basins into sustainable levels of pumping and recharge by the early 2040s. That said, the Committee will continue to work with local, regional and state partners and stakeholders to explore solutions for mitigating the drought hazard on its campuses by accessing the best available data and resources on climate change and its relationship to drought.

**Identified Data Limitations**

Data is limited concerning campus-related agricultural assets as well as data on campus tree mortality.

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**Earthquake**

**Description of the Hazard**

An earthquake is a sudden motion or shaking caused by the release of pressure accumulated along the edge of tectonic plates covering the earth. These huge plates are constantly moving and move ever so slowly under, over, or by passing one another. This movement is gradual however the plates may lock together accumulating enormous amounts of energy. When this energy builds, stress develops, and the adjoining plates will eventually break free and result in ground shaking – an earthquake.

Large earthquakes may result in fissuring, ground settlement, and/or vertical or horizontal displacement. Earthquakes occur without warning and can result in extensive damages and human casualties. Damages associated to earthquake generated ground shaking is normally confined to a narrow area along fault trend from the earthquake epicenter. However, seismic waves may generate ground shaking resulting in damages in areas outside of the fault trend.

**Fault Rupture** – The rupture of faults is the differential movement of the two sides of the earth’s plates at the point of the fault. Horizontal or vertical displacement may be significant and occur over great distances. The movement and energy that occurs along a fault is released in waves resulting in ground shaking. The intensity of ground shaking varies based on the magnitude of the earthquake, the proximity to the earthquake epicenter, the composition of the ground sediment or rock the waves travel through, and the depth of the earthquake.

**Liquefaction** – In addition to the primary fault rupture that occurs right along a fault during an earthquake, the ground many miles away can also fail during intense shaking. As seismic waves travel through saturated granular soil; the soil begins to liquefy and act as a fluid. Soil strength and stability is lost causing the effects of ground shaking to intensify and for ground deformation to occur. These water saturated soils when shaken quickly lose the ability to support buildings, bridges, utilities, and other structures. Areas susceptible to liquefaction include places where sandy sediments have been deposited by
rivers along their course or by wave action along beaches. The greater the magnitude of an earthquake and longer duration of strong ground shaking will result in an enhanced potential for liquefaction to occur. Settlement can cause damage when the amount settlement varies significantly across the length of a structure. Lateral spreading occurs when liquefaction occurs on gently sloping ground and the liquefied material at depth allows the area to slide, often toward a vertical discontinuity or “free face” such as a creek or stream channel. Liquefaction can occur in susceptible soils below bodies of water, and settlement and lateral spreading can damage structures built on or adjacent to these areas. Transportation bridges across water bodies, wharves, piers and other structures at ports and harbors, and underwater utility lines can be severely damaged by this hidden hazard.

**Subsidence** - Changes in the local environment that cause subsidence or sinkholes are called triggering mechanisms. Water is the primary factor that affects the local environment and causes subsidence. Water level decline, changes in groundwater flow, increased loading, and deterioration (such as abandoned mines) are all triggering mechanisms. Water level decline may occur naturally, or it may be the result of human action. Factors that lead to water decline are pumping (from wells), localized drainage (for construction activities), dewatering, or drought. Changes in groundwater flow can result from an increase in the velocity of groundwater movement, and increase in the frequency of water table fluctuations, and changes in discharge (either increase or decrease). Increased loading can cause pressure in the soil, leading to the failure of underground cavities and space, such as caves. Vibrations from earthquakes, heavy machinery, and blasting may result in structural collapse, followed by surface resettlement.

**Location of the Hazard**

The State of California is particularly vulnerable to earthquake activity due to California’s location residing between two large tectonic plates. CSU San Bernardino is located in the northern portions of the San Bernardino Valley. In general, fault systems surround and traverse through San Bernardino and Riverside Counties including the area of CSU San Bernardino. Throughout the basin the ground is saturated with sediment eroded from the mountains and foothills via multiple stream and river channels and resulting in liquefaction zones scattered across the region.

The Pacific Plate and the North American Plate come together at the San Andreas Fault ½ mile northeast of the CSU San Bernardino campus. In addition to the San Andreas Fault, San Bernardino County is home to or near additional fault systems with the potential to generate strong ground shaking. The San Jacinto Fault extends from Borrego Springs to Lytle Creek along the eastern edges of San Bernardino 2 ½ miles west of the campus. The Cucamonga Fault is another east to west fault 6-7 miles west of the campus traversing the base of the San Gabriel Mountains. There are numerous additional active faults in the area on all sides of the campus.

The CSU San Bernardino, Palm Desert campus is also in the area of a number of active faults. The San Andreas Fault is 3-4 miles north of the campus extending along the base
of the San Bernardino Mountains and the hills of the Joshua Tree National Park. The San Jacinto Fault is 21 miles west of the campus on the opposite side of the San Jacinto Mountains. The Blue Cut Fault extends east to west through the Joshua Tree National Park 11 miles from the campus.
The CSU San Bernardino campus resides next to areas designated to be liquefaction zones. All campus facilities are located outside of the liquefaction zone or areas where liquefaction zones overlap with areas prone to landslides. The areas designated as being susceptible to liquefaction is the Devils Canyon Flood Basins adjacent to the campus including the dams and levees onsite. Additionally, substantial areas of the community surrounding the campus reside within the liquefaction zones including access routes into and out of the campus. This includes Interstate 10, Interstate 215, State Route 210, State Route 30, Waterman Ave., and the Southern Pacific Railroad. The liquefaction zone generally follows the path of the Cajon Wash, the Santa Ana River, and downtown San Bernardino.

Extent of the Hazard

The extent or severity of earthquake damage is expressed in terms of magnitude, intensity, and duration. The amount of energy released during an earthquake is normally conveyed as a magnitude measured from a seismogram. Magnitude is expressed in numbers and decimals representing the physical size of the earthquake. The strength and effect of the shaking on the surface of the earth is classified as the intensity. Intensity is
further defined from the effects the earthquake has on people, structures, and the natural environment. The intensity of an earthquake in terms of measuring magnitude and evaluating its effects is generally expressed using the Modified Mercalli (MM) Intensity Scale. Duration is the length of time the earthquake’s energy is released.

The Richter magnitude scale was developed in 1935 by Charles F. Richter of the California Institute of Technology as a mathematical device to compare the size of earthquakes. The Richter Scale is the best-known scale for measuring the magnitude of earthquakes. The magnitude value is proportional to the logarithm of the amplitude of the strongest wave during an earthquake. A recording of 7, for example, indicates a disturbance with ground motion 10 times as large as a recording of 6. The energy released by an earthquake increases by a factor of 31 for every unit increase in the Richter scale.

Table 19-15: Earthquake Intensity and Frequency Comparisons

<table>
<thead>
<tr>
<th>Magnitude</th>
<th>Mercalli Intensity</th>
<th>Potential Damage</th>
<th>Global Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 2.0</td>
<td>I</td>
<td>None</td>
<td>Continually</td>
</tr>
<tr>
<td>2.0 - 2.9</td>
<td>I to II</td>
<td>None</td>
<td>&gt; 1M per year</td>
</tr>
<tr>
<td>3.0 - 3.9</td>
<td>II to IV</td>
<td>Light</td>
<td>&gt; 100,000 per year</td>
</tr>
<tr>
<td>4.0 - 4.9</td>
<td>IV to VII</td>
<td>Light</td>
<td>10K to 15 K per year</td>
</tr>
<tr>
<td>5.0 - 5.9</td>
<td>VI to VII</td>
<td>Moderate</td>
<td>1K to 1,500 per year</td>
</tr>
<tr>
<td>6.0 - 6.9</td>
<td>VII to X</td>
<td>Heavy</td>
<td>100 to 150 per year</td>
</tr>
<tr>
<td>7.0 - 7.9</td>
<td>VII &lt;</td>
<td>Very Heavy</td>
<td>10 - 20 per year</td>
</tr>
<tr>
<td>8.0 - 8.9</td>
<td>VII &lt;</td>
<td>Very Heavy</td>
<td>1 per year</td>
</tr>
<tr>
<td>&gt; 9.0</td>
<td>VII &lt;</td>
<td></td>
<td>1 per 10-50 years</td>
</tr>
</tbody>
</table>

The Modified Mercalli Intensity Scale provides descriptive values of earthquake intensity that may provide greater meaning to the broader population as the description of intensity refers to the effects actually experienced. This scale uses an arbitrary ranking based on observed earthquake effects. The scale is composed of increasing levels of intensity ranging from shaking that is not recognizable to intense shaking resulting in catastrophic damages and casualties. The Modified Mercalli Intensity Scale is demonstrated below:

Table 19-16: Modified Mercalli Intensity Scale

<table>
<thead>
<tr>
<th>Intensity</th>
<th>Shaking</th>
<th>Description / Damage</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Level</th>
<th>Intensity</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Not felt</td>
<td>Not felt except by a very few under especially favorable conditions.</td>
<td></td>
</tr>
<tr>
<td>II</td>
<td>Weak</td>
<td>Felt only by a few persons at rest, especially on upper floors of buildings.</td>
<td></td>
</tr>
<tr>
<td>III</td>
<td>Weak</td>
<td>Felt quite noticeably by persons indoors, especially on upper floors of buildings. Many people do not recognize it as an earthquake. Standing motor cars may rock slightly. Vibrations similar to the passing of a truck. Duration estimated.</td>
<td></td>
</tr>
<tr>
<td>IV</td>
<td>Light</td>
<td>Felt indoors by many, outdoors by few during the day. At night, some awakened. Dishes, windows, doors disturbed; walls make cracking sound. Sensation like heavy truck striking building. Standing motor cars rocked noticeably.</td>
<td></td>
</tr>
<tr>
<td>V</td>
<td>Moderate</td>
<td>Felt by nearly everyone; many awakened. Some dishes, windows broken. Unstable objects overturned. Pendulum clocks may stop.</td>
<td></td>
</tr>
<tr>
<td>VI</td>
<td>Strong</td>
<td>Felt by all, many frightened. Some heavy furniture moved; a few instances of fallen plaster. Damage slight.</td>
<td></td>
</tr>
<tr>
<td>VII</td>
<td>Very strong</td>
<td>Damage negligible in buildings of good design and construction; slight to moderate in well-built ordinary structures; considerable damage in poorly built or badly designed structures; some chimneys broken.</td>
<td></td>
</tr>
<tr>
<td>VIII</td>
<td>Severe</td>
<td>Damage slight in specially designed structures; considerable damage in ordinary substantial buildings with partial collapse. Damage great in poorly built structures. Fall of chimneys, factory stacks, columns, monuments, walls. Heavy furniture overturned.</td>
<td></td>
</tr>
<tr>
<td>IX</td>
<td>Violent</td>
<td>Damage considerable in specially designed structures; well-designed frame structures thrown out of plumb. Damage great in substantial buildings, with partial collapse. Buildings shifted off foundations.</td>
<td></td>
</tr>
</tbody>
</table>
The graph below illustrates the increasing intensity of energy that is released and as the measured magnitude increases. While each whole number increases in magnitude represents a tenfold increase in the measured amplitude, it represents an increasing rate of 32 times more energy released in the same increase in magnitude. As the magnitude of an earthquake is measured higher, the intensity of the earthquake worsens progressively from one category to the next.

Figure 19-9: Earthquake Magnitude and Equivalent Energy Release

Although the CSU San Bernardino campus resides next to areas designated to be liquefaction zones, all campus facilities are located outside of the liquefaction zone. However, the campus is surrounded and traversed by powerful fault systems, and the area has experienced several catastrophic events, including the Northridge event. Given the above factors along with the probability for future impacts, the planning committee ranks the extent of the hazard as **High**.

History of the Hazard

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The State of California has a long history of chronic and destructive earthquakes throughout the state. On average, earthquakes strong enough to result in structural damages occur three to four times a year in California, while earthquakes Magnitude 6.0 to 6.9 occur once every two to three years. San Bernardino County also has a long history of earthquake activity. The entire area of the Inland Empire is at risk to seismic activity and has a history of significant earthquakes resulting in damages.

Table 19-17: Historic Earthquakes Near San Bernardino, CA\textsuperscript{41}

<table>
<thead>
<tr>
<th>Date</th>
<th>Location</th>
<th>Magnitude</th>
<th>Damages</th>
</tr>
</thead>
<tbody>
<tr>
<td>12/8/1812</td>
<td>San Juan Capistrano</td>
<td>7.5</td>
<td></td>
</tr>
<tr>
<td>3/10/1933</td>
<td>Long Beach</td>
<td>6.4</td>
<td>120 fatalities, $40 million</td>
</tr>
<tr>
<td>2/9/1971</td>
<td>San Fernando</td>
<td>6.6</td>
<td>58-65 fatalities, $553 million</td>
</tr>
<tr>
<td>10/1/1987</td>
<td>Whittier</td>
<td>5.9</td>
<td>8 fatalities, $358 million</td>
</tr>
<tr>
<td>2/28/1990</td>
<td>Upland</td>
<td>5.7</td>
<td>30 injuries, $12.7 million</td>
</tr>
<tr>
<td>6/28/1991</td>
<td>Sierra Madre</td>
<td>5.6</td>
<td>1 fatality, $40 million</td>
</tr>
<tr>
<td>6/28/1992</td>
<td>Landers</td>
<td>7.3</td>
<td>3 fatalities, $92 million</td>
</tr>
<tr>
<td>6/28/1992</td>
<td>Big Bear</td>
<td>6.5</td>
<td>$60 million, Major Damage</td>
</tr>
<tr>
<td>1/17/1994</td>
<td>Northridge</td>
<td>6.7</td>
<td>57 fatalities, $40 billion</td>
</tr>
<tr>
<td>7/29/2008</td>
<td>Chino Hills</td>
<td>5.5</td>
<td>Minor</td>
</tr>
<tr>
<td>3/28/2014</td>
<td>La Habra</td>
<td>5.1</td>
<td>$10 million</td>
</tr>
</tbody>
</table>

The June 28, 1992 Landers and Big Bear Earthquakes struck early in the morning centered in the desert and mountains of San Bernardino County 50 and 30 miles east of CSU San Bernardino. The Landers epicenter was in a sparsely populated area but was felt from Los Angeles to areas in Nevada, Arizona, and Idaho. The earthquake ruptured five different faults. Significant ground ruptures were developed displacing the ground up to 6 feet vertically. The earthquake created $92 million in damages and killed 3 people. The Big Bear Earthquake struck 3 hours following the Landers event. The earthquake caused major damage to structures, roadways, and infrastructure of the mountain community of Big Bear. 40% of the structures on the mountain were damaged and generated landslides on the three roads into the resort community isolating the area for days.

The January 9, 1994 Northridge Earthquake became the costliest seismic event in California history. The earthquake caused extensive damage to structures, the transportation infrastructure, utility systems, water storage, communications, and critical facilities. This level of damage due to the fault that ruptured was directly underneath a densely populated urban area. The Northridge Earthquake was found to raise the nearby mountains by as much as 70 centimeters. The earthquake was provided a federal disaster declaration (DR-1008).

\textsuperscript{41} City of Fullerton Local Hazard Mitigation Plan, May 21, 2020
The October 1, 1987 Whittier Narrows Earthquake shook a large part of southern California. The earthquake caused $358 million in damages, especially in the Alhambra, Pasadena, and Whittier areas. The earthquake resulted in extensive infrastructure damages, multiple injuries, and 8 fatalities. The earthquake was provided a federal disaster declaration (DR-799).

The February 9, 1971 Magnitude 6.5 San Fernando Earthquake struck the San Fernando Valley in Los Angeles just after 6am. The intense shaking caused the collapse of freeway overpasses, hospitals, and other infrastructure. It damaged thousands of homes and businesses, a reservoir, and critical infrastructure. 65 people were killed and 2,000 more were injured. The shaking was felt for 300 miles including in Las Vegas, Nevada. The earthquake was provided a federal disaster declaration (DR-299).

The March 10, 1933 Long Beach Earthquake registered at a Magnitude 6.4 occurred along the Newport-Inglewood Fault. The earthquake resulted in over $50 million in damages, 500 injuries, and 120 fatalities. Unreinforced masonry structures were the source of most of the casualties. 70 schools were destroyed and 120 were damaged. This earthquake promoted statewide standards in building design and construction for schools and other structures to better withstand seismic events.

Potential Impacts of the Hazard

The shaking of the ground from earthquakes can result in building collapse, bridge failure, utility disruptions and other structural collapse. Large earthquakes can additionally cause natural gas lines to break resulting in structure fires. The proximity to the unstable soils surrounding the campus presents a potential for liquefaction creating greater ground instability during seismic events. A major earthquake in the Los Angeles area would likely result in region-wide social disruptions in addition to structural damages. The region-wide structural damages may disrupt lifelines and supply chain routes limiting the campus from effective evacuation routes and receiving necessary supplies or equipment.

Most injuries resulting from earthquakes are from collapsing walls, flying glass, or other objects moved by ground shaking. The lack of warning allows individuals minimal time to react and find areas of safety. A moderate earthquake occurring near San Luis Obispo could cause injuries or fatalities to members of the campus community or support networks the campus relies on. These earthquake effects might be aggravated by collateral incidents such as fire, flooding, hazardous material spills, dam/levee compromises, and other cascading events. A catastrophic earthquake near San Luis Obispo could result in extensive casualties, expansive structural damages, panic, widespread utility outages, communication failures, and secondary emergencies such as fire. A catastrophic earthquake would certainly affect the broader Central Coast region limiting immediate assistance that the campus may normally expect.
Local impacts to the CSU San Bernardino campus caused by an earthquake could include:

- Injuries and damage related casualties
- Ground rupture
- Potential hazardous material releases on and off campus
- Infrastructure damage to freeway and roadway system
- Landslides blocking primary access routes including US 101 and CA SR 1
- Damage to rail lines transiting through San Luis Obispo
- Structural damage to bridges over waterways and flood control channels
- Damage to power grid and widespread power outages
- Disruption in water services
- Potential isolation of campus from community
- Potential isolation among on-campus residents
- Structural damage to flood control facilities
- Structural damage to campus academic and support buildings
- Damage or loss of academic research, documents, electronic storage, art, and literature.
- Structural damage to residence halls resulting in displaced student populations
- Structural damage to nearby residences
- Community members arriving on campus for refuge from damaged homes
- Damaged university communications, computer systems, and networks
- Gaps in service delivery to vulnerable populations
- Considerable stress and fear among community
- Spontaneous creation of tent cities or outdoor camping on personal property
- Closure or reduction of service to campus operations
- Reduction of campus revenue

Probability of Future Occurrence of the Hazard

The Working Group on California Earthquake Probabilities (WGCEP), a collaboration between the United States Geological Survey (USGS), the Southern California Earthquake Center (SCEC), and the California Geological Survey (CGS) develops Uniform California Earthquake Forecasts (UCERFs) using the best currently available science and technology. The UCERF version 3 provides a three-dimensional view of the likelihood a region in California will experience a Magnitude 6.7 or greater earthquake in the next 30 years. The likelihood for the San Bernardino County fault systems surrounding CSU San Bernardino is included in the following table.
### Table 19-18: Major Potentially Active Faults in Proximity to CSU San Bernardino

<table>
<thead>
<tr>
<th>Fault Zone</th>
<th>Recurrence</th>
<th>Maximum Magnitude</th>
<th>UCERF3 Likelihood</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chino</td>
<td>Historic: Holocene</td>
<td>6.0 to 7.7</td>
<td>2-3%</td>
</tr>
<tr>
<td>Cleghorn</td>
<td>Varies: 400 years</td>
<td>Unknown</td>
<td>1%</td>
</tr>
<tr>
<td>Cucamonga</td>
<td>Historic: 600-700 years</td>
<td>6.0 to 7.0</td>
<td>1-2%</td>
</tr>
<tr>
<td>Elsinore</td>
<td>Historic: 250 years</td>
<td>6.0 to 7.2</td>
<td>1-2%</td>
</tr>
<tr>
<td>San Andreas</td>
<td>Varies: 100-300 years</td>
<td>6.8 to 8.0</td>
<td>18-22%</td>
</tr>
<tr>
<td>San Gorgonio Pass</td>
<td>Historic: Holocene</td>
<td>6.0 to 7.0</td>
<td>1-2%</td>
</tr>
<tr>
<td>San Jacinto</td>
<td>Varies: 100-300 years</td>
<td>6.5 to 7.5</td>
<td>4-5%</td>
</tr>
</tbody>
</table>

The San Bernardino County Multi-Jurisdictional Hazard Mitigation Plan identifies that the probability of an earthquake with a Magnitude 6.7 or greater occurring in Southern California in the next 30 years is estimated to be 97%.

Based on the earthquake shaking potential in the Inland Empire region, the proximity to the above listed fault systems, the probability of seismic ground shaking generating damage is considered Possible.

**Vulnerability to the Hazard**

A considerable challenge regarding earthquakes is they generally occur without warning. The fault systems surrounding the region all cross major transportation routes potentially reducing the availability of access and the supply chain. The geographic location of CSU San Bernardino places the campus in a suburban community near residential, commercial, and industrial areas that is moderately populated. Earthquake effects experienced in the neighboring local community will likely spill over onto the campus.

The known fault systems generating the threat to San Bernardino generally surround the city and some cross into the city including near the CSU San Bernardino campus. The San Andreas Fault traverses the northern edge of the campus. The proximity and potential for large earthquake development from these surrounding systems expose significant vulnerabilities. The potential for earthquake damaged structures being left uninhabitable including campus residence halls will result in numerous displaced

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42 San Bernardino County Multi-Jurisdictional Hazard Mitigation Plan, 2017
43 Southern California Earthquake Center, Earthquake Information, [https://scedc.caltech.edu/earthquake/faults.html](https://scedc.caltech.edu/earthquake/faults.html)
individuals and households. The lack of earthquake insurance will cause extreme financial burdens on those affected.

Elements of the vulnerability to a major earthquake on the CSU San Bernardino campus will vary depending on when the earthquake were to strike. The primary basis of vulnerability is based on the population affected and the built environment exposed. In general, newer construction will be more earthquake resistant than older buildings as building codes and construction technology have improved. A locally centered earthquake, even from moderate events, would have the potential for more damaging results when associated with the moderate liquefaction zones of the area. This would particularly be seen with greater damages to unreinforced masonry buildings.

The risk to the campus population will be lessened during periods when classes are not in session or during periods of breaks. Conversely, during the days and hours that classes are in session and staff are at their workplaces, the human vulnerability increases. Generally, people are safer when at home in wood frame structures as earthquakes tend to generate less structural damage to wood construction than in commercial or industrial facilities. The greater number of people on campus at the time of an earthquake will result in more people being exposed to effects from damaged campus facilities or equipment and require greater evacuation assistance. However, in region-wide events this vulnerability may simply shift to the homes and workplaces of members of the campus community and their families.

The aftermath of a major earthquake will likely result in widespread search and rescue operations for trapped and injured individuals. The demand on emergency services will be great, potentially requiring the campus community to be prepared for these scenarios and initiate response actions as needed. There will be needs for emergency medical care, shelter, water, and food for individuals who have been displaced by the earthquake. In earthquakes causing significant damages, there may be a necessity to provide assistance with identification and support to local agencies in mass fatality management.

There may be a need to evacuate members of the campus community from the campus and to other locations that are deemed to be safer locations. As the CSU San Bernardino campus is downstream from dam facilities, the decision to evacuate will need to take into account whether flood control facilities are filled with water and the actual threat to the dam or levees.

Certain campus populations will experience greater challenges to a post-earthquake environment. Vulnerable populations including those that rely on specific services, require electrical power, homeless students, experience disabilities, non-English speakers, those whose age make evacuating difficult, and others will be most affected. These individuals will likely need to navigate through earthquake generated debris, extreme stresses of a disaster, an inability to communicate to or gain access to support networks, and find difficulty in accessing equipment or supplies to aid in a specific need.
Estimate of Potential Losses

Estimates of potential losses will be influenced by a variety of factors. The intensity of the earthquake will determine what scale of damages affecting campus infrastructure, equipment, and other impacted features. Losses will be generated by the physical damages, the loss of revenue, loss of academic research, loss of building contents, and community wide economic reductions.

Based on estimate replacement costs of facilities and structures on campus, the maximum total replacement costs due to earthquake are $626,694,141.

Table 19-19: HAZUS Peak Ground Acceleration Zone (PGA) Estimated Losses

<table>
<thead>
<tr>
<th>PGA Zone Designation</th>
<th>Intensity</th>
<th>No of Buildings</th>
<th>Maximum Replacement Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Extreme</td>
<td>X+</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Violent</td>
<td>IX</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Severe</td>
<td>VIII</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Very Strong</td>
<td>VII</td>
<td>81</td>
<td>$626,694,141</td>
</tr>
<tr>
<td>Strong</td>
<td>VI</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Moderate</td>
<td>V</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Light</td>
<td>IV</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Weak</td>
<td>II-III</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Not Felt</td>
<td>I</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>NA</td>
<td>NA</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>No Building Value Data Provided*</td>
<td>NA</td>
<td>31</td>
<td>Unknown</td>
</tr>
</tbody>
</table>

*Buildings with no value defined are also included in the respective Zones they are found in.

The facilities of the CSU San Bernardino, Palm Desert campus are not included in the above table. The estimated facility costs were not available at the time of assessment.

Vulnerability Assessment Conclusions

It is difficult to predict the severity of casualties, property, and cascading impacts generated by future seismic events affecting the greater San Bernardino County, Low Desert region, and the CSU San Bernardino campus. Each of the earthquake generated effects will vary widely based on the intensity of the earthquake, location of the epicenter, proximity to people and development, time of day and year, the soil composition under the impacted structures, building construction, among others. In any case, the potential for a major earthquake exists affecting the campus and causing extensive challenges to the CSU San Bernardino campus and community.

In the event that a major earthquake was to strike along the many fault systems surrounding San Bernardino, the effects could be significant to the campus community and campus operations. The widespread impacts generated by a major earthquake would extend the effects of casualties, damages, and other impacts to the broader San Bernardino County region creating large-scale regionwide needs for critical assistance
and a heavy demand on limited emergency resources. The threat and impacts presented to the campus will be shared with the campus community from their homes and places of work. The campus will likely be required to address critical needs independently during early phases of the disaster.

The campus population are additionally vulnerable to the effects of major ground shaking that are far reaching. The psychological and social impacts a major earthquake will give rise to will potentially harm individuals and cause tremendous fear. The willingness to return indoors may be hampered especially as after-shocks continue. These effects are magnified for populations having specific vulnerabilities or access limitations. Populations having various limitations or specific needs may be vulnerable to reduced or eliminated access to essential services that have been rendered incapable to respond.

Identified Data Limitations

Data limitations include missing campus structural replacement costs, and lack of a complete inventory of building construction types to include status of earthquake retrofitting. HAZUS generated analysis is focused on the broader community level versus fine-tuning the analysis to the micro-level for facilities such as a university campus.

Erosion

Description of the Hazard

The US Geological Survey (USGS) defines erosion as “the process whereby materials of the earth’s crust are loosened, dissolved, or worn away and simultaneously moved from one place to another”. Erosion may occur in areas of streams and rivers, along bluffs, around immovable objects (such as buildings or bridge abutments), or as a cascading result of other natural hazards, such as earthquakes or wildfires. When erosion occurs along bodies of water, the removal of material causes the shore to move further landward.

Forces such as sea level rise and changes in sediment supply impact erosion gradually and can be difficult to recognize. In contrast, the impacts of short-term events, such as storms and flooding, can be severe and are immediately recognizable.

Location of the Hazard

Erosion is a relatively non-spatial hazard that can occur in any location with conducive soil structure and a source of movement such as water or wind. An area’s potential for erosion is determined by several factors, including rainfall, topography, soil characteristics, and vegetative cover. Streambank and bluff erosion can occur near any riverine area. For the purpose of this campus-level analysis, the erosion hazard poses a consistent risk across those areas of the campus with erosion-prone characteristics.

such locations have been identified on the campus, though an effort to do so may be conducted in the future.

Extent of the Hazard

There is no published scale of severity or extent for this geologic hazard. If conditions are favorable, erosion is likely to occur. Given no history of occurrence and no known erosion prone locations on campus, the planning committee ranks the extent of the hazard as **Low**.

History of the Hazard

**There have been no recorded incidents of erosion on the CSU San Bernardino campus.**

Potential Impacts of the Hazard

Erosion causes instability in soil. During high-intensity rain events, for example, eroded areas will continue to erode, resulting in additional loss of soil and ground stability in the area. This removal of sediment can result in damage to infrastructure, public health, and safety. On campus, areas of erosion can create pedestrian and transportation hazards, and structures may become unsafe if erosion is not controlled.

Probability of Future Occurrence of the Hazard

Erosion is an on-going and dynamic process that occurs regularly. As climate change induces more frequent and intense weather events, such as wildfires and flooding, erosion may generally become more widespread or severe. These events can cause erosion or exacerbate areas already experiencing erosion. As a result, and in consideration of the potential extent of erosion, the probability of future occurrence for at least a limited degree of erosion occurring somewhere on the campus is **High over the long term**.

Vulnerability to the Hazard

Topography, soil structure, land use, and precipitation are all factors of erosion. CSU San Bernardino infrastructure and buildings located on steep slopes, in areas with little vegetation, or in areas with conducive soil types are more vulnerable to erosion.

In the wider San Bernardino community, erosion vulnerabilities include agricultural sector job loss, degradation of riverine ecosystems, and loss of water quality.

Estimate of Potential Losses

The historic and potential impacts of erosion on property statewide include reduced agricultural productivity, lower surface water quality, and damaged drainage networks. Current modeling is not precise enough to allow for an assessment of potential losses to buildings and infrastructure on campus.

Vulnerability Assessment Conclusions
While the ability to predict future erosion on the CSU San Bernardino campus is limited, the core issues shaping erosion vulnerability on campus are flora and landscaping. If left unchecked, erosion can cause significant damage to campus infrastructure and the surrounding environment.

**Identified Data Limitations**

The complex interactions between soil erosion factors make predictive modeling, determination of hazard areas, and quantification of loss difficult. Localized data on this hazard is also limited, resulting in more generalized findings.

**Extreme Temperatures (Includes Extreme Cold and Extreme Heat)**

**Description of the Hazard (Extreme Heat)**

What is considered an excessively hot temperature varies according to the normal climate for that region. However, when temperatures are extremely high, people are at higher risk for heat-related illnesses, such as dehydration, heat exhaustion, heat stroke, and in severe cases, death.46

Hazards from extreme heat are made worse when high temperatures are accompanied by high levels of humidity, which is defined as the amount of moisture in the air.47 As the temperature climbs, the air is able to hold more moisture. High humidity prevents the human body from cooling down naturally, which leads people to perceive that the temperatures “feel” hotter. The combination of temperature and humidity is known as the heat index.48

Heat stroke, the most serious heat-related illness, occurs when the body is unable to control its temperature. Body temperature rises rapidly, the sweating mechanism fails, and the body cannot cool down.49 In extreme causes, heat stroke can cause confusion and unconsciousness, so the victim is unable to seek treatment without assistance.

There are several groups of people who are uniquely vulnerable to the effects of extreme heat, such as infants and children, older adults aged 65 and up, athletes and outdoor workers, low-income households, and individuals with certain chronic medical conditions.50

**Location of the Hazard**

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48 Ibid.


Extreme heat events are a non-spatial hazard, and may occur at the Cal State San Bernardino campus.

Extent of the Hazard

Extreme heat has a wide range of extent and severity markers and characteristics. In the City of San Bernardino, monthly average maximum temperatures in June through October range approximately from the high 80s to the high 90s. According to data from the National Climatic Data Center (NCDC), the highest daily temperature recorded at the San Luis Obispo Polytech Station was 113° F on September 2, 1982.

The National Weather Service issues a Heat Advisory when the heat index value is expected to reach 100° – 104° F within the next 12 to 24 hours. Excessive Heat Warnings are issued when there is an anticipated heat index of 105° F or greater that will last for two (2) or more hours. Excessive Heat Warnings are issued by the county when any location in the county is expected to reach those criteria. In anticipation of an Excessive Heat Warning, an Excessive Heat Watch may be issued 1 to 2 days in advance, when the Heat Warning criteria is 50 – 79% likely to occur. Given 28 excessive heat events with three events resulting in deaths and power outage emergencies, the planning committee ranks the extent of the hazard as **Moderate to High**.

Figure 19-10 (following) depicts the National Weather Service’s methodology for determining the heat index, using the % humidity and the actual temperature.

Figure 19-10: Methodology for Determining Heat Index

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As the heat index rises, so does the potential danger to people and animals. Table xx (following) shows the health hazards associated with extreme heat.

Table 19-20: Health Risks Associated with Heat Index

<table>
<thead>
<tr>
<th>Category</th>
<th>Heat Index</th>
<th>Health Hazards</th>
</tr>
</thead>
<tbody>
<tr>
<td>Extreme Danger</td>
<td>130° F or higher</td>
<td>Heat stroke / sunstroke is likely with continued exposure.</td>
</tr>
<tr>
<td>Danger</td>
<td>105° – 129° F</td>
<td>Sunstroke, heat cramps, and/or heat exhaustion is likely with prolonged exposure and/or physical activity.</td>
</tr>
<tr>
<td>Extreme Caution</td>
<td>90° – 104° F</td>
<td>Sunstroke, heat cramps, and/or heat exhaustion is possible with prolonged exposure and/or physical activity.</td>
</tr>
<tr>
<td>Caution</td>
<td>80° – 89° F</td>
<td>Fatigue is possible with prolonged exposure and/or physical activity.</td>
</tr>
</tbody>
</table>

History of the Hazard

Based on data gathered from the National Centers for Environmental Information (NCEI) Storm Events Database, there have been 28 excessive heat events that have affected San Bernardino County. Four deaths were attributed to a heat wave that occurred in September 2007. However, the majority of these events have not impacted the City of San Bernardino as greatly as the eastern areas of the county in terms of power outage impacts. Of the 28 excessive heat events identified for the County of San Bernardino, only two (in 2006 and 2010) have affected the city. In 2006, an excessive heat incident caused a power outage event, which then escalated to a Stage One CAISO Power Emergency and a 2010 heat wave that impacted much of the southeastern desert region.

Potential Impacts of the Hazard

During an excessive heat event, Cal State San Bernardino may experience impacts from extreme heat due to cancelled classes or postponed outdoor events in order to protect students, faculty, and staff from the weather.

In addition to the threat extreme heat poses to humans, high temperatures also pose a threat to utility production, which in turn threaten facilities and operations that rely on utilities. As temperatures rise, more people stay indoors, increasing the demand for air

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conditioning, fans, and other electronics. This puts a strain on the electrical grid, which can cause temporary outages. These outages can impact operations throughout campus, resulting in interruptions and delays in service. Outages may also negatively impact research efforts on campus, as the inability to maintain a steady, constant temperature may impact research specimens and experimental results.

**Probability of Future Occurrence of the Hazard**

The City of San Bernardino regularly experiences summertime temperatures well into the 90s. Using the scale provided, it is Possible that this hazard will occur annually.

**Vulnerability to the Hazard**

When dealing with an extreme heat event, the most common impacts are those generally felt by the people living in the targeted area. For people in particular, heat can kill when the body is pushed beyond its limits. Most heat disorders occur because the victim has been overexposed to heat. As discussed, the major human risks associated with extreme heat include dehydration, sunburn, fatigue, heat exhaustion, heat stroke, and in severe cases, death.

Some portions of the population are more at risk to the effects of extreme heat. The very young, the elderly, and certain groups with chronic medical conditions (such as asthma or other pulmonary illnesses, heart disease, poor blood circulation, neurological illnesses, and obesity) are generally more vulnerable to the effects of extreme heat, and are more likely to suffer illness or death as a result.\(^5^4\) This is especially true if exposure is extended for a period of time and preventative measures are not taken immediately.

Cal State San Bernardino is aware of the potential for extreme heat events during the summertime. The county sponsors nearly 50 cooling centers that are open to the public, one located in the City of San Bernardino.

The risk of power shut-offs is of concern to the campus. While the campus has ample warning from the utility, it is a constant threat, particularly during the summertime. In 2020, the campus had its power shut off four times, with the longest outage lasting 24 hours. Several buildings and facilities were forced to run on generator power, which had a significant impact on university operations. Cal State San Bernardino has invested in sustainability measures to reduce its energy footprint and use renewable energy sources. As an example, the school adjusts cooling operations in the San Bernardino Central Plant to use less energy. The water that is used to provide conditioned air is chilled late at night to take advantage of cooler outdoor temperatures and the lower price of electricity. This water is then stored in thermal energy storage tanks which insulates the water throughout the next day.\(^5^5\)

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\(^5^4\) Centers for Disease Control and Prevention. *Heat and People with Chronic Medical Conditions.* Retrieved 03.13.21 from [https://www.cdc.gov/disasters/extremeheat/medical.html](https://www.cdc.gov/disasters/extremeheat/medical.html)

\(^5^5\) CSUSB Office of Sustainability. *Energy Efficiency.* Retrieved 03.23.21 from [https://www.csusb.edu/sustainability/energy](https://www.csusb.edu/sustainability/energy)
Given the potential for hotter and more frequent heat waves due to climate change, Cal State San Bernardino may want to continue to invest in these types of strategies to handle the risks and vulnerabilities of extreme heat.

Estimate of Potential Losses

Based on the previous historical occurrences, annualized losses are considered to be negligible. In an extreme heat event, loss of human life or health impacts are a greater concern than is property damage.

Vulnerability Assessment Conclusions

While the ability to predict future heat events at the Cal State San Bernardino campus is limited, the effects of climate change may provide some information. According to the Environmental Protection Agency (EPA), Southern California has warmed about three degrees on average over the last century, with less rainfall. This may lead to stronger and more frequent heat events, drought, and an increased risk of wildfires.56

Description of the Hazard (Extreme Cold)

What is considered an excessively cold temperature varies according to the normal climate for that region. However, when temperatures are far below normal, with higher wind speeds, heat leaves the human body more rapidly, which increases the possibility of negative effects from these extreme temperatures.57

The greatest danger from extreme cold is to people, as prolonged exposure can cause frostbite or hypothermia, and can become life threatening. When someone is suffering from hypothermia, body temperatures can become so low that they affect the brain, making it difficult for the victim to think clearly or move well. In the case of frostbite, the frozen tissue becomes numb and the victim may be unaware that anything is wrong until someone else notices.58 This makes hazards from extreme cold particularly dangerous, as people may not understand what is happening to them or what to do about it.

The primary hazards from extreme cold are frostbite and hypothermia. Frostbite is caused by freezing of the skin and underly tissue. It causes a loss of feeling and color in the affected areas of the body, and most often affects the nose, chin, fingers, or toes.59 It can be permanently damaging if not treated promptly and can lead to infection, nerve

damage, or amputation in severe cases.60 The risk of frostbite is increased in people with preexisting conditions, the elderly, people with reduced blood circulation, and people who are not dressed warmly enough for the conditions.

Hypothermia occurs when the body loses heat faster than it can produce heat, causing a dangerously low body temperature. A normal body temperature is around 98.6°F. Hypothermia occurs when your body temperature falls below 95°F.61 As this happens, the heart and other essential organs cannot work properly. If hypothermia is not treated, it can lead to heart failure, respiratory failure, and eventually to death.

Excessive or extreme cold can accompany severe winter weather, or it can occur without severe weather. For this reason, extreme cold is a separate hazard from severe winter storms.

**Location of the Hazard**

Extreme cold events are a non-spatial hazard, and may occur at the Cal State San Bernardino campus.

**Extent of the Hazard**

Extreme cold has a wide range of extent and severity markers and characteristics. Average nighttime winter temperatures in the City of San Bernardino are typically in the low 40s to mid-40s. According to data from the National Climatic Data Center (NCDC), the lowest daily temperature recorded in San Bernardino was 16°F, which was reported on two consecutive days, January 21-22, 2002. Given 8 frost/freeze events and no extreme cold events, the panning committee ranks the extent of the hazard as **Low**.

The National Weather Service issues Extreme Cold Warnings when the temperature feels like it is -30°F or colder across a wide area for a period of at least several hours. When possible, these advisories are issued a day or two in advance of the conditions.62

The most common extent/severity marker for extreme cold is the Wind Chill scale. Figure 19-11(following) depicts the National Weather Service’s methodology for determining the wind chill, using wind speed and actual temperature. Although wind chill is not necessarily related to extreme cold as a single cause, the advisory system that the NWS currently uses relies on wind chill to relay warning and advisory information to the public. Extreme cold severity is a function of wind chill and other factors, such as precipitation amount (rain, sleet, ice, and/or snow).

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60 Ibid.
In 2011, the National Weather Service introduced an experimental program that issued warnings for extreme cold events, independent of other severe weather warnings. The test areas included North and South Dakota and Minnesota. However, in 2012, after a single season of use, the program was abandoned, based on reports of confusion among test audiences.64

History of the Hazard

Based on data gathered from the National Centers for Environmental Information (NCEI) Storm Events Database, San Bernardino County has had eight frost/freeze events on record dating back to 1998, but no extreme cold hazards. [Records for this hazard were first recorded in 1996].

Potential Impacts of the Hazard

Should an extreme cold event occur, Cal State San Bernardino might experience impacts due to cancelled classes.

In addition to the threat posed to humans, extreme cold weather poses a significant threat to utility production, which in turn threatens facilities and operations that rely on utilities, specifically climate stabilization. As temperatures drop and stay low, increased demand for heating places a strain on the electrical grid, which can lead to temporary outages. These outages can impact operations throughout the campus, which can result in interruptions and delays in services. These outages may also negatively impact research efforts throughout the campus, as the inability to maintain a steady, constant temperature may result in unintended effects on research specimens.

Probability of Future Occurrence of the Hazard

The City of San Bernardino has experienced frost/freeze events, but has never experienced an extreme cold event. Due to the campus’s location in a temperate climate, it is Unlikely that this hazard will occur annually.

Vulnerability to the Hazard

When dealing with an extreme cold event, the most common impacts are those generally felt by the people living in the targeted area. For people in particular, extreme cold can kill when the body is pushed beyond its limits. Most danger due to the cold is because the victim has been overexposed to low temperatures. As discussed, the major human risks associated with extreme cold include frostbite, hypothermia, and in severe cases, death.

Some portions of the population are more at risk to the effects of extreme cold. The elderly, those with certain preexisting conditions (hypothyroidism, diabetes, and high blood pressure, just to name a few), those with poor blood circulation, and people who are not dressed warmly enough for the cold are generally more vulnerable and are more likely to suffer illness or death as a result.65 This is especially true if exposure is extended for a period of time and preventative measures are not taken immediately.

Cal State San Bernardino is one of the CSU campuses facing the greatest variance in temperatures. Wintertime low temperatures average out in the 40s, while summertime highs are typically in the 90s. The campus has faced several freeze/frost events, but cold nighttime temperatures in the fall and winter are not unusual due to the Santa Ana winds.

Estimate of Potential Losses

Based on the previous historical occurrences of extreme cold events, annualized losses are considered to be negligible. In an extreme cold event, loss of human life or health impacts are a greater concern than is property damage.66

Vulnerability Assessment Conclusions

While the ability to predict future extreme cold events at the Cal State San Bernardino campus is limited, the effects of climate change may provide some information. According to the Environmental Protection Agency (EPA), areas of Southern California have warmed approximately three degrees on average over the last century, with less rainfall. This may lead to fewer frost/freeze events in the future.67

Identified Data Limitations

Numerous public and private actors conduct research, acquire data and disseminate meteorological information and forecasting to the general public, including the CSU university system. Currently, it is assumed that, apart from regular access to climate change models on changes to temperature extremes over time, the CSU community maintains sufficient access to the data needed to plan for, respond to, and mitigate the effects of extreme heat and cold.

Flood

Description of the Hazard

The incredible geographic diversity in California presents tremendous challenges for flood planning and response. The state is home to extensive mountain ranges such as the Sierra Nevada, Cascades, Klamath, Coastal Ranges, and the Southern California Transverse Range all creating tremendous watersheds. Large river systems drain the mountains traveling through populated communities including the Sacramento and San Joaquin Rivers draining into the California Delta. The state has a complex system of reservoirs, dams, and levees providing water storage and flood protection. Finally, California’s 840-mile coastline exposes the coastal regions to tidal influences.

Floods are characterized by the rising and overflowing of excess water from a water source such as a stream, river, lake, canal, or coastal body onto an area of normally dry floodplain. A floodplain is a lowland area downstream and adjacent to water bodies that

are subject to flood events. Flooding is a naturally occurring event that become hazardous when populations and property are affected.

Flooding can result from excessive precipitation from weather systems generating prolonged rainfall, excessive snowmelt from watersheds upstream from the floodplain, infrastructure failure, exceeding the capacity of dams or levees, tidal influences, or a combination from any of the previous factors.

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Flooding can result from excessive precipitation from weather systems generating prolonged rainfall, excessive snowmelt from watersheds upstream from the floodplain, infrastructure failure, exceeding the capacity of dams or levees, tidal influences, or a combination from any of the previous factors.
may result in a catastrophic flood with limited warning time and widespread areas affected.

- **Coastal Flooding** – Coastal flooding can occur in multiple areas along the California coastline. Flooding may result from intense storms coming from the Pacific Ocean that generate elevated water levels or storm surge. The size, duration, winds generated, and intensity of the storm will influence the effect the waves will have on the shoreline. Periods of high tide can aggravate the conditions allowing greater wave impingement into coastal areas.

**Atmospheric Rivers**

California, including the location of this campus, is subject to the effects of a phenomenon referred to as atmospheric rivers. These weather events consist of long, narrow regions in the atmosphere transporting tremendous amounts of water vapor from the tropics. These weather regions behave like rivers in the sky. They can carry heavy volumes of water vapor compared to the amount of water flow at the mouth of the Mississippi River. As these atmospheric rivers arrive into California, they tend to generate significant rain and snow.

Atmospheric rivers can arrive in many different shapes and sizes. The larger events are able to generate extreme rainfall amounts resulting in flooding. They can stall over watersheds vulnerable to flooding, often saturated with heavy snow amounts. The atmospheric rivers known as a “Pineapple Express” coming from the tropics and arriving with warmer air may produce heavy rains that will melt ground snow adding to the water volume that will be added in the flood runoff.

These events can produce heavy amounts of precipitation creating extensive damages. However, these events may present as weaker systems that produce precipitation that is enough to be beneficial for the local water supply. At the higher elevations in the California mountains, these events have the potential to generate a tremendous snowpack providing a source of water during the dry summer months.
Location of the Hazard

San Bernardino is located in the eastern end of the Inland Empire region of Southern California. San Bernardino is comprised of a diverse geography including dense urban areas, suburban neighborhoods, heavy industry, open fields, vegetation filled valleys, and the elevation rise into the San Bernardino Mountains. The City of San Bernardino sits at the base of the San Bernardino National Forest and steep mountain slopes. Along the northern edges of the CSU San Bernardino campus is the boundary to hillsides and drainages from higher elevations. These ravines drain the mountains that the campus sits below into the Devils Canyon and surrounding drainages. The Devils Canyon Reservoir facilities provide water distribution control for the State Water Project and local flood control that contribute to the potential for flooding on campus. The area surrounding the campus is a combination of developed suburban environments predominately consisting of residential and commercial land uses and open hillsides.

The CSU San Bernardino campus is entirely located in a designated Zone X: Area with Reduced Flood Risk Due to Levee. The access routes into and out of the campus servicing locations to the west and south are found in areas primarily designated as Zone X. The CSU San Bernardino campus is located adjacent to the Devils Canyon reservoir. The campus is situated in a valley between the San Bernardino Mountains and the Shandin Hills. The mountains to the north of the campus rise to over 5,000 feet in elevation and provide a collection source for the orographic effect of Pacific storms. The campus and the surrounding neighborhoods sit on a gentle slope allowing for most localized precipitation to drain south and away from the campus. The northern San Bernardino neighborhoods are served by a series of catchment basins and flood control channels to further distribute water.
Extent of the Hazard

The CSU San Bernardino campus is entirely located in a designated Zone X: Area with Reduced Flood Risk Due to Levee. The access routes into and out of the campus servicing locations to the west and south are found in areas primarily designated as Zone X: Area of Minimal Flood Hazard, access routes to and from the east are primarily located in Zone X: Area with Reduced Flood Risk Due to Levee or Zone X: 0.2% Annual Chance Flood Hazard. The CSU San Bernardino, Palm Desert Campus is entirely located in a designated Zone X: Area of Minimal Flood Hazard. The access routes into and out of the Palm Desert Campus are found in areas primarily designated as Zone X: Area of Minimal Flood Hazard. Based on the campus’ location in a minimal flood risk zone, and a history of limited and localized flooding, the planning committee ranks the extent of the hazard as Low.

In support of the NFIP, FEMA identifies those areas that are more vulnerable to flooding by producing Flood Hazard Boundary Maps (FHBM), Flood Insurance Rate Maps (FIRM), and Flood Boundary and Floodway Maps (FBFM). Several areas of flood hazards are commonly identified on these maps, including the 1% annual chance flood zone. Flood zones are further delineated by risk and are assigned a letter signifier. The flood zone designations are defined and described in the following table.

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Table 19-21: Flood Zone Designations and Descriptions

<table>
<thead>
<tr>
<th>Zone Designation</th>
<th>Percent Annual Chance of Flood</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Zone V</td>
<td>1%</td>
<td>Areas along coasts subject to inundation by the 1% annual chance of flooding with additional hazards associated with storm-induced waves. Because hydraulic analyses have not been performed, no BFEs or flood depths are shown.</td>
</tr>
<tr>
<td>Zones VE and V1-30</td>
<td>1%</td>
<td>Areas along coasts subject to inundation by the 1% annual chance of flooding with additional hazards associated with storm-induced waves. BFEs derived from detailed hydraulic analyses are shown within these zones. (Zone VE is used on new and revised map in place of Zones V1-30.)</td>
</tr>
<tr>
<td>Zone A</td>
<td>1%</td>
<td>Areas with a 1% annual chance of flooding and a 26% chance of flooding over the life of a 30-year mortgage. Because detailed analyses are not performed for such areas, no depths or base flood elevations are shown within these areas.</td>
</tr>
<tr>
<td>Zone AE</td>
<td>1%</td>
<td>Areas with a 1% annual chance of flooding and a 26% chance of flooding over the life of a 30-year mortgage. In most instances, BFEs derived from detailed analyses are shown at selected intervals within these zones.</td>
</tr>
<tr>
<td>Zone AH</td>
<td>1%</td>
<td>Areas with a 1% annual chance of flooding where shallow flooding (usually areas of ponding) can occur with average depths between 1 – 3 feet.</td>
</tr>
<tr>
<td>Zone AO</td>
<td>1%</td>
<td>Areas with a 1% annual chance of flooding, where shallow flooding average depths are between 1 – 3 feet.</td>
</tr>
<tr>
<td>Zone X (shaded)</td>
<td>0.2%</td>
<td>Represents areas between the limits of the 1% annual chance flooding and 0.2% chance flooding.</td>
</tr>
</tbody>
</table>
Areas outside of the 1% annual chance floodplain and 0.2% annual chance floodplain, areas of 1% annual chance sheet flow flooding where average depths are less than one (1) foot, areas of 1% annual chance stream flooding where the contributing drainage area is less than one (1) square mile, or areas protected from the 1% annual chance flood by levees. No BFEs or depths are shown within this zone.

History of the Hazard

Flooding in San Bernardino and the broader Inland Empire region have typically occurred during the winter months when Pacific storms are more common. The occurrences of significant flooding typically have been the result of successive intense storms with heavy precipitation. The region has experienced flood events that have caused tens of millions of dollars in damages and casualties. The following provides insight into information of past flooding events that are significant to the CSU San Bernardino campus. No record of flood events are reported for the campus, but in general, occasional heavy rainfall events will produce limited and localized ponding in low lying areas.

Table 19-22: Historic Flooding Events in San Bernardino County

<table>
<thead>
<tr>
<th>Date</th>
<th>Event</th>
<th>Declaration</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>September 1976</td>
<td>Flood; Tropical Storm</td>
<td>DR-521-CA</td>
<td>Countywide</td>
</tr>
<tr>
<td>February 1978</td>
<td>Flood; Winter Storms</td>
<td>DR-547-CA</td>
<td>Countywide</td>
</tr>
<tr>
<td>February 1980</td>
<td>Flood; Winter Storms</td>
<td>DR-615-CA</td>
<td>Countywide</td>
</tr>
<tr>
<td>June 1983</td>
<td>Flash Flood</td>
<td>DR-687-CA</td>
<td>Mountains, Deserts</td>
</tr>
<tr>
<td>February 1992</td>
<td>Winter Storms</td>
<td>DR-935-CA</td>
<td>Countywide</td>
</tr>
<tr>
<td>January 1993</td>
<td>Winter Storms</td>
<td>DR-979-CA</td>
<td>Countywide</td>
</tr>
<tr>
<td>January 1995</td>
<td>Flash Flood; Heavy Rains</td>
<td>DR-1044-CA</td>
<td>Countywide</td>
</tr>
<tr>
<td>March 1995</td>
<td>Flash Flood; Heavy Rains</td>
<td>DR-1046-CA</td>
<td>Countywide</td>
</tr>
<tr>
<td>February 1998</td>
<td>Flood; Winter Storms</td>
<td>DR-1203-CA</td>
<td>Countywide</td>
</tr>
<tr>
<td>January 2005</td>
<td>Flood; Winter Storms</td>
<td>DR-1577-CA</td>
<td>Countywide</td>
</tr>
<tr>
<td>February 2005</td>
<td>Flood; Debris Flows</td>
<td>DR-1585-CA</td>
<td>Countywide</td>
</tr>
<tr>
<td>January 2010</td>
<td>Flood; Winter Storms</td>
<td>NA</td>
<td>Countywide</td>
</tr>
<tr>
<td>August 2013</td>
<td>Flood; Tropical Storm</td>
<td>NA</td>
<td>Mountains, Deserts</td>
</tr>
<tr>
<td>February 2014</td>
<td>Winter Storms</td>
<td>NA</td>
<td>Countywide</td>
</tr>
<tr>
<td>January 2016</td>
<td>Flood; Heavy Rains</td>
<td>NA</td>
<td>Countywide</td>
</tr>
<tr>
<td>January 2017</td>
<td>Flood; Winter Storms</td>
<td>DR-4305-CA</td>
<td>Countywide</td>
</tr>
</tbody>
</table>

70 San Bernardino County Multi-Jurisdictional Hazard Mitigation Plan, 2017
Potential Impacts of the Hazard

A flood will potentially result in extensive amounts of water entering onto developed areas. The force and volume of water that is generated by a flood may cause extensive structural damage in areas subject to standing or moving water. The effects of flooding may spread over significant distances covering large areas of land. The extent of the impacts would vary based on a number of factors such as the volume of water flooding, the time of the flood event, the amount of warning provided, the location and extent of the flood boundary, facility elevation, and distance from the flood source. Potential impacts resulting from flooding include:

- Injuries or loss of life
- Property destruction or damage
- Loss of property contents
- Infrastructure damage including roadways, bridges, other transportation means
- Public health hazards resulting from mold, mildew, and disease due to flood water
- Flooded or destroyed lifelines/supply routes
- Damaged or destroyed utilities
- Loss of community economic base
- Employment losses
- Agricultural (crops and livestock) damages or destruction
- Environmental damage
- Prolonged periods of necessary dewatering
- Flooding erosion may alter natural drainage channels
- Societal and community impacts
- Psychological impacts of impacted populations
- Disruptions to education delivery to community
- Damage or destruction of academic materials, fine arts, and research
- Damage or destruction of university computer systems and networks
- Damaged university infrastructure
- Inability for campus operations to resume
- Reduced or eliminated student engagement with academic programs
- Reductions in campus revenues

Additionally, individuals who were unable to evacuate in time or refused to leave will likely need assistance or rescue from the flooded area. Remaining in or being trapped by flood waters places individuals in significant risk of injury or death. The impacts extend beyond the danger placed upon the affected individual and places greater resource demands on agencies and organizations making efforts to rescue trapped individuals.

Probability of Future Occurrence of the Hazard
San Bernardino County is determined have considerable portions of the county to be at high risk from flooding. Flooding is the second most common and widespread hazard identified by the County. San Bernardino County has experienced 10 flooding events since January of 2010. The repeated historic occurrences have shown that the region is subject to flooding in any given year. Floods can occur at any time but are most common in the San Bernardino area with winter storms saturated with subtropical moisture. The CSU San Bernardino campus is located within a Zone X Special Flood Hazard Area (Area with Reduced Flood Risk Due to Levee) and borders a Zone A (Area Inundated by 1% Annual Chance for Flooding). There are specific buildings and areas of the campus that have a greater risk for isolated flooding.

The probability of future occurrence for flooding is **Unlikely**.

**Vulnerability to the Hazard**

The CSU San Bernardino campus is subject to the effects of limited and localized flooding resulting primarily from excessive precipitation and isolated strong storms. There is a remote potential for flooding and damage on campus and surrounding residential and commercial areas of northern San Bernardino due to overflow or damage to flood control systems at Devils Canyon. The channels and extending irrigation channels that surround the campus have limited storage or volume capacities. However, the campus and the campus community are vulnerable to the effects generated by flooding from these systems.

Vulnerability to flooding on the CSU San Bernardino campus will vary depending on when the flood were to occur and depending on whether any people and assets are located near low lying flood prone areas where localized flooding or ponding occurs. The risk to the campus population will be lessened during periods when classes are not in session or during periods of breaks. Conversely, during the days and hours that classes are in session and staff are at their workplaces, the human vulnerability increases. Members of the campus community may become trapped on campus depending on the level of flooding occurring on surface streets. However, during low probability, severe region-wide events this vulnerability may be extended to the homes and workplaces of members of the campus community and their families.

CSU San Bernardino is in proximity to a variety of industrial and commercial facilities in the areas east of the campus. When these facilities are inundated with flood water, the potential for chemical release exists presenting possible exposures to individuals from the campus community. These facilities additionally line many of the primary access routes in and out of the campus. The areas that these facilities reside are lower in elevation than the campus.

The campus sits on land that slowly elevates towards the San Bernardino Mountains that are situated behind the university limiting the effects of widespread flooding. Some campus buildings and infrastructure might be vulnerable to localized flooding if it reaches the university. Campus utilities and communication capabilities might be impacted by flood waters rendering them disabled. A low probability flood covering a large portion of
the city might affect communication capabilities well beyond the boundaries of the campus. Remaining flood waters will leave behind molds and other health concerns in affected campus buildings and facilities likely requiring extensive restoration or demolishing. The residents of the on-campus residence halls may have transportation limitations requiring evacuation and alternative housing procedures to be implemented if populated. Flood waters may result in damage to campus equipment, communication systems, protected documents, artwork, academic materials, computer systems, research, and other critical activities on lower levels of buildings in any areas of the campus prone to localized flooding.

Certain campus populations will experience greater challenges to a post-flood / failure environment. Vulnerable populations will likely need to navigate through flood generated debris, face extreme health safety issues from flood waters, experience extreme stresses of a disaster, an inability to communicate to or gain access to support networks, and find difficulty in accessing equipment or supplies to aid in a specific need. Students remaining on campus such as those residing in the residence halls would be particularly vulnerable especially those without access to adequate transportation.

Estimate of Potential Losses

Estimates of potential losses will be influenced by a variety of factors. The volume and force of the water will determine the scale of damages affecting campus infrastructure, equipment, and other impacted features. The location and elevation above flood waters will affect the level of damage and individuals exposed. The time of the academic year, the day of week, and hour in which the flooding was to occur will influence the number of people on campus and potential casualties. The severity of the storms producing precipitation, the speed of the storms moving across the area, the level of snowpack in the higher elevations, and amount of resulting snowmelt will produce varying effects on damages produced and costs incurred. Losses will be generated by the physical damages, the loss of revenue, loss of academic research, loss of building contents, and community wide economic reductions.

Based on estimate replacement costs of facilities and structures on campus, the maximum total replacement costs due to flood are $626,694,141. However, it is unlikely for flood to cause destructive losses to the entire campus.

Table 19-23: Special Flood Hazard Area (SFHA) Estimated Losses

<table>
<thead>
<tr>
<th>Zone Designation</th>
<th>No of Buildings</th>
<th>Maximum Replacement Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Zone V</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Zone VE &amp; V 1-30</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Zone A</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Zone AE</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Zone AH</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Zone AO</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Zone X .2%</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>
Zone X Levee Reduced Risk | 81 | $626,694,141  
Zone X Minimal Risk | 0 | 0  
Not in a SFHA | 0 | 0  
No Building Value Data Provided* | 17 | Unknown  

*Buildings with no value defined are also included in the respective Zones they are found in.

The facilities of the CSU San Bernardino, Palm Desert campus are not included in the above table. The estimated facility costs were not available at the time of assessment.

Vulnerability Assessment Conclusions

While the campus is located in an area of minimal flood potential (Zone X), the primary vulnerabilities to flood on campus are people and assets exposed to mostly localized flooding and ponding from overflow of campus creeks or isolated or large-scale storms that produce heavy amounts of precipitation directly over the campus and surrounding neighborhoods. In addition to localized flood vulnerabilities, the proximity to the Devils Canyon system presents an additional hazard for the campus.

The potential for flooding generates the potential for a number of cascading effects such as disruptions to the local economy, utility failures, disruptions to providing for the needs of the community, and development of public health hazards. These effects would be exacerbated by effects of seasonal flooding, ongoing heavy precipitation, or excessive run-off from the watershed contributing to the river system. The potential for widespread flooding and damage of structures due to the force of water, while unlikely, has exponentially powerful impacts on particular segments of the campus community including those with access or functional needs, international students, the homeless, and students residing in the residence halls.

Identified Data Limitations

Data limitations include missing campus structural replacement costs, and an incomplete inventory of both building construction features and mitigation efforts to lessen the impact due to flood inundation. HAZUS generated analysis is focused on the broader community level versus fine-tuning the analysis to the micro-level for facilities such as a university campus.

Hazardous Materials

Description of the Hazard

A hazardous material is defined in California’s State Hazardous Materials Incident Contingency Plan (1991) as “a substance or combination of substances which, because of quantity, concentration, physical, chemical, or infectious characteristics may: cause, or
significantly contribute to an increase in deaths or serious illnesses; and/or pose a substantial present or potential hazard to humans or the environment.” Hazardous materials are one or more of the following: flammable, corrosive or an irritant, oxidizing, explosive, toxic (poisonous or infectious), thermally unstable or reactive, or radioactive. Hazardous materials are ubiquitous in modern society and may be found at all stages of production, consumption, and disposal.

Federal and state laws permit the intentional release of some hazardous materials into the environment such that the risk to human health and the environment is thought to be acceptable. However, sometimes releases are unintentional, resulting from leaks, accidents, or natural hazards. This section focuses on such accidental releases and fall into the following key categories:

**Fixed Hazardous Materials Incident:** A fixed hazardous materials incident is the accidental release of chemical substances or mixtures during production or handling at a fixed facility.

**Transportation Hazardous Materials Incident:** A transportation hazardous materials incident is the accidental release of chemical substances or mixtures during highway, waterway or air transport. Populations, built and natural environments are potentially impacted.

**Pipeline Incident:** A pipeline transportation incident occurs when a break in a pipeline creates the potential for an explosion or leak of a dangerous substance (oil, gas, etc.) possibly requiring evacuation. An underground pipeline incident can be caused by environmental disruption, accidental damage, or sabotage. Incidents can range from a small, slow leak to a large rupture where an explosion is possible. Inspection and maintenance of the pipeline system along with marked gas line locations and an early warning and response procedure can lessen the risk to those near the pipelines.

Hazardous materials can also be classified according to worker safety and health. Information provided by California Division of Safety and Health includes guidelines related to:

- **Safety hazards:** fire and fire byproducts, electricity, flammable gases, unstable structures, demolition, sharp or flying objects, excavations)
- **Health hazards:** carbon monoxide ash, soot and dust; asbestos; hazardous liquids; other hazardous substances; heat illness)

**Natural-Technological Incidents (Natechs):** During the past two decades, increasing attention has been given to hazardous materials releases resulting from Natechs or a

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Hazardous materials and infrastructure such as fuel tanks, rail lines, chemicals, hazardous waste sites and gas pipelines to varying degrees are located within the CSU system and/or within its surrounding communities. The planning committee indicates that chemicals are located in science labs on campus, and mapping indicates that hazardous waste sites, gas pipeline and a rail line are located near campus. At larger scales (beyond the campus planning area) hazardous materials and infrastructure are located throughout the city and county of San Bernardino, and reflect different types, configurations and scales dispersed across these geographic areas.

Extent of the Hazard

There is no comprehensive statewide vulnerability assessment available at this time. As such, the true extent of the hazardous materials risk in California and its communities is not known, meaning no overarching conclusions have been reached which have been able to integrate all qualitative and quantitative risk factors to produce a comprehensive measure of the extent of the hazard.

For the CSU – San Bernardino planning committee, chemicals are managed in campus science labs, and no events have taken place on campus. The rail line, gas pipeline and waste sites are approximately ½ mile from the campus. Based on these factors, the extent of the hazard for the CSU – San Bernardino campus is Low, but to consider worst case scenarios as the main driver of policy in order to fully mitigate all possible hazardous materials event outcomes.

For example, according to the 2018 CA State Hazard Mitigation Plan, 400 hazardous materials problems are tied to 32 past earthquakes, including over 150 problems from the Loma Prieta Earthquake alone. That said, the plan indicates that it is likely that many such hazardous materials releases have received little attention in the past because public authorities, the media, and the public have overlooked them in the rush to address and

recover from immediate disaster threats, and that responsible parties may have an
incentive to understate the extent of releases or not to report them at all.

History of the Hazard

According to the CA Governor’s Office of Emergency Services’ Hazardous Materials Spill
Report, the state experiences from 10 to 30 spill events daily. As of April 20th, 2021 already
2096 spill events had occurred. Such events have occurred in all the cities and/or counties
where CSU campuses are located. 76

According to the 2018 CA State Hazard Mitigation Plan, with regard to natural-
technological hazard events (Natechs), 400 hazardous materials events are tied to 32 past
earthquakes, including over 150 Natech events from the Loma Prieta Earthquake alone.

According to the campus planning committee, no events have taken place on campus.

Potential Impacts of the Hazard

A large hazardous materials release could affect an entire community or city under
certain conditions related to direction of air flow (air-based chemical release) and
population density or the contamination of a community’s main water supply. Either type
of release could necessitate large scale evacuation. By contrast, in the rural
unincorporated areas where population densities are low, even in the event of a large
release, the number of homes that may need to be evacuated would be significantly
lower than in an urban environment. The occurrence of a hazmat incident can also result
in the shut-down of transportation corridors which can last for hours at a time while the
impacted area is stabilized.

The release of some toxic gases may cause immediate death, disablement, or sickness if
absorbed through the skin, injected, ingested, or inhaled. Contaminated water resources
become unsafe and unusable, depending on the amount of contaminant. Some
chemicals cause painful and damaging burns if they come in direct contact with skin.
Prolonged and concentrated exposure to such chemicals can produce severe long-term
impacts to respiratory, endocrine and nervous systems, heart and brain health.

The potential impacts of chemicals and toxic gases discussed here also apply to the
students, staff and environment on the CSU – San Bernardino campus.

With regard to the natural environment overall, contamination of air, ground, or water
may result in harm to fish, wildlife, livestock, and crops. The release of hazardous
materials into the environment may cause debilitation, disease, or birth defects over a
long period of time. Loss of livestock and crops may lead to economic hardships within
the community.

76 Cal OES. Spill Report View. Retrieved 04.21.2021 from:
https://w3.calema.ca.gov/operational/malhaz.nsf/$defaultView?OpenView&Start=121&ExpandView
Recent California examples include the 2016 Aliso Canyon methane gas leak\(^77\), which caused evacuation of nearby residents, many of whom experienced temporary health problems such as difficulty breathing and eye irritation; and the 2016 Fruitland metal recycle plant fire in Maywood, which released heavy metals such as lead, magnesium, copper, aluminum, antimony, calcium, iron, sulfur, tin, potassium, and zinc which pose severe risks to public health. \(^78\) Health effects from exposure to these metals included short-term symptoms such as irritation to the eyes, nose, throat, and lungs.

**Potential Impacts of the Hazard (Natechs)**

Natural disasters, including earthquake, flood, and fire also pose risks to public health and the environment. For example, following the Northridge Earthquake, California State University (CSU) Northridge laboratories and chemical storage rooms experienced multiple chemical spills. Such incidents, triggered by a natural disaster, pose a significant risk to students, faculty, staff, and first responders. At a minimum, all CSU campuses with a science lab (including CSU – San Bernardino) is at risk of potential impact from a natural-technological (combined impact) event.

In a severe flood event, floodwaters are often contaminated with hazardous materials posing a threat to public and animal health, groundwater, and other parts of the environment. These hazardous materials may be released from damaged or flooded underground tank sites (e.g., gas stations or chemical storage facilities), propane tanks, manure or human waste handling facilities, fertilizer and pesticide storage, agricultural sites, and household hazardous waste.

In a fire event, (such as the October 2017 Northern California firestorms which destroyed approximately 6,000 residences) entire neighborhoods can be burned to the ground. Hazardous material release creates public health concerns which can delay the initial steps of fire recovery, including reopening burned areas to residents and initiating debris removal activities. The post-fire “toxic sweep” poses a risk of coming into contact with toxic substances due to the presence of synthetic and hazardous materials.

**Probability of Future Occurrence of the Hazard**

The probability of occurrence for a hazmat event on the CSU – San Bernardino campus can be viewed in two different ways: the history of occurrence serves as a sound predictor of future probability assuming current risk and vulnerability factors remain somewhat constant. For the purposes of the current estimate, no current data clearly indicates otherwise. As such, the probability of occurrence is Low - the campus has not experienced a hazmat event on campus. In addition, hazardous materials and


infrastructure ½ mile away may increase vulnerability and the probability of a campus-
related event. Moreover, hazmat occurrences are largely based on human error, and any
changes in risk and vulnerability factors such as a decreased vigilance in materials
oversight and handling practices or changes in the amount of chemicals or exposure will
likely increase the probability on campus.

Vulnerability to the Hazard

Hazardous materials pose a risk to the CSU – San Bernardino campus. As identified by
the campus planning committee and on the hazmat map, the following vulnerabilities are
present on campus: chemicals are present in science and research labs. In addition, a rail
line, gas pipeline and several hazardous waste sites are about ½ mile to the campus
footprint. Gases and chemicals or hazardous waste, if spilled or released, could impact
human health and campus operations.

Although it is quite difficult to produce a quantitative measure of vulnerability because
(unlike natural hazards) the probability of occurrence is dependent on human error, which
itself is variable based upon a fluctuating set of interrelated factors, some of which lack
prediction or control, given the complexity of how all natural and built environments and
hazmat risks factors interrelate at the local or campus level, it is prudent to assume for
planning purposes that the campus’ vulnerability is a sub-set of the larger community’s
vulnerability. As such, the CSU – San Bernardino leadership maintains vigilance to
mitigate the campus’ vulnerabilities identified above at a minimum.

Estimate of Potential Losses

As discussed previously, it is difficult if not impossible to produce an accurate
quantitative measure of vulnerability because of the variable nature of a hazardous
materials spill. For example, the release of a toxic airborne chemical in a populated area
has severe impact potential, whereas the impact potential of a small chemical spill in a
remote or rural area is most likely limited to remediation of soil. And, in both cases, the
probability of occurrence is dependent on human error, which itself is variable based
upon a fluctuating set of interrelated factors, some of which lack prediction or control. In
all cases, different types and amounts of hazardous materials interact with fluctuating
combinations of human error to produce different event outcomes with variable impact
costs.
Vulnerability Assessment Conclusions

It is well understood that with regards to hazmat vulnerability, each campus and its surrounding community (including CSU – San Bernardino) operates through a complex and dynamic interaction between industrial and commercial inputs and outputs and the natural and built environment. Such activity produces hazardous materials that move through the environment along both convergent and divergent routes and across all levels of land-use from site to campus to city and county and beyond. It is also clear from a review of the San Bernardino County hazard mitigation plan and Cal OES’ records of hazardous material spills, that such events occur with great frequency and varying degrees of severity across jurisdictions statewide. As such, in assessing the vulnerability of the CSU – San Bernardino campus, campus-level risks and vulnerabilities are not discreet or isolated but can become exacerbated or augmented through connections to broader community-level hazmat risks and vulnerabilities.

Finally, in order to draw conclusions on vulnerability, it should be noted that any identified vulnerabilities at the campus level and/or community level are circumscribed and potentially reduced by targeted policy and program interventions. Numerous policies and programs have been established in recent years in response to California’s widespread and complex and integrated hazardous materials risks - California established the Unified Program which consolidates and integrates the administrative requirements, permits, inspections, and enforcement activities of the following environmental and emergency response programs: the Aboveground Petroleum Storage Act (APSA) Program, Area Plans for Hazardous Materials Emergencies, the California Accidental Release Prevention (CalARP) Program, the Hazardous Materials Release Response Plans and Inventories (Business Plans), Hazardous Material Management Plan (HMMP) and Hazardous Material Inventory Statement (HMIS) requirements (California Fire Code), the Hazardous Waste Generator and Onsite Hazardous Waste Treatment (tiered permitting) Programs, and the Underground Storage Tank Program.

Identified Data Limitations

The CSU – San Bernardino planning committee has provided information on campus-level hazmat materials and risks. Data limitations pertain to a comprehensive understanding of human activity and error related to materials control over the long term.
**Landslide**

Description of the Hazard

A landslide is a down-slope movement of soil, rock, or other debris, and can also be referred to as a mass movement or slope failure. These geological hazards can range in size from a few feet to over a mile in length and width and, when heavy and rapidly moving, can cause serious damage and loss of life.

Landslides are classified based on the type of material and type of movement involved. They can range from slow-moving earth flows to fast-moving debris flows, though many large slope failures involve more than one type of movement. The primary natural triggers of slope failures are water, seismic activity, and volcanic activity. Slope saturation by water can occur from intense rainfall, snowmelt, changes in ground-water levels, and surface-water level changes along coastlines. In winter months, El Nino storms or other high rainfall events may saturate soils and trigger slope failure.

**Deep-Seated Landslides**

Deep-seated landslides, ranging in depth from ten to several hundred feet, occur as a result of geologic and hydraulic changes, such as earthquakes or increased levels of groundwater. These landslides can move slowly or quickly and can cause extensive property damage, but rarely result in loss of life.

**Debris Flows Related to Shallow Landslides**

Shallow landslides may mobilize into rapidly moving debris flows and typically occur after sudden saturation of the ground. These types of debris flows are typically more dangerous because they move rapidly, causing both property damage and loss of life.

Debris flows may also occur as a result of post-fire conditions, where wildfires have left barren ground exposed to heavy rainfall. Intense rainfall, generally greater than .5 inch per hour, has the potential to trigger a post-fire debris flow. These landslides may impact lives and properties within its deposition zone, and can result in downstream flooding. These post-fire debris flows often occur during the fall and winter following major summer fires.

Location of the Hazard

The susceptibility of an area to landslides depends on several variables, including magnitude of slope gradients, water content, ground cover, presence of erosion, and slope material and structure. However, landslides are most prevalent in terrain with weak material and steep slopes, and the highest risk is found in areas with high rainfall or high

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earthquake potential. Slope failures are also most likely to occur in areas where they have occurred in the past. In California, the most landslide-prone areas are found along the coast and in the northern Franciscan Formation.

General landslide vulnerability can be estimated from the distribution of weak rocks and steep slopes as seen in Figure 19-15. Based on the Figure below, the campus is adjacent to landslide susceptibility zones and sits between two small areas of high susceptibility.

Figure 19-15: Deep-seated Landslide Susceptibility Surrounding CSU San Bernardino

Extant of the Hazard

In San Bernardino, landslides are more likely to occur in the steep slopes to the north and south of the city. The San Gabriel mountains, both steep and erosive, contain steeply walled canyons above areas with high population density. When heavy rain occurs, there is significant potential for floods and landslides throughout the County, and indirect impacts may cover a larger geographical extent. Based on the campus’ close proximity to

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the landslide hazard zone, and the history of significant impacts in the county, the planning committee ranks the extent of the landslide hazard for the campus as **Moderate**.

**History of the Hazard**

FEMA has declared twelve major disasters involving landslides, mudslides, mud flows, and debris flows since 1978 in San Bernardino County. NOAA recorded thirty debris flow events from 2003 to 2019. On December 25, 2003, a landslide formed in the San Bernardino Mountains and filled the percolation basins located 3.5 miles north of San Bernardino City center, resulting in 14 casualties and $5 million in damage. The landslide was induced by rainfall. No landslides have been reported on or immediately adjacent to the campus.

**Potential Impacts of the Hazard**

CSU San Bernardino may be impacted by the disruption of services as a result of landslides in the region. Landslides can result in physical damage to buildings and property and have the potential to significantly affect infrastructure. As a landslide moves, it distresses structural foundations by settlement, cracking, and tilting. Fast-moving flows can remove entire structures in one instance, while other types of flows can cause damage gradually.

Transportation and utility infrastructure are particularly vulnerable to landslides, since the failure of any component can disrupt service over a large area. The loss of power and communication and disruption of transportation can have cascading effects throughout an area, including impaired disposal of sewage, contamination of water supplies, and the release of flammable fuels. Transportation routes are also often expensive to clean up, and prolonged obstruction can disrupt the movement of people and goods for long periods of time.

**Probability of Future Occurrence of the Hazard**

Slope failures are often triggered by other natural hazards such as heavy rainfall and earthquakes, so landslide frequency is often related to the frequency of these other hazards. As climate change impacts the frequency and intensity of triggers such as rain events, fires, and coastal erosion, landslides may generally occur more often. Historically, landslides have occurred frequently in the San Gabriel Mountains and therefore are highly likely to occur in the future. Given the location of the campus adjacent to the landslide zone, and the occasional occurrence of severe landslides in the county, the planning committee ranks the probability of the landslide hazard in some way affecting the campus as **Possible**.

**Vulnerability to the Hazard**

The vulnerability of the built environment to landslides depends on exposure and is more likely to incur damage as a result of proximity, rather than inferior structural design. The
structures most vulnerable to landslides are buildings and utility/transportation lifelines, which can be impacted by either impact or ground deformation. Utilities and transportation infrastructure are particularly vulnerable, due to their geographic extent and susceptibility to physical distress.

Any population proximal to a landslide when it occurs is vulnerable to its impacts.

Estimate of Potential Losses

There are no current models for estimating potential losses from a landslide directly impacting the campus.

Although the economic impact of landslide damage can exceed that of the direct repair costs, there are currently no applicable methods for estimating indirect costs related to CSU San Bernardino.

Vulnerability Assessment Conclusions

Community exposure to landslides varies depending on their physical locations – whether in flat plains or on steep hillsides – and on their dependence on critical infrastructure located in landslide hazard zones.

Landslides could impact the campus in a variety of ways, primarily related to indirect impacts to transportation and utilities. Utility outages can impact health, particularly for vulnerable populations, and can cause interruptions in operations. Interruptions may impact student and employee’s ability to travel to campus and the delivery of classes and events.

Identified Data Limitations

The ability to predict future landslides at the CSU San Bernardino campus is limited. However, the USGS estimates that climate change-induced shifts in weather will increase the frequency of post-wildfire landslides, which are expected to occur almost every year in California.
**Power Outage**

**Description of the Hazard**

San Bernardino is a city situated in an area of Southern California known as the Inland Empire. Located in San Bernardino County, the City of San Bernardino has a span of nearly 60 square miles and is the home of CSU San Bernardino. The city and county are situated within a valley topography. San Bernardino is unique among Southern Californian cities because of its wealth of water, which is mostly contained in underground aquifers; a large part of the city is over the Bunker Hill Groundwater Basin, including Downtown.

Most aspects of modern life, and almost all aspects of urban life, rely on the availability of reliable utilities, such as electricity, water, and natural gas. An interruption in the supply or distribution of these commodities can leave highly populated areas like San Bernardino without basic services, such as electricity or sanitation. These interruptions can be cascading effects from other hazard events, such as windstorms, floods, wildfires and earthquakes, or they can be caused by intentional disruptions of transmission lines.

A power outage event can interrupt day-to-day operations of the CSU San Bernardino campus, like in-person classes, impede or limit digital, telephonic or radio communications, create traffic jams around the busy avenues and boulevards surrounding the campus, close the student health center, and close restaurants around campus and outside the campus. Additionally, thousands of SJSU student residents in on-campus housing would also be affected by a power outage on campus and in the area.

Additionally, a severe outage to San Bernardino would also directly affect the campus and the community.

Electric power disruptions and outages fall into two categories: intentional and unintentional.

The four types of intentional disruptions are:

- **Planned:** Some disruptions are intentional and can be scheduled based on maintenance or upgrading needs.
- **Unscheduled:** Some intentional disruptions must be done "on the spot" in response to an emergency.
- **Demand-Side Management:** Some customers (i.e., on the demand side) have entered into an agreement with their utility provider to curtail their demand for electricity during periods of peak system loads.
- **Load Shedding:** When the power system is under extreme stress due to heavy demand and/or failure of critical components, it is sometimes necessary to intentionally interrupt the service to selected customers to prevent the entire system from collapsing. These intentional interruptions result in rolling blackouts.
Unintentional or unplanned disruptions are outages that come with essentially no advance notice or warning. This type of disruption is the most problematic. The following are categories of unplanned disruptions:

- Accident by the utility, utility contractor, or others.
- Malfunction or equipment failure.
- Equipment overload (utility company or customer).
- Reduced capability (equipment that cannot operate within its design criteria).
- Tree contact other than from storms.
- Vandalism or intentional damage.
- Weather, including lightning, wind, earthquake, flood, and broken tree limbs taking down power lines.
- Wildfire that damages transmission lines.

Location of the Hazard

Although power outages can take place within a certain area, as a hazard, it has the potential to occur and affect the entire planning area equally.

Extent of the Hazard

In order to anticipate outage conditions and reduce impacts, campus facility managers and others keep track of conditions and data provided by the media, municipal utilities and the California Independent System Operator (CAISO). CAISO is tasked with managing the power distribution grid that supplies most of California, except in areas served by municipal utilities, and is thus the entity that coordinates statewide flow of electrical supply. CAISO uses a series of stage alerts to the media based on system conditions. The alerts are:

- Stage 1 - reserve margin falls below 7 percent.
- Stage 2 - reserve margin falls below 5 percent.
- Stage 3 - reserve margin falls below 1.5 percent.

Rotating blackouts become a possibility when Stage 3 is reached.

A power outage could affect the entire area of the campus, including the CSU San Bernardino athletic fields, classrooms resident halls, administrative offices, virtual, telephonic and radio communications, leading to loss of lighting in campus parking structures, and creating a cascading hazard for commuters as they depart from or arrive to campus in the evening. Additionally, the university is located within proximity of highly utilized thoroughfares for the transportation of goods to throughout California, within one of the busiest areas of the Inland Empire.

Given the prevalence of rolling blackouts and other power outages in California, the campus maintains safety precautions, situational awareness, access to emergency power generators and other protocols for managing campus power outages. However, given that recorded outages have taken place on campus, the planning committee ranks the extent of the power outage hazard as Moderate.
History of the Hazard

The City of San Bernardino has experienced major power outages in the past, affecting a large number of residents. Some of the most recent power outage events include the following:

- September 5, 2020: Rolling power outages occurred in an effort to conserve energy due to an overwhelmed grid and Public Safety Power Shut-offs due to extreme heat and wind events occurring in San Bernardino County.
- December 7, 2020: Southern California Edison cut electricity to more than 43,000 of its customers in public safety power shutoffs as Santa Ana winds battered much of the region.
- January 19, 2021: High wind events prompted SCE to create outages through Public Safety Power Shut offs.

The CSU San Bernardino campus has also experienced power outages in recent years:

- October 10, 2019: Cal State San Bernardino closed because of an electricity outage aimed at mitigating the threat of wildfires amid dry, windy conditions in Southern California.

Potential Impacts of the Hazard

Instructors, campus residents, staff, and administration rely on electricity for basic survival and operations. During a widespread power failure, it may take days to restore operations. Electrical power may be the only cooling source for many individuals around the campus and its community, and long-term outages can potentially put people’s health and life at risk. Disruptions in the supply of heating fuel may put people and property at risk during extremely cold weather if it relies on electric generation or heating mechanisms instead of gas. Additionally, many medical devices, communications devices, and security rely on power to maintain their functions.

Climate Change and Energy Shortage

Climate change is expected to bring more frequent and intense natural disasters. These changes have created a variability at a rate that makes historical data a poor predictor of future climate. For example, the warmest years on record in California occurred in 2014, 2015, and 2016. The 2016-2017 year broke the record as the wettest ever recorded in the northern Sierra Nevada Mountains.

Changes in temperatures, precipitation patterns, extreme events, and sea-level rise have the potential to decrease the efficiency of thermal power plants and substations, decrease the capacity of transmission lines, render hydropower less reliable, spur an increase in electricity demand, and put energy infrastructure at risk of flooding.

With climate warming, higher costs from increased demand for cooling in the summer are expected to outweigh the decreases in heating costs in the cooler seasons. Hotter
temperatures in California will mean more energy (typically measured in “cooling-degree days”) needed to cool homes and businesses both during heat waves and on a daily basis, during the daytime peak of the diurnal temperature cycle. During future heat waves, historically cooler coastal cities (e.g., San Francisco and Los Angeles) are projected to experience greater relative increases in temperature, such that areas that never before relied on air conditioning will experience new cooling demands.

Secondary impacts of energy shortages are most often felt by vulnerable populations. For example, those who rely on electric power for life-saving medical equipment, such as respirators, are extremely vulnerable to power outages. Also, during periods of extreme heat emergencies, the elderly and the very young are more vulnerable to the loss of cooling systems requiring power sources.

**Probability of Future Occurrence of the Hazard**

The probability of California experiencing a power outage can be difficult to quantify but is a hazard that occurs annually during the same seasonal periods of temperature variance throughout the calendar year. The City of San Bernardino experiences such outages. As such, the probability ranking for the San Bernardino area is **Likely**. Since the CSU San Bernardino campus has also recorded power outage events, it is prudent to assign this same ranking for the campus.

Climate models suggest summer global temperatures are likely to increase while changes between temperature extremes would be more pronounced. As such, it is expected that power outages will occur more frequently in the future.

**Vulnerability to the Hazard**

Based on the data available, and in consideration of the increasing effects of climate change, the campus remains vulnerable to power outages in terms of impacts to people, power infrastructure and campus operations. Nonetheless, as discussed campus leadership works to reduce vulnerabilities through consistent use of safety and operational protocols and emergency power sources to ensure it is able to mitigate an interruption to electrical power.

**Estimate of Potential Losses**

The data provided by Cal State San Bernardino State does not report any value for potential losses due to power outage.

**Vulnerability Assessment Conclusions**

Elevators, entry ways, air filtration systems and lighting provide the campus community with the necessary infrastructure and systems to function and navigate through the campus and to maintain a safe campus environment and visibility during nighttime hours. The primary concern for campus leadership is that a loss of power can lead to potential hazards to students, faculty, and staff at SJSU. Vulnerable populations (especially students with physical disabilities) may be the most heavily affected by loss of power, as they rely on elevators, entry ways with automatic doors, and locks and lights; a
power outage would impede a disabled student’s ability to travel and utilize the campus and its structures safely.

The use of communication devices, billing, records, and electrical tools may also become unusable due to a loss of electricity. Many records and billing items may have to revert to “by-hand” procedures and paper copies may have to be kept continuing operations. Additionally, classrooms may not be usable if lighting equipment is not functioning, impacting a semester or quarter’s progress for the academic year.

Identified Data Limitations

Cal State San Bernardino did not report any monetary or life losses due to a power outage. Also, the campus did not report any incidents involving a power outage directly affecting the campus community and operations.
Volcano (Associated Air Quality)

Description of the Hazard

The US Geological Service defines volcanoes as “openings or vents where lava, tephra (small rocks), and steam erupt on to the Earth’s surface. Through a series of cracks within and beneath the volcano, the vent connects to one or more linked storage areas of molten or partially molten rock (magma). This connection to fresh magma allows the volcano to erupt over and over again in the same location.”

A volcanic eruption occurs when magma, lighter than surrounding rock, is driven upwards by its buoyancy and by pressure from the dissolved gases contained within it. Gases are released from magma as it reaches the surface and pressure decreases. Magma can be erupted in several ways and violent eruptions typically cause tiny pieces of tephra (ash) to be carried away by the wind. This ash is hard, does not dissolve in water, is extremely abrasive and mildly corrosive, and conducts electricity when wet.

The gases released in an eruption include carbon dioxide, sulfur dioxide, hydrogen sulfide, and hydrogen halides. Depending on their concentration, these are potentially hazardous to people, animals, agriculture, and property.

Location of the Hazard

There are eight volcanic areas located throughout California. Seven of these - Medicine Lake Volcano, Mount Shasta, Lassen Volcanic Center, Clear Lake Volcanic Field, Long Valley Volcanic Region, Coso Volcanic Field, and Salton Buttes – are considered active volcanoes. No portion of CSU San Bernardino or San Bernardino County is within a volcano hazard zone.

Extent of the Hazard

Volcanic hazards are most severe within a few miles of the volcano vent and the severity generally decreases with distance. Ash impact zones can range from tens to hundreds of miles from the vent source. The US Geological Survey has estimated zones surrounding active volcanoes wherein 2 inches or more of ashfall following an eruption is possible. While CSU San Bernardino does not fall within an estimated ashfall zone, lighter dustings of ash outside of those areas may directly or indirectly impact the campus. As such, the planning committee ranks the extent of the hazard for the campus as Low.

History of the Hazard


No historical eruption events in California have affected the campus. Over the last 1,000 years, there have been at least 12 eruptions in California. The most recent volcanic eruption in California occurred at Lassen Peak about 100 years ago, when a major explosion delivered windborne ash over 275 miles away.
Potential Impacts of the Hazard

The specific impacts vary widely and depend on which type of volcano erupts, the style of explosion, the volume of lava, the eruption duration, and the local water conditions. As CSU East Bay is not proximal to an active volcano, only the potential impacts of ashfall and gases have been detailed. While both these hazards can be widespread, their most severe impacts are generally seen closer to the volcanic source.

Although ashfall is typically a nonlethal volcanic hazard, it is the most widespread and disruptive. Falling ash can damage crops, electronics, and machinery. It can also impact human health by irritating the respiratory tract, eyes, and skin. The particles may enter drinking water and structures and may cause structure failure if it is thick and heavy enough. Even a fine layer of ash can disrupt utilities. A portion of California’s major electric transmission lines, aerial telecommunication lifelines, transportation corridors, and water storage and conveyance lie within the state’s volcano hazard zones. Impacts to any of these can impact operations at CSU San Bernardino.

The potential impacts of gases released during volcanic eruptions are as follows:

- Carbon dioxide typically becomes diluted very quickly and is not life threatening. However, it can become trapped in higher concentrations in low-lying areas and has the potential to be fatal.
- Sulfur dioxide can cause acid rain and air pollution downwind of a volcano.
- Hydrogen sulfide can cause irritation of the upper respiratory tract. At high concentrations it can cause unconsciousness and death.
- Hydrogen halides can coat ash particles and, once deposited, poison drinking water, agricultural crops, and grazing land.

Probability of Future Occurrence of the Hazard

The US Geological Survey, based on the record of volcanic activity in California, estimates that the probability of another small- to moderate-sized eruption in the next thirty years is about 16 percent. As such, the annual probability of future occurrence for the campus is ranked by the committee as Unlikely.

Vulnerability to the Hazard

Populations living near volcanoes are the most vulnerable to eruptions and lava flows. However, volcanic ash can travel and affect populations miles away. The location and thickness of ash in any given area is a function of the severity of the eruption and wind speed and direction. For CSU San Bernardino, there is low vulnerability to the immediate impacts of volcanic eruptions due to the limited area affected and remote potential of an eruption. In the event of a widespread ashfall event, the elderly, infants, and populations with existing respiratory disease will be at higher risk.

Estimate of Potential Losses
Impacts to critical infrastructure, agriculture, and property from ashfall have the potential to cause widespread disruption, damage, and economic loss throughout the state. In the event of a widespread ashfall event, impacts will be immediate.

Current modeling is not precise enough to allow for an assessment of potential losses from ashfall to structures or infrastructure on or surrounding the campus.

**Vulnerability Assessment Conclusions**

CSU San Bernardino is unlikely to experience the direct impacts of a volcanic event. While the campus may be indirectly impacted by ashfall elsewhere in the state, direct ashfall impacts are generally unlikely but possible in a widespread event. However, the likelihood of any volcanic eruption in the state impacting the campus is very low.

**Identified Data Limitations**

Not all active volcanoes in California have been zoned for hazards by the US Geological Survey. This, together with the infrequent occurrence of volcanic explosions and number of factors determining type and extent of impacts, make the quantification of potential loss difficult.

**Wildfire**

**Description of the Hazard**

While wildfires are a natural part of California’s ecosystem, wildfires in California represent a hazard that presents one of the greatest probabilities of destruction along with a demonstrated history of catastrophic fire events in recent years. The destructive fire seasons of 2017 to 2020 illustrated the destructive forces fire presents to communities across the state. Wildfires may result in the structural loss, infrastructure loss, dangerous air quality, environmental damages, economic impacts, injuries, and loss of life. In many communities throughout California, wildfire presents greatest risk to human life and property.

Wildfires have been defined as any free burning vegetation fire that initiates from an unplanned ignition, whether natural or human caused demanding fire suppression actions to contain. These fires are prone to become uncontrolled, spreading through vegetative fuels rapidly exposing people and structures to harm. Wildfires present a significant risk to communities across the state, as evidenced by increasing trends of structural losses from wildland fires. This risk is elevated in areas where development and community growth has intersected, also known as the wildland-urban interface (WUI). In the interface setting, development itself can provide additional fuel for large fires. Recent fires have also demonstrated the ability of fire to consume populated areas in extreme conditions.

California’s Mediterranean climate in combination with its geography and vast population create a combination of factors that promotes an optimal environment for large fire

84 **State of California Hazard Mitigation Plan**, September 2018
growth and consequences. As there is great diversity of geographic characteristics across the state, the risks and potential consequences of wildfire must be assessed locally. The physical location, weather patterns, local fuel types and volume, extent of the WUI, topography, and additional factors will factor differently from part of the state to another.

The behavior of wildfires in California is significantly influenced by three distinct geographic factors. These factors will help shape the size, direction of spread, rate of combustion, fire intensity, and ability to pre-heat fuels. The physical factors contributing to wildfire behavior include:

- **Topography** – The rate in which wildfires spread increases with greater slopes in topography. The greater the slope will result in more pre-heating of fuel above the advancing fire. The direction that a slope faces will also influence fire behavior as south facing slopes receive greater solar radiation and thus drier vegetation that is more susceptible to combustion. Ridgetops often denote the end of fire spread as fire has greater difficulty spreading downhill.

- **Weather** – Weather factors substantially influence the behavior of wildfires. Wind, temperature, humidity, lightning, and lack of precipitation all contribute to a fire’s ability or inability to spread and intensify. California routinely experiences conditions in which these factors are in alignment to contribute to extreme fire behavior during the summer and fall seasons. High winds, low humidity, and high temperatures provide an environment promoting extreme fire activity.

- **Fuels** – Certain types of vegetation are increasingly prone to igniting and promote more intense burning. Areas with greater “fuel loading” (amount of fuel present in terms of weight of fuel per unit of area) increases the amount of fuel to fuel a fire. Greater volumes of dead or dry vegetation compared to live plants is a critical factor. Vegetation during drought conditions will experience decrease in moisture content increasing the conditions for combustion. Fuels close proximity to one another allows for rapid spread through contact or radiant exposures.

A risk assessment for wildfires should be implemented within a geospatial context focusing on the specific location features and incorporates the three components of the wildfire risk triangle – likelihood, intensity, and susceptibility.

**Location of the Hazard**

Substantial portions of the State of California are exceptionally vulnerable to wildfire activity or reside in a wildland-urban interface (WUI) area due to the vast open spaces, rangelands, forests, and other lands with high susceptibility to fire occurring throughout the state. CSU San Bernardino is located along the base of the San Bernardino Mountains and at the opening of the Cajon Pass. Areas considered to be within Fire Hazard Severity Zones defined by the Fire and Resource Assessment Program (FRAP) within the California Department of Forestry and Fire Protection (CalFire) occur to the east, west, north, and south of the campus. Additionally, these fire hazard zones exist in other areas throughout San Bernardino County. These areas surrounding the valley are topographically diverse,
contain heavier vegetative fuels, and often have residential development interspersed. The land in the San Bernardino Valley where the CSU San Bernardino campus is located, is largely developed with a variety of mixed land uses. The North San Bernardino neighborhoods surrounding the campus exist within wildland-urban interface area with a history of destructive fires.

The CSU San Bernardinno campus is located in the northern portion of the City of San Bernardino and bordering open lands that are within the San Bernardino National Forest. The areas immediately to the south and east of the campus are predominately residential neighborhoods. The areas to the west and north include open hillsides with dense vegetation. Fire Hazard Severity Zones are found throughout the campus and throughout the hillsides surrounding the campus to include Very High Fire Hazard Severity Zones (VHFHSZ).

CSU San Bernardino further is located at the opening of the Cajon Pass providing over mountain access from the San Bernardino Valley to the California High Desert. This pass is also the sight of a funneling of winds in “Santa Ana” wind conditions. These offshore winds result when high pressure builds over the Great Basin or Upper Mojave Desert. The high-pressure systems push air into the mountain passes of the Transverse Ranges and through the few passes through the mountains. As the air is funneled through these passes, the wind narrows and is compressed causing the velocity to increase significantly. The relative humidity during these events is often critically low. These downslope winds are extremely dry and strong adding to enhanced fire threat or increases the intensity of existing fires. The CSU San Bernardino campus is just 5 miles from the opening of the Cajon Pass at Devore, CA.
Figure 19-16: Fire Hazard Severity Zones, CSU San Bernardino

Figure 19-17: Fire Hazard Severity Zones, San Bernardino, CA

Extent of the Hazard

While the threat to fire directly affecting the campus is considerable, the direct effect of fire generated smoke is also likely to occur. Fires are likely to occur in close proximity to the campus generating smoke that could envelop the campus in the right atmospheric conditions. Fires that are large enough to generate volumes of smoke to cover great distances have the potential to affect the air quality of the San Bernardino County and Inland Empire area including the campus. This will especially be the case in weather conditions creating strong offshore Santa Ana Winds. The potential for this impact has been demonstrated during the summers of 2018, 2019, and 2020 as fires burned across the state and spread smoke over vast distances. Fires burning well outside of the San Bernardino County region have the potential to distribute smoke onto the CSU San Bernardino campus.

The area immediately surrounding the CSU San Bernardino campus is in direct proximity to fire hazard zones designated as High or Very High Fire Hazard Severity Zones. The County is surrounded by areas that are considered to be of high fire threat that would produce vast quantities of smoke and particulates into the air. Based on the above factors, the planning committee ranks the extent of the hazard for the campus as **High**.
The National Fire Danger Rating System (NFDRS) is the current system in use for rating and classifying the potential danger of fire. The NFDRS tracks the effects of previous weather events on both dead and live fuel loads and adjusts accordingly based on future or predicted weather conditions. These complex relationships and equations are computed, and the outputs are expressed in terms that users can quickly and easily understand. The current NFDRS is used by all federal and most state agencies to assess fire danger conditions.

The following table depicts the NFDRS, from the US Forest Service’s Wildland Fire Assessment System.

Table 19-24: National Fire Danger Rating System

<table>
<thead>
<tr>
<th>Rating</th>
<th>Basic Description</th>
<th>Detailed Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>CLASS 1: Low Danger (L)</td>
<td>Fires not easily started</td>
<td>Fuels do not ignite readily from small firebrands. Fires in open or cured grassland may burn freely a few hours after rain, but wood fires spread slowly by creeping or smoldering and burn in irregular fingers. There is little danger of spotting.</td>
</tr>
<tr>
<td>COLOR CODE: Green</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CLASS 2: Moderate Danger (M)</td>
<td>Fires start easily and spread at a moderate rate</td>
<td>Fires can start from most accidental causes. Fires in open cured grassland will burn briskly and spread rapidly on windy days. Woods fires spread slowly to moderately fast. The average fire is of moderate intensity, although heavy concentrations of fuel -- especially draped fuel -- may burn hot. Short-distance spotting may occur but is not persistent. Fires are not likely to become serious and control is relatively easy.</td>
</tr>
<tr>
<td>COLOR CODE: Blue</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CLASS 3: High Danger (H)</td>
<td>Fires start easily and spread at a rapid rate</td>
<td>All fine dead fuels ignite readily, and fires start easily from most causes. Unattended brush and campfires are likely to escape. Fires spread rapidly and short-distance spotting is common. High intensity burning may develop on slopes or in concentrations of fine fuel. Fires may become serious and their control difficult, unless they are hit hard and fast while small.</td>
</tr>
<tr>
<td>COLOR CODE: Yellow</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Color Code</th>
<th>Class Description</th>
<th>Fire Behavior</th>
</tr>
</thead>
<tbody>
<tr>
<td>Orange</td>
<td>Class 4: Very High Danger (VH)</td>
<td>Fires start very easily and spread at a very fast rate. Fires start easily from all causes and immediately after ignition, spread rapidly and increase quickly in intensity. Spot fires are a constant danger. Fires burning in light fuels may quickly develop high-intensity characteristics - such as long-distance spotting - and fire whirlwinds when they burn into heavier fuels. Direct attack at the head of such fires is rarely possible after they have been burning more than a few minutes.</td>
</tr>
<tr>
<td>Red</td>
<td>Class 5: Extreme (E)</td>
<td>Fire situation is explosive and can result in extensive property damage. Fires under extreme conditions start quickly, spread furiously, and burn intensely. All fires are potentially serious. Development into high intensity burning will usually be faster and occur from smaller fires than in the Very High Danger class (4). Direct attack is rarely possible and may be dangerous, except immediately after ignition. Fires that develop headway in heavy slash or in conifer stands may be unmanageable while the extreme burning condition lasts. Under these conditions, the only effective and safe control action is on the flanks, until the weather changes or the fuel supply lessens.</td>
</tr>
</tbody>
</table>

Due to the impacts of wildfires on public health, agencies across the nation have adopted the use of the Air Quality Index (AQI) to communicate and provide a consistent approach to air quality measurements and categorization. The AQI primarily focuses on the health effects caused by pollutants in the air such as smoke. The goal of the AQI is to provide advisories to assist the public in determining when to reduce exposures to inhalation of air pollution as pollution levels rise.
History of the Hazard

The State of California has a long history of chronic and destructive wildfires throughout the state. On average, 8,300 wildfires have caused burnt 928,245 acres across the state over the 20-year period between 2000 and 2020. San Bernardino County also has a long history of wildfire activity primarily along the foothills and in the mountains. Wildfires occurring in the San Bernardino County have resulted in hundreds of thousands of acres burned and hundreds of millions of dollars in damages.

The campus does have a history of wildfire activity occurring within direct proximity to the campus. Additionally, the campus has experienced the effects of large wildfires occurring elsewhere in San Bernardino County. The campus closed due to fires in 1980 and 2003. The San Bernardino campus has experienced days of poor air quality due to fires burning in parts of the county, although infrequent.

Table 19-25: Historic Large-Scale Fires Near CSU San Bernardino

<table>
<thead>
<tr>
<th>Date</th>
<th>Fire</th>
<th>Location</th>
<th>Declaration</th>
<th>Damages</th>
</tr>
</thead>
<tbody>
<tr>
<td>11/1980</td>
<td>Panorama</td>
<td>San Bernardino</td>
<td>DR-635-CA</td>
<td>28,800 acres; 425 structures; 5 fatalities</td>
</tr>
<tr>
<td>10/2003</td>
<td>Old</td>
<td>San Bernardino</td>
<td>DR-1498-CA; FM-2503-CA</td>
<td>91,281 acres; 1,003 structures; 6 fatalities</td>
</tr>
</tbody>
</table>

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89 California Department of Forestry and Fire Protection, Stats and Events, [https://www.fire.ca.gov/stats-events/](https://www.fire.ca.gov/stats-events/)
90 San Bernardino County Multi-Jurisdictional Hazard Mitigation Plan, 2017
The Panorama Fire ignited on November 24, 1980, because of an arsonist. Strong Santa Ana winds gusting up to 90 miles per hour quickly pushed the fire from the San Bernardino Mountains downhill into the neighborhoods of northern San Bernardino. The fire would destroy 425 structures, burn 28,800 acres, and kill 5 people. The fire would also burn onto the CSU San Bernardino campus and destroy the Shipping and receiving Warehouse and severely damage the campus’ cooling towers.

The Old Fire started on October 21, 2003 in Waterman Canyon near the point of ignition for the Panorama Fire. This Arson caused fire would end up consuming much of the southern facing slopes of the San Bernardino Mountains pushed by strong Santa Ana Winds. This fire would ultimately merge with the Grand Prix Fire. The Old Fire burned 91,281 acres, destroyed 1,003 structures including over 900 homes, forced over 80,000 people to evacuate, and killed 6 people. The fire burned onto the CSU San Bernardino campus destroying modular classrooms, damaged others, and burned landscaping.

Potential Impacts of the Hazard

The location of the CSU San Bernardino campus surrounded by areas designated as High or Very High Fire Hazard Severity Zones places a threat of flame, ember, and smoke exposure from wildfire to the campus. There is potential for fire to occur on three sides of the campus and in the surrounding hillsides composed of light to moderate fuels. The threat of these neighboring hillsides to campus structures is substantial.

Potential impacts to the campus community resulting from wildfires include:

- Injuries or loss of life
- Campus property destruction of damage
- Residential property destruction or damage
- Damage to residence halls located along borders of campus
- Commercial property destruction or damage
- Loss of property contents
- Infrastructure damage
- Damaged or disrupted transportation, lifelines, and supply routes
- Damaged or destroyed utilities
- Damaged or destroyed critical facilities supporting campus emergency support needs
- Potential for community wide evacuation
- Loss of community economic base
- Employment losses
- Loss to ground supporting vegetation on hillsides resulting in erosion or landslides in future precipitation events
- Agricultural (crops and livestock) damages or destruction
- Threat to Murillo Family Observatory
- Threat to Animal House
- Environmental damage
- Societal and community impacts
- Damage to organizations and facilities providing support services to vulnerable populations
- Greater evacuation challenges for those most vulnerable
- Psychological impacts of impacted populations
- Disruptions to education delivery to community

Potential impacts resulting from wildfire generated smoke include:

- Dangerous levels of air pollution
- Human Health Effects
  - Similar health impacts to pets
- Air conditioning systems overwhelmed
- Greater demands on air filtration systems
- Greater demands on healthcare systems
- Reduced outdoor work productivity
- Closures of academic sessions

Additionally, there remains a number of secondary impacts from wildfires that could affect the campus community. Utilities feeding areas of Inland Empire including the campus may be damaged resulting in power outages. Fire related damage in the watersheds will likely cause future landslides, degradation to plants supporting hillsides, and impact hydroelectric power capabilities. Fires may present threats to areas of recreation, scenic value, and wildlife that are a part of the culture of the campus community. Finally, the campus may experience effects of evacuated individuals arriving on campus from other areas as a location of refuge.

**Probability of Future Occurrence of the Hazard**

Based on the wildfire threat potential in the area surrounding the CSU San Bernardino campus and hillsides along the north and east side of the campus, including the immediate proximity to Local Fire Hazard Severity Zones listed as “Very High”, the density of residential and commercial development, and the historic occurrences of fires, the annual probability of wildfire related damage on the campus is considered Possible.

Based on the wildfire threat potential in the area surrounding Southern California including the hills and mountains throughout the region, the volume of areas in elevated Fire Hazard Severity Zones throughout the southern portions of the state, and the historic occurrences of smoke, the probability of wildfire generated smoke impacts to air quality on campus is considered Possible.

**Vulnerability to the Hazard**
The CSU San Bernardino campus is subject to direct impact from wildfire due to the campus location within a wildland-urban interface zone. The campus is identified to reside within designated local Very High Fire Hazard Severity Zones. The campus is surrounded by hillsides and open lands containing combustible vegetation combined with residential development. Additionally, vulnerabilities to the effects of wildfire would lie within the campus community who may reside or work in locations that are exposed to the Fire Hazard Severity Zones in other parts of the surrounding region. Wildfires occurring in other areas of the region may result in the displacement of large numbers of people. These effects may spill onto the campus in the form of evacuees or facility support to emergency resources.

Fire directly threatening the campus would likely take the form of vegetation fires along the hillsides adjacent to the campus and extending onto the campus or localized fires involving single structures or small areas in the surrounding neighborhoods. Smaller vegetation fires are possible surrounding the campus in the urban forest or fields surrounding the city. These localized incidents occur periodically throughout the year in this area around CSU San Bernardino. Incidents of this nature could likely have significant impact to the campus.

The primary basis of vulnerability is based on the population affected and the built environment exposed. In general, newer construction will be more fire resistant than older buildings as building and fire codes and construction technology have improved. Density of buildings and proximity of fuels to buildings or equipment at risk of combustion would additionally influence the fire’s ability to spread to structures. Structures with vegetation and other combustibles near the structure increases the ability of fire to spread to buildings.

Depending on the extent of a wildfire affecting the campus, access could become cutoff during fire incidents. The campus is served by three roadways providing access on and off of university grounds. University Parkway is the primary route providing access to Interstate 215, Campus Parkway provides the western side of the campus access to Kendall Drive, and NorthPark Blvd allows access to into the neighborhoods east and south of the campus. The availability of these access routes will be dependent upon the conditions at the time of the event. The primary routes including Kendall Drive and Interstate 215 could also be impacted by larger fires extending beyond the area of the campus restricting access and generating congestion closer to the campus. The university is limited by these routes for access to and from the campus. Access for supplies, equipment, and emergency services in addition to evacuation away from the campus would likely be forced to use alternative routes through the northern San Bernardino area.

The greater concerns regarding vulnerabilities to wildfire are related to the smoke that fires in the area would produce. The recent summer seasons have clearly demonstrated the reality of large wildfires producing enough smoke to fill the Inland Empire even from substantial distances away. These recent fires have displayed how the effects of this smoke impact the general population and especially vulnerable populations. CSU San
Bernardino students, faculty, and staff both on campus and off campus face these same vulnerabilities related to smoke filled air.

Smoke generated from large wildfires pose a threat in terms of diminished air quality that would be exposed to the population within the area of smoke distribution. Individuals with existing health problems such as respiratory or cardiac illnesses are increasingly vulnerable to wildfire generated smoke. Staff who work in roles requiring outdoor activity will be increasingly exposed during days where the air quality index is considered unhealthy or worse. Student athletes participating in outdoor sports and engaging in aerobic activities are increasingly vulnerable to the effects of wildfire.

The vulnerability to members of the campus community in which wildfire generated smoke on the CSU San Bernardino campus will vary depending on when the air quality was to reach unhealthy levels. The risk to the campus population will be lessened during periods when classes are not in session or during periods of breaks. Conversely, during the days and hours that classes are in session and staff are at their workplaces, the human vulnerability increases. However, in region-wide events this vulnerability may be shared with the homes and workplaces of members of the campus community and their families.

Certain campus populations will experience greater challenges to a post-fire environment. Vulnerable populations will likely face disproportionate health safety issues from smoke filled air, experience increased stresses, may require the need to remain away from the campus enclosed at home, and may find difficulty in accessing equipment or supplies to aid in a specific need.

Estimate of Potential Losses

Estimates of potential losses will be influenced by a variety of factors. Costs would also be likely to include mitigation or repairs of HVAC systems, sealing of doors and windows, and other methods of keeping smoke from entering buildings. Secondary costs would include lost academic days during campus closures, lost staff on campus productivity, and health and medical interventions for affected members of the campus community.

Based on estimate replacement costs of facilities and structures on campus, the maximum total replacement costs due to wildfire are $626,694,141. However due to the lack of a complete inventory of building and facility costs, the total replacement estimate is likely much higher.

Table 19-26: Wildfire Hazard Potential (WHP) Zone Estimated Losses

<table>
<thead>
<tr>
<th>WHP Zone</th>
<th>No of Buildings</th>
<th>Maximum Replacement Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Extreme</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Very High</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>High</td>
<td>1</td>
<td>$1,362,976</td>
</tr>
<tr>
<td>Moderate</td>
<td>27</td>
<td>$430,857,225</td>
</tr>
</tbody>
</table>
Vulnerability Assessment Conclusions

The occurrence of wildfires has been frequent in San Bernardino County, including wildfire incidents that have threatened or caused damages near the CSU San Bernardino campus. The location of the CSU San Bernardino campus surrounded by open hillsides with light to moderate vegetative fuels along the entire northern edges presents a threat of fire to the campus community and campus assets. The placement at the opening of the Cajon Pass and the Santa Ana Winds coming down the pass exacerbate the threat provide greater emphasis on campus vulnerabilities to fire. The foothills and mountains surrounding San Bernardino County host environments that are ideal for the development of wildfire activity. The consequences of fires in these areas would present primary and secondary consequences to the CSU San Bernardino campus and expose vulnerabilities on the campus and to the campus community.

The topography of the valley surrounded by mountains allows for smoke filled air to linger in the valleys of the Inland Empire with the potential for unhealthy air quality depending on wind conditions. Fires in the watersheds of the San Bernardino and San Gabriel Mountains and tributaries may damage vegetation stabilizing hillsides and result in increased sediments to be discharged into the river system and reservoirs reducing their capacity and effectiveness.

Communities located within or near the Wildland Urban Interface may be subject to damaging fires. These same communities may be home to members of the campus community. The potential for large-scale wildfires in the region further generates the added potential for a number of cascading effects such as disruptions to the local economy, utility failures, disruptions to providing for the needs of the community, and development of public health hazards. The potential for large-scale wildfires and resulting damage of homes and businesses has exponentially powerful impacts on particular populations among the campus community including those with access or functional needs, international students, the homeless, and students residing in the residence halls.

Identified Data Limitations

Data limitations include missing campus structural replacement costs, and lack of both a complete inventory of building construction types and mitigation efforts to lessen the impact due to fire activity. HAZUS generated analysis is focused on the broader community level versus fine-tuning the analysis to the micro-level for facilities such as a university campus.
Severe Weather (Wind, Tornado, Hail, Lightning)

Description of the Hazard

Severe weather can be described as a variety of weather or climate events that are beyond or near the ends of the range of observed weather patterns and behavior. These events can include high or extreme winds, storms, lightning, hail, tornadoes, heat waves, unusually cold temperatures, extreme rainfall, and flooding. According to the Intergovernmental Panel on Climate Change (IPCC), to be classified as severe (or extreme), the occurrence of each value of a climate or weather variable (e.g., wind, hail, lightning, tornado, etc.) must be “above (or below) a threshold value near the upper (or lower) ends of the range of observed values of the variable.”

Severe weather in California can be generated by local, regional, and/or global weather and climate influences. From the individual thunderstorm to the Santa Ana wind event to the strong El Niño, damaging weather elements that are produced by and accompany severe weather and climate phenomena (e.g., damaging winds, hail, lightning, and tornadoes) occur throughout California and the California State University (CSU) system.

Global Scale Influences on Severe Weather in California: El Niño, La Niña, and ENSO

The El Niño-Southern Oscillation (ENSO) is a recurring climate pattern involving changes in the temperature of waters in the central and eastern tropical Pacific Ocean. On periods ranging from about three (3) to seven (7) years, the surface waters across a large swath of the tropical Pacific Ocean warm or cool by anywhere from 1°C to 3°C, compared to normal. This oscillating warming and cooling pattern, referred to as the ENSO cycle, directly affects rainfall distribution in the tropics and can have a strong influence on weather across the United States and other parts of the world.

El Niño and La Niña are extreme phases of the ENSO cycle, with a third phase occurring between them called the Neutral phase. The El Niño phase is characterized by unusually warm ocean temperatures and weaker-than-normal east winds in the Equatorial Pacific, while the La Niña phase is characterized by unusually cold ocean temperatures and stronger-than-normal east winds in the Equatorial Pacific. Both extreme ENSO phases are associated with significant changes in weather patterns around the world.
lead to significant differences from the average ocean temperatures, winds, surface pressure, and rainfall across parts of the tropical Pacific. The Neutral phase indicates that conditions are near their long-term average.\(^{95}\)

The extreme ENSO phases affect the frequency and intensity of weather events across the world, including in California.\(^{96}\) On average, areas across California experience exceptionally stormy winters with increased precipitation under El Niño conditions, but experience less stormy and drier winters under La Niña conditions.\(^{97}\) This variability in storminess and precipitation brought on by El Niño and La Niña events affects the both the frequency and intensity of severe weather conditions experienced by all CSU campuses, including CSU San Bernardino.

**Regional Climate Influences on Severe Weather across California**

Most of the weather in California is influenced by the wet-winter/ dry-summer Mediterranean climate pattern. In the summer months, Pacific storm tracks are deflected north due to the position of the Pacific High (i.e., a large-scale atmospheric circulation over the Northeast Pacific Ocean), preventing Pacific storms from reaching California. As a result, most summer storms are generated due to the incursion of moist air from the Gulf of Mexico or the Gulf of California, and occur as scattered, locally heavy showers in the desert and mountain regions of the state. In the winter months, the Pacific High decreases in intensity and moves south, permitting powerful Pacific storms to move into and across the state; these storms can produce extreme winds, heavy rains (including “atmospheric river” events), and widespread coastal and inland flooding. (Please see the Flood Hazard profile in this document for information on Floods.) As a result, storm events accompanied by precipitation in California are far more frequent in the winter months than they are in the summer months.\(^{98}\)

While the Mediterranean climate pattern influences the seasonal frequency, intensity, geographic spread, and type of some severe weather events CSU campuses experience (including CSU San Bernardino), other severe weather phenomena may occur in California at any time of the year. For example, near the coast and over the Central Valley, there appears to be no defined seasonality to thunderstorms, and these storms are usually light and infrequent. Thunderstorms are more intense and more frequent in the intermediate and higher elevations of the Sierra Nevada, and occur with greater frequency during the summer months.\(^{99}\)

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\(^{95}\) Retrieved on 07.17.2021 from https://www.climate.gov/news-features/understanding-climate/el-ni%C3%B1o-and-la-ni%C3%B1a-frequently-asked-questions

\(^{96}\) Retrieved on 07.16.2021 from https://www.pmel.noaa.gov/elnino/what-is-el-nino


\(^{98}\) Retrieved on 07.17.2021 from https://wrcc.dri.edu/Climate/narrative_ca.php

Types of Storms in California

The 2018 California State Hazard Mitigation Plan (SHMP) defines a storm as a violent atmospheric disturbance occurring over land and/or water that is distinguished by its strength, characteristics, and the scale of the resulting damage. The SHMP also lists the following types of storms that produce hazardous conditions and potential damage throughout the state of California. These storms affect (in varying degrees) all CSU campuses, including CSU San Bernardino.

- **Thunderstorm**: A rain-bearing cloud that also produces lightning. Thunderstorms can produce some of nature’s most destructive and deadly weather including tornadoes, hail, strong winds, lightning and flooding. Thunderstorms are caused by an atmospheric imbalance from warm unstable air rising rapidly into the atmosphere. Lightning, which occurs during all thunderstorms, can strike anywhere. Thunderstorms can produce some of nature’s most destructive and deadly weather including tornadoes, hail, strong winds, lightning and flooding. Severe thunderstorms are more intense, violent, and dangerous thunderstorms. The National Oceanic and Atmospheric Administration (NOAA) defines a severe thunderstorm as any storm that produces one or more of the following elements: Damaging winds or speeds of 58 mph (50 knots) or greater, hail 1 inch in diameter or larger, and/or a tornado.

- **Hailstorm**: a type of storm that precipitates round chunks of ice. Hailstorms usually occur during regular thunderstorms.

- **Wind storm**: marked by high wind with little or no precipitation.

- **Winter storm**: A storm that can produce a combination of freezing rain, sleet, heavy snow, and/or strong winds.

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105 Retrieved on 07.15.2021 from [https://www.noaa.gov/explainers/severe-storms](https://www.noaa.gov/explainers/severe-storms)

106 Retrieved on 07.15.2021 from [https://www.weather.gov/safety/thunderstorm](https://www.weather.gov/safety/thunderstorm)


- **Coastal storm**: large wind-driven waves and/or storm surge that strike the coastal zone.\(^{110}\)

- **Ice storm**: Ice storms are one of the most dangerous forms of winter storms. When surface temperatures are below freezing, but a thick layer of above-freezing air remains aloft, rain can fall into the freezing layer and freeze upon impact into a glaze of ice. In general, 8 millimeters (0.31 inch) of accumulation is all that is required, especially in combination with breezy conditions, to start downing power lines as well as tree limbs. Ice storms also make unheated road surfaces too slick to drive on. Ice storms can vary in time range from hours to days and can cripple small towns and large urban centers alike.\(^{111}\)

- **Snowstorm**: A heavy fall of snow accumulating at a rate of more than 5 centimeters (2 inches) per hour that lasts several hours. Snowstorms, especially ones with a high liquid equivalent and breezy conditions, can down tree limbs, cut off power, and paralyze travel over a large region.\(^{112}\)

**Severe Weather Hazard Elements: Wind Hazards, Hail, and Lightning**

This hazard profile concentrates on the following types of severe weather hazards: wind hazards (including tornadoes), hail, and lightning. These hazards are produced by a variety of weather phenomena, including thunderstorms, coastal storms, winter storms, and topographically-enhanced downslope winds. While storm and downslope wind hazards are responsible for severe weather events across the CSU system, only the wind, tornado, hail, and lightning elements generated by these hazards are covered in this profile. (Storm-related hazards such as flooding and extreme temperatures are covered in other sections of this document.)

**Wind Hazards**

**Wind** is the horizontal movement of air past any given point. Wind begins with differences in air pressures; pressure that is higher at one point than another sets up a force, pushing the high towards the low pressure.\(^{113}\) Wind gusts are defined as “rapid fluctuations in the wind speed with a variation of 10 knots or more between peaks and lulls.” \(^{114}\)

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Wind hazards in California take several forms: High Wind, Strong Winds, Thunderstorm Winds, Mountain-Valley (Donslope) Winds, and Tornadoes. These hazards are encountered across California, and have the potential to cause harm to or loss of life and/or property throughout California and the CSU system (including CSU San Bernardino).

**High Winds, Strong Winds, and Thunderstorm Winds**

The National Weather Service reports three (3) types of wind events that occur areas over land: High Winds, Strong Winds, and Thunderstorm Winds. Collectively, these reports are used to determine the frequency with which wind hazard events have affected areas across the U.S., including California.

**High Winds**

High winds are defined as sustained non-convective winds of 35 knots (40 mph) or greater lasting for 1 hour or longer, or gusts of 50 knots (58 mph) or greater for any duration (or otherwise locally/regionally defined). In some mountainous areas, the above numerical values are 43 knots (50 mph) and 65 knots (75 mph), respectively.\(^\text{115}\)

**Strong Winds**

Strong winds are defined as non-convective winds gusting less than 50 knots (58 mph), or sustained winds less than 35 knots (40 mph), resulting in a fatality, injury, or damage.\(^\text{116}\)

**Thunderstorm Winds**

Thunderstorm winds are winds that arise from thunderstorm convection (occurring within 30 minutes of lightning being observed or detected), with speeds of at least 50 knots (58 mph). They can also be winds of any speed (non-severe thunderstorm winds below 50 knots (58 mph)) producing a fatality, injury, or damage.\(^\text{117}\)

Please note: **Straight-line wind** is a term used to define any thunderstorm wind that is not associated with rotation. It is used mainly to differentiate from the rotational winds found in tornado-producing storms.\(^\text{118}\) However, it is not a term used in the NCEI Storm Events Database, and therefore cannot be used to determine severe weather history of or potential impacts to CSU campuses.

**Tornadoes**

A tornado is an extreme severe weather wind hazard. A tornado is a rapidly rotating column of air extending from a thunderstorm to the surface of the Earth.\(^\text{119}\) This column extends between cloud and the Earth’s surface. The damage from tornadoes comes from


\(^\text{118}\) Retrieved on 07.15.2021 from [https://www.nssl.noaa.gov/education/svrwx101/wind/types/](https://www.nssl.noaa.gov/education/svrwx101/wind/types/)

\(^\text{119}\) Retrieved on 07.15.2021 from [https://www.earthnetworks.com/tornado/](https://www.earthnetworks.com/tornado/)
the strong winds they contain and the flying debris they create. It is generally believed that rotational wind speeds can be as high as 300 mph in the most violent tornadoes.\textsuperscript{120} On a local scale, tornadoes are the most violent and most destructive of all atmospheric phenomena.\textsuperscript{121}

**Mountain-Valley (Downslope) Wind Systems: Santa Ana, Diablo, and Sundowner Winds.**

*Santa Ana Winds.* A type of wind hazard that is peculiar to Southern California is called a *Santa Ana Wind.* Santa Ana winds are strong, topographically-enhanced, extremely dry downslope winds that originate inland and affect coastal southern California and northern Baja California (Mexico).\textsuperscript{122} They occur when air from a region of high pressure over the dry, desert region of the southwestern U.S. flows westward towards low pressure located off the California coast. This creates dry winds that flow east to west through the mountain passages in Southern California. These winds have a strong seasonal component; they are most common during the cooler months of the year, occurring from September through May. Santa Ana winds typically feel warm (or even hot) because as the cool desert air moves down the side of the mountain, it is compressed, which causes the temperature of the air to rise. If strong enough, Santa Ana winds can cause major property damage, and may present difficulties for airborne and seagoing transportation. They also may increase wildfire risk because of the dryness of the winds and the speed at which they can spread a flame across the landscape.\textsuperscript{123} (Note: The Wildfire hazard is profiled elsewhere in this document.)

Figure below illustrates the mechanisms involved in the generation of Santa Ana winds across Southern California.

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\textsuperscript{120} Retrieved on 07.15.2021 from https://www.nssl.noaa.gov/education/svrwx101/tornadoes/faq/
\textsuperscript{121} Retrieved on 07.15.2021 from https://www.weather.gov/bgm/severedefinitions
\textsuperscript{123} Retrieved on 07.13.2021 from https://www.weather.gov/safety/wind-mountain-valley
What Drives a Santa Ana Wind?

1. High surface pressure builds over the Great Basin region with lower pressure off Southern Cal Coast. (Fall-mid Spring)

2. Air remains relatively cold across the deserts. As the air extends through the mountain passes...it become compressed and warms. (See lower right map) Lower relative humidity also occurs helping to dry out vegetation and can fan any existing fires.

3. Wind speed increases as it squeezes through the mountain and valley canyons. Wind gusts can vary from 45 to 100 mph depending on the strength of the Santa Ana event.

4. Strong winds create turbulence for area flights and can make interstate travel difficult as well as choppy seas for mariners.

Diablo Winds. The Diablo wind is another type of topographically-enhanced downslope wind phenomenon that occurs in the North-Central areas of California. Diablo winds are offshore wind events that flow northeasterly over Northern California’s Coast Ranges, often creating high wind speeds downwind of major canyons and over ridges, and extreme fire danger for the San Francisco Bay Area. Diablo winds are driven by a surface pressure gradient that forms in response to an inverted pressure trough that develops over California.\(^\text{125}\)

Sundowner Winds. Sundowner winds are significant and potentially damaging downslope wind and warming events that periodically occur along a short segment of the southern California coast in the vicinity of Santa Barbara, CA. The unique topography of this coastal region promotes the development of Sundowner wind events: over a length of about 100 km, the coastline is oriented approximately west–east, with the adjoining narrow coastal plain bounded by a steeply rising (to elevations greater than 1200 m) and

\(^{125}\) Retrieved on 07.13.2021 from https://www.fireweather.org/diablo-winds
coast-parallel mountain range. Called Sundowner winds because they often begin in the late afternoon or early evening, their onset is typically associated with a rapid rise in temperature and decrease in relative humidity, and the winds tend to blow from the north from the Santa Ynez Mountains to the coast of Santa Barbara County, California. During the more intense Sundowner wind events, wind speeds can be of gale force 39-54 miles per hour or higher, and can even reach hurricane force (≥ 74 miles per hour) in the most extreme cases. Temperatures over the coastal plain, and even at the coast itself, can rise significantly above 37.8°C (100°F). Seasonally, Sundowner winds peak in March, April, and May, with a minimum during summer and a secondary peak in winter that often corresponds with Santa Ana winds. In addition to causing a dramatic change from the more typical marine-influenced local weather conditions, Sundowner wind episodes have produced significant wind-related property and agricultural damage, as well as conditions of extreme fire danger.\footnote{126} \footnote{127} \footnote{128}

**Hail**

Hail is a form of precipitation consisting of solid ice that forms inside thunderstorm updrafts.\footnote{129} It is roughly round in shape and at least 0.2’ in diameter. Hail develops in the upper atmosphere as ice crystals that are bounced about by high velocity updraft winds; the ice crystals accumulate frozen droplets and fall after developing enough weight. The size of hailstones varies and is a direct consequence of the severity and size of the storm that produces them – the higher the temperatures at the Earth’s surface, the greater the strength of the updrafts and the amount of time hailstones are suspended, and therefore the greater the size of the hailstone.\footnote{130}

**Lightning**

Lightning is an electrical discharge produced by a thunderstorm. Lightning rapidly heats the air in its immediate vicinity to about 50,000°F - about five times the temperature of the surface of the sun. This compresses the surrounding air and creates a supersonic shock wave, which decays to an acoustic wave that is heard as thunder.\footnote{131}

The discharge may occur within or between clouds, between the cloud and air, between a cloud and the ground, or between the ground and a cloud.\textsuperscript{132} Lightning that is produced from thunderstorms in which precipitation evaporates before reaching the ground is called “dry lightning.”

**Location of the Hazard**

Severe weather is a non-spatial hazard, and can occur anywhere in the CSU system, including either at the CSU San Bernardino main campus or at satellite campus facilities owned by the school. No one area of the campus – or of the surrounding community – is subject to experiencing severe weather more than any other area.

There is geographic variability among the different types of mountain and valley wind events (as a sub-category of the severe weather hazard). Santa Ana winds occur in Southern California, Diablo winds occur in North-Central California, and Sundowner winds occur almost exclusively in Santa Barbara County, California.

**Extent of the Hazard**

Severe weather hazards are non-spatial hazards that potentially affect all CSU San Bernardino campus areas equally. However, the smallest geographic unit of measurement for almost all official severe weather event data is at the county level. Because the severe weather data used do not exist at the campus level, it is assumed that the same (or similar) severe weather risks to CSU San Bernardino campuses reflect those of the surrounding community and County. As a result, all assets and people at CSU San Bernardino campuses are at risk from the effects of severe weather and can expect to experience at least some (or the complete range of) endemic severe weather hazards. In consideration of the campus’ design, layout, and operations, the severe weather history and degree of severity in the San Bernardino (San Bernardino County) and Palm Desert (Riverside County) areas, and the history and degree of severity of each severe weather sub-type identified by the extent scales (below), the campus planning committee ranks the overall extent of the Severe Weather hazard as **MODERATE**. See each sub-hazard below for the planning committee’s sub-type extent ranking.

**Wind Hazard: Non-Rotational**

The Beaufort Scale is an empirical measure that relates wind speed to observed conditions at sea or on land. Its full name is the Beaufort wind force scale.\textsuperscript{133} First developed in 1805, it is still used today to estimate wind strengths.\textsuperscript{134}

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\textsuperscript{133} Retrieved on 07.15.2021 from [https://www.rmets.org/resource/beaufort-scale](https://www.rmets.org/resource/beaufort-scale)

\textsuperscript{134} Retrieved on 07.15.2021 from [https://www.weather.gov/mfl/beaufort](https://www.weather.gov/mfl/beaufort)
<table>
<thead>
<tr>
<th>Force</th>
<th>Speed (mph)</th>
<th>Speed (knots)</th>
<th>Description</th>
<th>Specifications for use at sea</th>
<th>Specifications for use on land</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0-1</td>
<td>0-1</td>
<td>Calm</td>
<td>Sea like a mirror.</td>
<td>Calm; smoke rises vertically.</td>
</tr>
<tr>
<td>1</td>
<td>1-3</td>
<td>1-3</td>
<td>Light Air</td>
<td>Ripples with the appearance of scales are formed, but without foam crests.</td>
<td>Direction of wind shown by smoke drift, but not by wind vanes.</td>
</tr>
<tr>
<td>2</td>
<td>4-7</td>
<td>4-6</td>
<td>Light Breeze</td>
<td>Small wavelets, still short, but more pronounced. Crests have a glassy appearance and do not break.</td>
<td>Wind felt on face; leaves rustle; ordinary vanes moved by wind.</td>
</tr>
<tr>
<td>3</td>
<td>8-12</td>
<td>7-10</td>
<td>Gentle Breeze</td>
<td>Large wavelets. Crests begin to break. Foam of glassy appearance. Perhaps scattered white horses.</td>
<td>Leaves and small twigs in constant motion; wind extends light flag.</td>
</tr>
<tr>
<td>4</td>
<td>13-18</td>
<td>11-16</td>
<td>Moderate Breeze</td>
<td>Small waves, becoming larger; fairly frequent white horses.</td>
<td>Raises dust and loose paper; small branches are moved.</td>
</tr>
<tr>
<td>5</td>
<td>19-24</td>
<td>17-21</td>
<td>Fresh Breeze</td>
<td>Moderate waves, taking a more pronounced long form; many white horses are formed.</td>
<td>Small trees in leaf begin to sway; crested wavelets form on inland waters.</td>
</tr>
<tr>
<td>6</td>
<td>25-31</td>
<td>22-27</td>
<td>Strong Breeze</td>
<td>Large waves begin to form; the white foam crests are more extensive everywhere.</td>
<td>Large branches in motion; whistling heard in telegraph wires; umbrellas used with difficulty.</td>
</tr>
<tr>
<td>7</td>
<td>32-38</td>
<td>28-33</td>
<td>Near Gale</td>
<td>Sea heaps up and white foam from breaking waves begins to be blown in streaks along the direction of the wind.</td>
<td></td>
</tr>
</tbody>
</table>

\[135\] Retrieved on 07.15.2021 from https://www.weather.gov/mfl/beaufort
<table>
<thead>
<tr>
<th>Ext. No.</th>
<th>Ext. Range</th>
<th>V. Range</th>
<th>Condition</th>
</tr>
</thead>
<tbody>
<tr>
<td>8</td>
<td>39-46</td>
<td>34-40</td>
<td>Gale</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Whole trees in motion; inconvenience felt when walking against the wind.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Moderately high waves of greater length; edges of crests begin to break into spindrift. The foam is blown in well-marked streaks along the direction of the wind.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Breaks twigs off trees; generally impedes progress.</td>
</tr>
<tr>
<td>9</td>
<td>47-54</td>
<td>41-47</td>
<td>Severe Gale</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>High waves. Dense streaks of foam along the direction of the wind. Crests of waves begin to topple, tumble and roll over. Spray may affect visibility</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Slight structural damage occurs (chimney-pots and slates removed)</td>
</tr>
<tr>
<td>10</td>
<td>55-63</td>
<td>48-55</td>
<td>Storm</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Very high waves with long overhanging crests. The resulting foam, in great patches, is blown in dense white streaks along the direction of the wind. On the whole the surface of the sea takes on a white appearance. The tumbling of the sea becomes heavy and shock-like. Visibility affected.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Seldom experienced inland; trees uprooted; considerable structural damage occurs.</td>
</tr>
<tr>
<td>11</td>
<td>64-72</td>
<td>56-63</td>
<td>Violent Storm</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Exceptionally high waves (small and medium-size ships might be for a time lost to view behind the waves). The sea is completely covered with long white patches of foam lying along the direction of the wind. Everywhere the edges of the wave crests are blown into froth. Visibility affected.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Very rarely experienced; accompanied by widespread damage.</td>
</tr>
<tr>
<td>12</td>
<td>73+</td>
<td>64+</td>
<td>Hurricane</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>The air is filled with foam and spray. Sea completely white with driving spray; visibility very seriously affected.</td>
</tr>
</tbody>
</table>

Based on those extent ranking factors identified (above), the planning committee ranks the extent of non-rotational wind hazards as **MODERATE**.
**Extent: Tornado**

Tornadoes have their own severity/extent scale. Until 2007, tornadoes were measured and described according to the Fujita Scale.136

In February 2007, use of the Fujita Scale was discontinued. In its place, the Enhanced Fujita (EF) Scale is used. The Enhanced Fujita scale considers how most structures are designed and is thought to be a much more accurate representation of the surface wind speeds in the most violent tornadoes. Like the original Fujita scale, the Enhanced Fujita scale is a set of wind estimates (not measurements) based on damage.

It is important to note the date that a tornado occurred. Tornadoes that occurred prior to February, 2007 are classified using the original Fujita scale and will not be converted to the Enhanced Fujita Scale.

Table below illustrates the Fujita Scale in use prior to February 2007.

Table 19-28: Fujita Tornado Scale (Pre-February 2007) 137

<table>
<thead>
<tr>
<th>F-Scale Number</th>
<th>Intensity Phrase</th>
<th>Wind Speed</th>
<th>Type of Damage</th>
</tr>
</thead>
<tbody>
<tr>
<td>F0</td>
<td>Gale tornado</td>
<td>40-72 mph</td>
<td>Some damage to chimneys; breaks branches off trees; pushes over shallow-rooted trees; damages sign boards.</td>
</tr>
<tr>
<td>F1</td>
<td>Moderate tornado</td>
<td>73-112 mph</td>
<td>The lower limit is the beginning of hurricane wind speed; peels surface off roofs; mobile homes pushed off foundations or overturned; moving autos pushed off the roads; attached garages may be destroyed.</td>
</tr>
<tr>
<td>F2</td>
<td>Significant tornado</td>
<td>113-157 mph</td>
<td>Considerable damage. Roofs torn off frame houses; mobile homes demolished; boxcars pushed over; large trees snapped or uprooted; light object missiles generated.</td>
</tr>
<tr>
<td>F3</td>
<td>Severe tornado</td>
<td>158-206 mph</td>
<td>Roof and some walls torn off well-constructed houses; trains</td>
</tr>
</tbody>
</table>

---

<table>
<thead>
<tr>
<th></th>
<th>Description</th>
<th>Speed Range</th>
<th>Damage</th>
</tr>
</thead>
<tbody>
<tr>
<td>F4</td>
<td>Devastating tornado</td>
<td>207-260 mph</td>
<td>Well-constructed houses leveled; structures with weak foundations blown off some distance; cars thrown and large missiles generated.</td>
</tr>
<tr>
<td>F5</td>
<td>Incredible tornado</td>
<td>261-318 mph</td>
<td>Strong frame houses lifted off foundations and carried considerable distances to disintegrate; automobile sized missiles fly through the air in excess of 100 meters; trees debarked; steel reinforced concrete structures badly damaged.</td>
</tr>
<tr>
<td>F6</td>
<td>Inconceivable tornado</td>
<td>319-379 mph</td>
<td>These winds are very unlikely. The small area of damage they might produce would probably not be recognizable along with the mess produced by F4 and F5 wind that would surround the F6 winds. Missiles, such as cars and refrigerators would do serious secondary damage that could not be directly identified as F6 damage. If this level is ever achieved, evidence for it might only be found in some manner of ground swirl pattern, for it may never be identifiable through engineering studies.</td>
</tr>
</tbody>
</table>

Table below illustrates the Enhanced Fujita (EF) Scale, currently in use. Tornadoes that have occurred since February, 2007 are classified using the Enhanced Fujita Scale.
Table 19-29: Enhanced Fujita Scale (February 2007 and Later) \(^{138}\)

<table>
<thead>
<tr>
<th>Enhanced Fujita Category</th>
<th>Wind Speed</th>
<th>Potential Damage</th>
</tr>
</thead>
<tbody>
<tr>
<td>EF0</td>
<td>65-85 mph</td>
<td>Light damage. Peels surface off some roofs; some damage to gutters or siding; branches broken off trees; shallow-rooted trees pushed over.</td>
</tr>
<tr>
<td>EF1</td>
<td>86-110 mph</td>
<td>Moderate damage. Roofs severely stripped; mobile homes overturned or badly damaged; loss of exterior doors; windows and other glass broken.</td>
</tr>
<tr>
<td>EF2</td>
<td>111-135 mph</td>
<td>Considerable damage. Roofs torn off well-constructed houses; foundations of frame homes shifted; mobile homes completely destroyed; large trees snapped or uprooted; light-object missiles generated; cars lifted off ground.</td>
</tr>
<tr>
<td>EF3</td>
<td>136-165 mph</td>
<td>Severe damage. Entire stories of well-constructed houses destroyed; severe damage to large buildings such as shopping malls; trains overturned; trees debarked; heavy cars lifted off the ground and thrown; structures with weak foundations blown away some distance.</td>
</tr>
<tr>
<td>EF4</td>
<td>166-200 mph</td>
<td>Devastating damage. Well-constructed houses and whole frame houses completely leveled; cars thrown and small missiles generated.</td>
</tr>
<tr>
<td>EF5</td>
<td>&gt;200 mph</td>
<td>Incredible damage. Strong frame houses leveled off foundations and swept away; automobile-sized missiles fly through the air in excess of 100 m (107 yd); high-rise buildings have significant structural deformation; incredible phenomena will occur.</td>
</tr>
</tbody>
</table>

Based on the extent ranking factors identified (above), the planning committee ranks the extent of tornados as **LOW**.

**Extent: Hail**

The National Oceanic and Atmospheric Administration and the Tornado and Storm Research Organization (TORRO) have combined efforts to create the Hailstorm Intensity Scale. Table below provides details of this scale.

Table 19-30: Combined NOAA/TORRO Hailstorm Intensity Scale\(^{139}\)

<table>
<thead>
<tr>
<th>Size Code</th>
<th>Intensity Category</th>
<th>Typical Hail Diameter</th>
<th>Approximate Size</th>
<th>Typical Damage Impacts</th>
</tr>
</thead>
<tbody>
<tr>
<td>H0</td>
<td>Hard Hail</td>
<td>Up to 0.33”</td>
<td>Pea</td>
<td>No damage</td>
</tr>
<tr>
<td>H1</td>
<td>Potentially Damaging</td>
<td>0.33” – 0.60”</td>
<td>Marble or Mothball</td>
<td>Slight damage to plants and crops</td>
</tr>
<tr>
<td>H2</td>
<td>Potentially Damaging</td>
<td>0.60” – 0.80”</td>
<td>Dime or grape</td>
<td>Significant damage to fruit, crops, and vegetation</td>
</tr>
<tr>
<td>H3</td>
<td>Severe</td>
<td>0.80” – 1.20”</td>
<td>Nickel to Quarter</td>
<td>Severe damage to fruit and crops, damage to glass and plastic structures, paint and wood scored</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Extent</th>
<th>Damage</th>
<th>Diameter Range</th>
<th>Size Comparison</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>H4</td>
<td>Severe</td>
<td>1.20” – 1.60”</td>
<td>Half Dollar to Ping Pong Ball</td>
<td>Widespread glass damage, vehicle body damage</td>
</tr>
<tr>
<td>H5</td>
<td>Destructive</td>
<td>1.60” – 2.0”</td>
<td>Silver Dollar to Golf Ball</td>
<td>Wholesale destruction of glass, damage to tiled roofs, significant risk of injuries</td>
</tr>
<tr>
<td>H6</td>
<td>Destructive</td>
<td>2.0” – 2.4”</td>
<td>Lime or Egg</td>
<td>Aircraft body dented; brick walls pitted</td>
</tr>
<tr>
<td>H7</td>
<td>Very Destructive</td>
<td>2.4” – 3.0”</td>
<td>Tennis Ball</td>
<td>Severe roof damage, risk of serious injuries</td>
</tr>
<tr>
<td>H8</td>
<td>Very Destructive</td>
<td>3.0” – 3.5”</td>
<td>Baseball to Orange</td>
<td>Severe damage to aircraft body</td>
</tr>
<tr>
<td>H9</td>
<td>Super Hailstorms</td>
<td>3.5” – 4.0”</td>
<td>Grapefruit</td>
<td>Extensive structural damage, risk of severe or fatal injuries to persons caught in the open</td>
</tr>
</tbody>
</table>

Based on those extent ranking factors identified (above), the planning committee ranks the extent of the hail hazard as **LOW**.
**Extent: Lightning**

The National Weather Service (NWS) uses a Lightning Activity Level (LAL) scale to indicate the frequency and character of cloud-to-ground (C/G) lightning. The scale uses a range of 1 – 6, with 6 being the high end of the scale. Table below provides details of the LAL scale.

Table 19-31: Lightning Activity Level (LAL) Scale

<table>
<thead>
<tr>
<th>Rank</th>
<th>Cloud and Storm Development</th>
<th>Areal Coverage</th>
<th>Counts C/G per 5 Minutes</th>
<th>Counts C/G per 15 Minutes</th>
<th>Average C/G per Minute</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>No Thunderstorms</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>2</td>
<td>Cumulus clouds are common but only a few reaches the towering stage. A single thunderstorm must be confirmed in the rating area. The clouds mostly produce virga, but light rain will occasionally reach ground. Lightning is very infrequent.</td>
<td>&lt;15%</td>
<td>1-5</td>
<td>1-8</td>
<td>&lt;1</td>
</tr>
<tr>
<td>3</td>
<td>Cumulus clouds are common. Swelling and towering cumulus cover less than 2/10 of the sky. Thunderstorms are few, but 2 to 3 occur within the observation area. Light to moderate rain will reach the ground, and lightning is infrequent.</td>
<td>15% to 24%</td>
<td>6-10</td>
<td>9-15</td>
<td>1-2</td>
</tr>
</tbody>
</table>

140 Retrieved on 07.19.2021 from [https://graphical.weather.gov/definitions/defineLAL.html](https://graphical.weather.gov/definitions/defineLAL.html)
Lightning Activity Level Scale

<table>
<thead>
<tr>
<th>Rank</th>
<th>Cloud and Storm Development</th>
<th>Areal Coverage</th>
<th>Counts C/G per 5 Minutes</th>
<th>Counts C/G per 15 Minutes</th>
<th>Average C/G per Minute</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>Swelling cumulus and towering cumulus cover 2-3/10 of the sky. Thunderstorms are scattered but more than three must occur within the observation area. Moderate rain is commonly produced, and lightning is frequent.</td>
<td>25% to 50%</td>
<td>11-15</td>
<td>16-25</td>
<td>2-3</td>
</tr>
<tr>
<td>5</td>
<td>Towering cumulus and thunderstorms are numerous. They cover more than 3/10 and occasionally obscure the sky. Rain is moderate to heavy, and lightning is frequent and intense.</td>
<td>&gt;50%</td>
<td>&gt;15</td>
<td>&gt;25</td>
<td>&gt;3</td>
</tr>
<tr>
<td>6</td>
<td>Dry lightning outbreak. (LAL of 3 or greater with majority of storms producing little or no rainfall.)</td>
<td>&gt;15%</td>
<td>None</td>
<td>None</td>
<td>None</td>
</tr>
</tbody>
</table>

Based on those extent ranking factors identified (above), the planning committee ranks the extent of the lightening hazard as LOW.

**Extent: Thunderstorms that Generate Wind, Tornado, Hail, and Lightning Hazard Events**

Thunderstorms are not explicitly identified as a severe weather category for this hazard profile. However, they are responsible for most tornado, lightning, and hail hazard events – as well as a significant number of wind hazard events – across California and the CSU system. While individual thunderstorms affect relatively small areas, there are many instances in which thunderstorms can cluster together and/or travel in a line over long distances, producing significant damage over large geographic areas.

A thunderstorm is classified as “severe” when certain meteorological parameters within the thunderstorm are reached (i.e., damaging winds or speeds of 58 mph (50 knots) or greater, hail 1 inch in diameter or larger, and/or a tornado). However, there is currently no
established, objective severity scale for thunderstorms.\textsuperscript{141} \textsuperscript{142} That said, according to the *Glossary of Meteorology* published by the American Meteorological Society (AMS), a thunderstorm is reported as *light*, *medium*, or *heavy* according to following five (5) characteristics:

- the nature of the lightning and thunder;
- the type and intensity of the precipitation, if any;
- the speed and gustiness of the wind;
- the appearance of the clouds; and
- the effect upon surface temperature.\textsuperscript{143}

A thunderstorm may also be classified by the nature of the overall weather situation in which the thunderstorm is produced, including:

- **Airmass Thunderstorm**: A thunderstorm produced by local convection within an unstable air mass;\textsuperscript{144}
- **Frontal Thunderstorm**: An individual thunderstorm the initiation of which results from rising motion associated with a front, or a thunderstorm within a convective system generated and organized by frontal rising motion;\textsuperscript{145} or
- **Squall-line Thunderstorm**: An individual thunderstorm included within a squall line (i.e., a continuous or broken line of active deep moist convection frequently associated with thunder).\textsuperscript{146} \textsuperscript{147}

Based on the extent ranking factors identified (above) in relation to campus layout and operations, and past event low degree of severity, the planning committee ranks the extent of the thunderstorm hazard as **LOW**.

\textsuperscript{141} Retrieved on 07.15.2021 from https://www.noaa.gov/explainers/severe-storms
\textsuperscript{142} Retrieved on 07.15.2021 from https://www.weather.gov/safety/thunderstorm
History of the Hazard

Severe weather hazards have been an annual occurrence in San Bernardino and on the CSU San Bernardino campus. Historical data for these hazards are presented below.

Historical Storm Data Collection: NCEI Storm Events Database

Historical information regarding severe weather hazards can be found using The National Centers for Environmental Information (NCEI) Storm Events Database. The Storm Events Database contains searchable, archived National Weather Service (NWS) storm data from January 1950 to April 2021, as entered by NOAA’s National Weather Service (NWS). Due to changes in the data collection and processing procedures over time, there are unique periods of record available depending on the event type.\textsuperscript{148} For example, from 1950 through 1954, only tornado events were recorded; from 1955 through 1995, only tornado, thunderstorm wind, and hail events were introduced into the database; from 1996 to present, 45 additional event types are recorded, including high wind, strong wind, and lightning events.\textsuperscript{149} To obtain the most accurate portrayal of severe weather event frequency, searches of the Storm Events Database are conducted using data collected since 01/01/1996. As a reminder, all official severe weather event data is at the county level. Severe weather data do not exist at the campus level. That said, it may be the case that the campus to some degree experiences the severe weather events reported for the surrounding community and County.

San Bernardino County

Wind Hazards (excluding Tornadoes)

Information obtained from the NCEI Storm Event Database website shows the number of events (or occurrences) of wind hazard events in San Bernardino County since 1996.\textsuperscript{150} Here, wind hazard events include all “High Wind,” “Strong Wind,” and “Thunderstorm Wind” storm reports.\textsuperscript{151}

- **High Wind**: at least 493 events, or approximately 19.46 events per year\textsuperscript{152}

\textsuperscript{150} National Climatic Data Center. Storm Events Database. Retrieved 07.19.2021 from https://www.ncdc.noaa.gov/stormevents/
\textsuperscript{151} National Climatic Data Center. Storm Events Database. Retrieved 07.19.2021 from https://www.ncdc.noaa.gov/stormevents/
\textsuperscript{152} National Climatic Data Center. Storm Events Database. Retrieved 07.30.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28Z%29+High+Wind&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=SAN%2BBERNARDINO%3A71&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitButton=Search&statefips=6%2CCALIFORNIA
- **Strong Wind**: at least 70 events, or 2.76 events per year\(^\text{153}\)
- **Thunderstorm Wind**: at least 116 events, or approximately 4.58 events per year\(^\text{154}\)
- **All Wind Hazard events** (excluding Tornadoes): at least 673 events, or approximately 26.57 events per year.\(^\text{155, 156}\) (Note: This was determined by conducting a simultaneous search of the component wind hazards of high wind, strong wind and thunderstorm wind.)

Overall, in San Bernardino County, there have been at least 673 wind hazard events since 1996, excluding tornadoes.\(^\text{157, 158}\) That translates to an approximate average historical frequency of occurrence of **26.57** wind hazard events per year.

Please note: Differences between the sums of individual component severe weather hazard event Database searches (i.e., 679 events) and simultaneous Database searches of all severe weather hazard events (i.e., 673 events) may be due to the following factors: (1) multiple event types are in the same record (e.g., "Thunderstorm Wind/Hail" or "Hail/Tornado;“ and/or (2) severe weather hazard events such as “Thunderstorm Wind”

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\(^\text{153}^\) National Climatic Data Center. Storm Events Database. Retrieved 07.30.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28Z%29+Strong+Wind&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=SAN%2BBERNARDINO%3A71&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA

\(^\text{154}^\) National Climatic Data Center. Storm Events Database. Retrieved 07.30.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Thunderstorm+Wind&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=SAN%2BBERNARDINO%3A71&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA

\(^\text{155}^\) National Climatic Data Center. Storm Events Database. Retrieved 07.30.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28Z%29+High+Wind&eventType=%28Z%29+Strong+Wind&eventType=%28C%29+Thunderstorm+Wind&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=SAN%2BBERNARDINO%3A71&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA

\(^\text{156}^\) National Climatic Data Center. Storm Events Database. Retrieved 07.30.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28Z%29+High+Wind&eventType=%28Z%29+Strong+Wind&eventType=%28C%29+Thunderstorm+Wind&beginDate_mm=01&beginDate_dd=30&beginDate_yyyy=2016&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=SAN%2BBERNARDINO%3A71&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA

\(^\text{157}^\) National Climatic Data Center. Storm Events Database. Retrieved 07.30.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28Z%29+High+Wind&eventType=%28Z%29+Strong+Wind&eventType=%28C%29+Thunderstorm+Wind&beginDate_mm=01&beginDate_dd=30&beginDate_yyyy=2016&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=SAN%2BBERNARDINO%3A71&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA

\(^\text{158}^\) National Climatic Data Center. Storm Events Database. Retrieved 07.30.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28Z%29+High+Wind&eventType=%28Z%29+Strong+Wind&eventType=%28C%29+Thunderstorm+Wind&beginDate_mm=01&beginDate_dd=30&beginDate_yyyy=2016&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=SAN%2BBERNARDINO%3A71&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA
or “Hail” that are reported for San Bernardino County have actually taken place hundreds of miles away, but are erroneously recorded as events that have occurred in the County.\textsuperscript{159} When such a discrepancy arises, the more conservative aggregate hazard wind event value (i.e., 673 events) is used to determine the historical frequency of occurrence for the severe weather hazard. The origin of this discrepancy is unknown at this time.

### Historical Wind Hazard Losses for San Bernardino County since 1996

According to the NCEI Storm Events Database, the wind hazard events that San Bernardino County has experienced since 1996 have been costly. There have been 4 deaths and 42 injuries, and property and crop damage estimates have totaled approximately $52,873,000 and $2,000,000, respectively.\textsuperscript{160} 161

#### Tornado Wind Hazards

Information from the NCEI Storm Events Database indicates that since 1996, there have been 16 reported events of tornadoes in San Bernardino County, which translates to approximately 0.63 tornado events per year.\textsuperscript{162}

The 11 out of the 16 the tornadoes reported in San Bernardino County since 1996 have been of tornadoes with a severity rating of F0/EF0. Each of the remaining five (5) tornadoes have had a severity rating of F1/EF1; that translates to approximately 0.20 events of F1/EF1 tornadoes that have occurred per year in San Bernardino County.\textsuperscript{163}


\textsuperscript{160} National Climatic Data Center. Storm Events Database. Retrieved 07.30.2021 from [https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28Z%29+High+Wind&eventType=%28C%29+Thunderstorm+Wind&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=SAN%2BBERNARDINO%3A71&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitButton=Search&statefips=6%2CCALIFORNIA](https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28Z%29+High+Wind&eventType=%28C%29+Thunderstorm+Wind&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=SAN%2BBERNARDINO%3A71&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitButton=Search&statefips=6%2CCALIFORNIA)

\textsuperscript{161} National Climatic Data Center. Storm Events Database. Retrieved 07.30.2021 from [https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28Z%29+High+Wind&eventType=%28C%29+Thunderstorm+Wind&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=SAN%2BBERNARDINO%3A71&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitButton=Search&statefips=6%2CCALIFORNIA](https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28Z%29+High+Wind&eventType=%28C%29+Thunderstorm+Wind&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=SAN%2BBERNARDINO%3A71&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitButton=Search&statefips=6%2CCALIFORNIA)

\textsuperscript{162} National Climatic Data Center. Storm Events Database. Retrieved 07.30.2021 from [https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Tornado&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=SAN%2BBERNARDINO%3A71&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitButton=Search&statefips=6%2CCALIFORNIA](https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Tornado&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=SAN%2BBERNARDINO%3A71&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitButton=Search&statefips=6%2CCALIFORNIA)

\textsuperscript{163} National Climatic Data Center. Storm Events Database. Retrieved 07.30.2021 from [https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Tornado&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=SAN%2BBERNARDINO%3A71&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitButton=Search&statefips=6%2CCALIFORNIA](https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Tornado&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=SAN%2BBERNARDINO%3A71&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitButton=Search&statefips=6%2CCALIFORNIA)
Historical Tornado Hazard Losses for San Bernardino County since 1996

According to the NCEI Storm Events Database, the tornado hazard events that San Bernardino County has experienced since 1996 have been moderate. There have been no deaths, injuries, or crop damages reported, but property damage estimates have totaled approximately $41,000.164

**Hail**

Information from the NCEI Storm Events Database indicates that since 1996, there have been 52 reported events of hail in San Bernardino County, which translates to approximately 2.05 hail events per year.165 (Note: The NCEI Storm Event Database search results for hail indicate that there has been a total of 53 reports of hail since 1996. However, one (1) entry is for a hail event in San Diego County, hundreds of miles away from San Bernardino County. The origin of this error is unknown at this time.)

Historical Hail Hazard Losses for San Bernardino County since 1996

According to the NCEI Storm Events Database, the hail hazard events that San Bernardino County has experienced since 1996 have been costly. While there have been no deaths, injuries, or crop damages reported, property damage estimates have totaled approximately $358,100.166 (Note: The San Diego County hail event that was included erroneously in the search results for hail hazard events in San Bernardino County accounted for all injuries (i.e., 5) and crop damage estimates (i.e., $300,000) presented in the search results.)

**Lightning**

Information from the NCEI Storm Events Database indicates that since 1996, there have been 55 reported events of lightning in San Bernardino County, which translates to approximately 2.17 lightning events per year.167

164 National Climatic Data Center. Storm Events Database. Retrieved 07.30.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Tornado&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=SAN%2BBERNARDINO%3A71&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA

165 National Climatic Data Center. Storm Events Database. Retrieved 07.30.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Hail&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=SAN%2BBERNARDINO%3A71&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA

166 National Climatic Data Center. Storm Events Database. Retrieved 07.30.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Hail&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=SAN%2BBERNARDINO%3A71&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA

167 National Climatic Data Center. Storm Events Database. Retrieved 07.30.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Lightning&beginDate_mm=01&
Historical Lightning Hazard Losses for San Bernardino County since 1996

According to the NCEI Storm Events Database, the lightning hazard events that San Bernardino County has experienced since 1996 have been costly. There have been 3 deaths and 9 injuries, and property damage estimates have totaled approximately $1,343,000; reported crop damage estimates have been negligible (i.e., $100).168

All Severe Weather Hazard Events Recorded by the NCEI Storm Events Database

Information obtained from the NCEI Storm Events Database indicates that there have been 796 occurrences of the severe weather hazard in San Bernardino County. This translates to 31.42 severe weather hazard occurrences per year.169 170

Please note: Differences between the sums of individual component severe weather hazard event Database searches (i.e., 803 events) and simultaneous Database searches of all severe weather hazard events (i.e., 796 events) may be due to the following factors: (1) multiple event types are in the same record (e.g., "Thunderstorm Wind/Hail" or "Hail/Tornado;" and/or (2) severe weather hazard events such as “Thunderstorm Wind” or “Hail” that are reported for San Bernardino County have actually taken place hundreds of miles away, but are erroneously recorded as events that have occurred in the County.171 When such a discrepancy arises, the more conservative aggregate hazard wind event value (i.e., 796 events) is used to determine the historical frequency of occurrence for the severe weather hazard. The origin of this discrepancy is unknown at this time.

Historical, Aggregated Severe Hazard Losses for San Bernardino County since 1996

beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=S
AN%2BBERNARDINO%3A71&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&st
atefips=6%2CCALIFORNIA

168 National Climatic Data Center. Storm Events Database. Retrieved 07.30.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Lightning&beginDate_mm=01&
beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=S
AN%2BBERNARDINO%3A71&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&st
atefips=6%2CCALIFORNIA

169 National Climatic Data Center. Storm Events Database. Retrieved 07.30.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Hail&eventType=%28Z%29+High+W
ind&eventType=%28C%29+Lightning&eventType=%28Z%29+Strong+Wind&eventType=%28C%29+Thun
derstorm+Wind&eventType=%28C%29+Tornado&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=19
96&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=SAN%2BBERNARDINO%3A71&hailfilter
=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA

170 National Climatic Data Center. Storm Events Database. Retrieved 07.30.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Hail&eventType=%28Z%29+High+W
ind&eventType=%28C%29+Lightning&eventType=%28Z%29+Strong+Wind&eventType=%28C%29+Thun
derstorm+Wind&eventType=%28C%29+Tornado&beginDate_mm=09&beginDate_dd=11&beginDate_yyyy=20
12&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=SAN%2BBERNARDINO%3A71&hailfilter
=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA

171 Dos Santos, Renato. (2016). Some Comments on the Reliability of NOAA’s Storm Events Database. SSRN
According to the NCEI Storm Events Database, the severe weather events that San Bernardino County has experienced since 1996 have been costly. There have been 7 deaths and 51 injuries, and property and crop damage estimates have totaled approximately $54,615,000 and $2,000,000, respectively.\(^{172}\) It is important to note that for all San Bernardino County severe weather hazard events recorded on the Storm Events Database, more than half of all deaths, the vast majority of injuries, all estimated crop damage, and approximately 96.8% of all estimated property damage have been caused by wind hazard events alone.

**Riverside County**

**Wind Hazards (excluding Tornadoes)**

Information obtained from the NCEI Storm Event Database website shows the number of events (or occurrences) of wind hazard events in Riverside County since 1996.\(^{174}\) Here, wind hazard events include all “High Wind,” “Strong Wind,” and “Thunderstorm Wind” storm reports.\(^{175}\)

- **High Wind**: at least 486 events, or approximately 19.18 events per year\(^{176}\)
- **Strong Wind**: at least 44 events, or 1.74 events per year\(^{177}\)

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\(^{172}\) National Climatic Data Center. Storm Events Database. Retrieved 07.30.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Hail&eventType=%28Z%29+High+Wind&eventType=%28C%29+Lightning&eventType=%28Z%29+Strong+Wind&eventType=%28C%29+Thunderstorm+Wind&eventType=%28C%29+Tornado&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=SAN%2BERNARDINO%3A71&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA

\(^{173}\) National Climatic Data Center. Storm Events Database. Retrieved 07.30.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Hail&eventType=%28Z%29+High+Wind&eventType=%28C%29+Lightning&eventType=%28Z%29+Strong+Wind&eventType=%28C%29+Thunderstorm+Wind&eventType=%28C%29+Tornado&beginDate_mm=09&beginDate_dd=11&beginDate_yyyy=2012&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=SAN%2BERNARDINO%3A71&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA


\(^{176}\) National Climatic Data Center. Storm Events Database. Retrieved 08.05.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28Z%29+High+Wind&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=RIVERSIDE%3A65&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA

\(^{177}\) National Climatic Data Center. Storm Events Database. Retrieved 08.05.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28Z%29+Strong+Wind&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=RIVERSIDE%3A65&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA
- **Thunderstorm Wind:** at least 114 events, or approximately 4.50 events per year\textsuperscript{178}

- **All Wind Hazard events** (excluding Tornadoes): at least 638 events, or approximately 25.18 events per year.\textsuperscript{179, 180} (Note: This was determined by conducting a simultaneous search of the component wind hazards of high wind, strong wind and thunderstorm wind.)

Overall, in Riverside County, there have been at least 638 wind hazard events since 1996, excluding tornadoes.\textsuperscript{181, 182} That translates to an approximate average historical frequency of occurrence of 25.18 wind hazard events per year.

Please note: Differences between the sums of individual component severe weather hazard event Database searches (i.e., 644 events) and simultaneous Database searches of all severe weather hazard events (i.e., 638 events) may be due to the following factors: (1) multiple event types are in the same record (e.g., "Thunderstorm Wind/Hail" or "Hail/Tornado;" and/or (2) severe weather hazard events such as “Thunderstorm Wind” or “Hail” that are reported for Riverside County have actually taken place hundreds of miles away, but are erroneously recorded as events that have occurred in the County.\textsuperscript{183} When such a discrepancy arises, the more conservative aggregate hazard wind event value (i.e., 638 events) is used to determine the historical frequency of occurrence for the severe weather hazard. The origin of this discrepancy is unknown at this time.

\textsuperscript{178} National Climatic Data Center. Storm Events Database. Retrieved on 08.05.2021 from [https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Thunderstorm+Wind&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=RIVERSIDE%3A65&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitButton=Search&statefips=6%2CCALIFORNIA](https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Thunderstorm+Wind&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=RIVERSIDE%3A65&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitButton=Search&statefips=6%2CCALIFORNIA)

\textsuperscript{179} National Climatic Data Center. Storm Events Database. Retrieved on 08.05.2021 from [https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28Z%29+High+Wind&eventType=%28Z%29+Strong+Wind&eventType=%28C%29+Thunderstorm+Wind&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=RIVERSIDE%3A65&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitButton=Search&statefips=6%2CCALIFORNIA](https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28Z%29+High+Wind&eventType=%28Z%29+Strong+Wind&eventType=%28C%29+Thunderstorm+Wind&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=RIVERSIDE%3A65&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitButton=Search&statefips=6%2CCALIFORNIA)

\textsuperscript{180} National Climatic Data Center. Storm Events Database. Retrieved on 08.05.2021 from [https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28Z%29+High+Wind&eventType=%28Z%29+Strong+Wind&eventType=%28C%29+Thunderstorm+Wind&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=RIVERSIDE%3A65&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitButton=Search&statefips=6%2CCALIFORNIA](https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28Z%29+High+Wind&eventType=%28Z%29+Strong+Wind&eventType=%28C%29+Thunderstorm+Wind&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=RIVERSIDE%3A65&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitButton=Search&statefips=6%2CCALIFORNIA)

\textsuperscript{181} National Climatic Data Center. Storm Events Database. Retrieved on 08.05.2021 from [https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28Z%29+High+Wind&eventType=%28Z%29+Strong+Wind&eventType=%28C%29+Thunderstorm+Wind&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=RIVERSIDE%3A65&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitButton=Search&statefips=6%2CCALIFORNIA](https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28Z%29+High+Wind&eventType=%28Z%29+Strong+Wind&eventType=%28C%29+Thunderstorm+Wind&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=RIVERSIDE%3A65&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitButton=Search&statefips=6%2CCALIFORNIA)

\textsuperscript{182} National Climatic Data Center. Storm Events Database. Retrieved on 08.05.2021 from [https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28Z%29+High+Wind&eventType=%28Z%29+Strong+Wind&eventType=%28C%29+Thunderstorm+Wind&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=RIVERSIDE%3A65&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitButton=Search&statefips=6%2CCALIFORNIA](https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28Z%29+High+Wind&eventType=%28Z%29+Strong+Wind&eventType=%28C%29+Thunderstorm+Wind&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=RIVERSIDE%3A65&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitButton=Search&statefips=6%2CCALIFORNIA)

Historical Wind Hazard Losses for Riverside County since 1996

According to the NCEI Storm Events Database, the wind hazard events that Riverside County has experienced since 1996 have been costly. There have been three (3) deaths and 40 injuries, and property and crop damage estimates have totaled approximately $62,933,000 and $65,000, respectively.  

Tornado Wind Hazards

Information from the NCEI Storm Events Database indicates that since 1996, there have been 18 reported events of tornadoes in Riverside County, which translates to approximately 0.71 tornado events per year. While the vast majority of tornado reports in Riverside County since 1996 have been of tornadoes with a severity rating of F0/EF0, there have been (3) F1/EF1 tornadoes and one (1) EF2 tornado also reported.

Historical Tornado Hazard Losses for Riverside County since 1996

According to the NCEI Storm Events Database, the tornado hazard events that Riverside County has experienced since 1996 have been costly. While there have been no deaths or crop damages reported, there have been three (3) injuries, and property damage estimates have totaled approximately $21,486,000.

184 National Climatic Data Center. Storm Events Database. Retrieved on 08.05.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?showAll=1&eventType=Z+High+Wind&eventType=Z+Strong+Wind&eventType=C+Thunderstorm+Wind&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=RIVERSIDE%3A65&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA

185 National Climatic Data Center. Storm Events Database. Retrieved on 08.05.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?showAll=1&eventType=Z+High+Wind&eventType=Z+Strong+Wind&eventType=C+Thunderstorm+Wind&beginDate_mm=04&beginDate_dd=29&beginDate_yyyy=2017&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=RIVERSIDE%3A65&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA

186 National Climatic Data Center. Storm Events Database. Retrieved on 08.05.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?showAll=1&eventType=C+Tornado&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=RIVERSIDE%3A65&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA

187 National Climatic Data Center. Storm Events Database. Retrieved on 08.05.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?showAll=1&eventType=C+Tornado&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=RIVERSIDE%3A65&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA

188 National Climatic Data Center. Storm Events Database. Retrieved on 08.05.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?showAll=1&eventType=C+Tornado&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=RIVERSIDE%3A65&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA
**Hail**

Information from the NCEI Storm Events Database indicates that since 1996, there have been 17 reported events of hail in Riverside County, which translates to approximately **0.67** hail events per year.\(^{189}\) (Note: The NCEI Storm Event Database search results for hail indicate that there has been a total of 18 reports of hail since 1996. However, one (1) entry is for a hail event in San Diego County coastal areas not proximal to Riverside County. The origin of this error is unknown at this time.)

**Historical Hail Hazard Losses for Riverside County since 1996**

According to the NCEI Storm Events Database, the hail hazard events that Riverside County has experienced since 1996 have been moderate. While there have been no deaths or crop damage, there have been two (2) injuries, and property damage estimates have totaled approximately $16,500.\(^{190}\)

**Lightning**

Information from the NCEI Storm Events Database indicates that since 1996, there have been 31 reported events of lightning in Riverside County, which translates to approximately **1.22** lightning events per year.\(^ {191}\)

**Historical Lightning Hazard Losses for Riverside County since 1996**

According to the NCEI Storm Events Database, the lightning hazard events that Riverside County has experienced since 1996 have been costly. There have been one (1) death and six (6) injuries, and property and crop damage estimates have totaled approximately $249,500 and $10,100, respectively.\(^{192}\)

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\(^{189}\) National Climatic Data Center. Storm Events Database. Retrieved on 08.05.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Hail&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=RIVERSIDE%3A65&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA

\(^{190}\) National Climatic Data Center. Storm Events Database. Retrieved on 08.05.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Hail&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=RIVERSIDE%3A65&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA

\(^{191}\) National Climatic Data Center. Storm Events Database. Retrieved on 08.05.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Lightning&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=RIVERSIDE%3A65&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA

\(^{192}\) National Climatic Data Center. Storm Events Database. Retrieved on 08.05.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Lightning&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=RIVERSIDE%3A65&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA
All Severe Weather Hazard Events Recorded by the NCEI Storm Events Database (Riverside County)

Information obtained from the NCEI Storm Events Database indicates that there have been 704 occurrences of the severe weather hazard in Riverside County. This translates to **27.79** severe weather hazard occurrences per year.\(^{193}\) \(^{194}\)

Please note: Differences between the sums of individual component severe weather hazard event Database searches (i.e., 710 events) and simultaneous Database searches of all severe weather hazard events (i.e., 704 events) may be due to the following factors: (1) multiple event types are in the same record (e.g., “Thunderstorm Wind/Hail” or “Hail/Tornado;” and/or (2) severe weather hazard events such as “Thunderstorm Wind” or “Hail” that are reported for Riverside County have actually taken place hundreds of miles away, but are erroneously recorded as events that have occurred in the County.\(^{195}\)

When such a discrepancy arises, the more conservative aggregate hazard wind event value (i.e., 704 events) is used to determine the historical frequency of occurrence for the severe weather hazard. The origin of this discrepancy is unknown at this time.

Historical, Aggregated Severe Hazard Losses for Riverside County since 1996

According to the NCEI Storm Events Database, the severe weather events that Riverside County has experienced since 1996 have been costly. There have been four (4) deaths and 51 injuries, and property and crop damage estimates have totaled approximately **$84,685,000** and **$75,100**, respectively.\(^{196}\) \(^{197}\) **It is important to note that for all Riverside**
County severe weather hazard events recorded on the Storm Events Database, 75% of all deaths, 78.4% of all injuries, 74.9% of all estimated property damages, and 86.6% of all estimated crop damages have been caused by wind hazard events alone.

Wind Hazards Not Included in the NCEI Storm Events Database

Santa Ana Winds

Santa Ana wind events occur at least twice per month from October through April. From 1948 to 2012, total of 2056 events on the 65-year record were recorded in the Southern California region, yielding an average of 32 occurrences per year. Typical Santa Ana wind events last 1–2 days and represent 27% of the occurrences, with events lasting up to 6 days accounting for 90% of all occurrences. The remaining 10% are made up almost entirely of events lasting between 7 and 12 days.

Figure below shows the mean monthly frequency per season of Santa Ana Wind events detected from 1948 to 2012. Extreme Santa Ana wind events are shown in dark red, and are defined as those events that are above the 90th percentile of all events on record.

Diablo Winds

Diablo wind events occur approximately **2.5 events per year**. These events are most frequent during the fall and early winter seasons, with the highest frequency of events occurring in October. As a result, the highest risk of Diablo-wind-related damage is in the fall and early winter.²⁰³
Figure below shows the monthly frequency of Diablo winds (along with average live fuel moisture content). The Diablo Wind data are derived from a 17-year climatology of San Francisco Bay Area regional surface weather stations.\textsuperscript{204}

Figure 19-21: Monthly Frequency of Diablo Winds and Average Live Fuel Moisture Content (Dashed Line)\textsuperscript{205}

\textbf{Sundowner Winds}

Strong sundowner wind events occur approximately \textit{2-3 times per year}. These events can create sharp temperature rises, local gale force winds, and significant weather-related problems. Rare, “explosive” types of sundowner wind events occur about 6 times per century that present dangerous weather situations, generating extremely strong and hot winds that can reach gale force or higher speeds.\textsuperscript{206}

\textbf{Historical Frequency of All Severe Weather Hazards}

Table below shows the average historical frequency of severe weather hazard events for San Bernardino County since 1996.)

\begin{figure}[h]
\centering
\includegraphics[width=\textwidth]{figure}
\caption{Monthly Frequency of Diablo Winds and Average Live Fuel Moisture Content}
\end{figure}

\textsuperscript{204} Retrieved on 07.15.2021 from https://www.fireweather.org/diablo-winds
\textsuperscript{205} Retrieved on 07.13.2021 from https://www.fireweather.org/diablo-winds
Table 19-32: Severe Weather Hazard Event

Frequencies for San Bernardino County since 1996.

<table>
<thead>
<tr>
<th>Severe Weather Hazard Category</th>
<th>Average Number of Hazard Events Per Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wind (Includes High, Strong and Thunderstorm Winds ONLY)</td>
<td>26.57</td>
</tr>
<tr>
<td>Tornado</td>
<td>0.63</td>
</tr>
<tr>
<td>Hail</td>
<td>2.05</td>
</tr>
<tr>
<td>Lightning</td>
<td>2.17</td>
</tr>
<tr>
<td>Diablo Wind*</td>
<td>2.5</td>
</tr>
<tr>
<td>Santa Ana Wind</td>
<td>32</td>
</tr>
<tr>
<td>Sundowner Wind*</td>
<td>2 to 3</td>
</tr>
</tbody>
</table>

* Note: The Diablo and Sundowner wind hazards are not present in San Bernardino County. They are included here for information purposes only.

Table below shows the average historical frequency of severe weather hazard events for Riverside County since 1996.

Table 19-33: Severe Weather Hazard Event

Frequencies for Riverside County since 1996.

<table>
<thead>
<tr>
<th>Severe Weather Hazard Category</th>
<th>Average Number of Hazard Events Per Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wind (Includes High, Strong and Thunderstorm Winds ONLY)</td>
<td>25.18</td>
</tr>
<tr>
<td>Tornado</td>
<td>0.71</td>
</tr>
<tr>
<td>Hail</td>
<td>0.67</td>
</tr>
<tr>
<td>Lightning</td>
<td>1.22</td>
</tr>
<tr>
<td>Diablo Wind*</td>
<td>2.5</td>
</tr>
</tbody>
</table>
Potential Impacts of the Hazard

The significance (or priority) of a hazard’s potential impacts is based primarily on the frequency and resulting damage caused by the hazard, including deaths/injuries and property, crop, and economic damage. All assets and people within CSU San Bernardino campus areas are at risk from the effects of severe weather hazards.

**Wind Hazards (Including Tornadoes)**

Wind hazard events have the potential to impact people, property, and operations on campuses across the CSU system. People caught in the open during an extreme wind event are exposed to high winds and debris, and could be injured or killed.

The habitability of buildings can be compromised (by damaging roofs, windows, or other weak points in the building envelope), leading to long-term operational issues for the campus. As with most university campuses, space is always at a premium at the CSU San Bernardino campus, and the loss of any currently utilized space due to building or structural damage would likely disrupt operations and the University’s mission.

Extreme wind events can result in power failure, which would impact the operation of the campus. Fallen tree limbs and other potential transportation hazards may also cause disruption to the surrounding community and limit ingress/egress to the campus.

**CSU San Bernardino Main Campus, San Bernardino (San Bernardino County)**

According to the 2016 City of San Bernardino Hazard Mitigation Plan Update, High Winds/Straight Line Winds and Tornado hazards are each considered to have a “Low” or minimal potential impact on the city and (by extension) on the CSU San Bernardino main campus.\(^\text{207}\)

**CSU San Bernardino – Palm Desert Campus, Palm Desert (Riverside County)**

According to the 2018 County of Riverside Multi-Jurisdictional Local Hazard Mitigation Plan, wind hazards (excluding tornadoes) are considered to have a moderate to high potential impact, and tornadoes are considered to have a moderate potential impact on Riverside County and (by extension) on the CSU San Bernardino – Palm Desert Campus.208

**Hail**

Hail typically impacts property by damaging structures, cars, and utilities as it falls. Dents in cars, broken glass, and holes in roofs are common impacts of hail. Injuries to people from hail are less common, though they can happen, as hail is a hard object falling in an unpredictable manner at a fairly high rate of speed.

**CSU San Bernardino Main Campus, San Bernardino (San Bernardino County)**

According to the 2016 City of San Bernardino Hazard Mitigation Plan Update, hail is considered to have a “Low” or minimal potential impact on the city of San Bernardino and (by extension) on the CSU San Bernardino main campus.209

**CSU San Bernardino – Palm Desert Campus, Palm Desert (Riverside County)**

The 2018 County of Riverside Multi-Jurisdictional Local Hazard Mitigation Plan does not include the hail hazard as significant enough to profile; as a result, the hail hazard is considered to have a minimal potential impact on Riverside County and (by extension) on the CSU San Bernardino – Palm Desert Campus.210

**Lightning**

Lightning strikes the United States about 20-25 million times a year.211 Although most lightning occurs in the summer months, people can be struck at any time of year. Since 1990, lightning has killed an average of 39 people each year in the United States, and hundreds more have been injured.212 Property losses due to lightning have been very costly across the U.S. For example, from 2005 through 2020, U.S. homeowner’s insurance claim payouts for lightning losses totaled approximately $15,334,600,000, or $958,412,500 worth of payouts per year.213 (Commercial claim payouts for lightning losses for the U.S. were not available.)

---

**CSU San Bernardino Main Campus, San Bernardino (San Bernardino County)**

According to the 2016 City of San Bernardino Hazard Mitigation Plan Update, lightning is considered to have a “Medium/Limited” or moderate potential impact on the city and (by extension) on the CSU San Bernardino main campus.  

**CSU San Bernardino – Palm Desert Campus, Palm Desert (Riverside County)**

The 2018 County of Riverside Multi-Jurisdictional Local Hazard Mitigation Plan does not include the lightning hazard as significant enough to profile; as a result, the lightning hazard is considered to have a minimal potential impact on Riverside County and (by extension) on the CSU San Bernardino – Palm Desert Campus.

**Probability of Future Occurrence of the Hazard**

Areas throughout California, including all California State University (CSU) campuses, experience severe weather events every year. Future occurrences of such events are projected to increase in both their frequency and intensity.

**CSU San Bernardino Main Campus, San Bernardino (San Bernardino County)**

The 2016 City of San Bernardino Hazard Mitigation Plan Update states that wind and lightning severe weather hazards each have a “High” (i.e., “Highly Likely/Likely”) probability of future occurrence in the County, while tornadoes and hail each have a “Low” (i.e., “Unlikely”) probability of future occurrence in the County. Also, according to the NCEI Storm Events Database, some of these same severe weather hazards (i.e., wind and lightning) have occurred in San Bernardino County more than once per year. Furthermore, while the severe weather hazard is a non-spatial hazard that affects all areas of both CSU San Bernardino main campus equally, the smallest geographic unit of measurement for almost all official severe weather event data is at the county level. Because the severe weather data used in this assessment do not exist at the campus level, it is assumed that the severe weather probabilities for the CSU San Bernardino main campus reflect those of the surrounding community and County identified in the Table below.

Based on the data available from both the 2016 City of San Bernardino Hazard Mitigation Plan Update and the NCEI Storm Events Database, the severe weather hazard is expected to occur on (or otherwise impact) the CSU San Bernardino campus at least once on an

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annual basis. Therefore, the probability of future occurrence of the severe weather hazard for the CSU San Bernardino main campus is **HIGHLY LIKELY**.

**CSU San Bernardino – Palm Desert Campus, Palm Desert (Riverside County)**

The 2018 County of Riverside Multi-Jurisdictional Local Hazard Mitigation Plan states that there is a moderate possibility that high wind hazard events will occur in the County occasionally (i.e., once every 5 years) in the future.\(^{217}\) However, according to the NCEI Storm Events Database, severe weather wind hazards have occurred in Riverside County far more than once annually – at an average of 25.18 events per year since 1996. Furthermore, while the severe weather hazard is a non-spatial hazard that affects all areas of the CSU San Bernardino – Palm Desert campus equally, the smallest geographic unit of measurement for almost all official severe weather event data is at the county level. Because the severe weather data used in this assessment do not exist at the campus level, it is assumed that the severe weather probabilities for CSU San Bernardino – Palm Desert reflect those of the surrounding community and County identified in the Table below.

Taking into account the data available from both 2018 County of Riverside Multi-Jurisdictional Local Hazard Mitigation Plan and the NCEI Storm Events Database, the severe weather hazard is expected to occur on (or otherwise impact) the for CSU San Bernardino – Palm Desert campus at least once on an annual basis. Therefore, the probability of future occurrence of the severe weather hazard for CSU San Bernardino – Palm Desert is **HIGHLY LIKELY**.

**CSU San Bernardino – All Campus Areas**

The probability of future occurrence of the severe weather hazard for all CSU San Bernardino campus areas is **HIGHLY LIKELY**.

The following tables show the probabilities of future occurrence for component severe weather hazards for CSU San Bernardino campuses in San Bernardino County and Riverside County.

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Table 19-34: Severe Weather Hazard Probabilities of Future Occurrence for San Bernardino County and CSU San Bernardino.

<table>
<thead>
<tr>
<th>Severe Weather Hazard Category</th>
<th>Average Number of Hazard Events Per Year</th>
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<td>Lightning</td>
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</tr>
<tr>
<td>Diablo Wind**</td>
<td>2.5</td>
<td>Not Rated</td>
</tr>
<tr>
<td>Santa Ana Wind</td>
<td>32</td>
<td>Highly Likely</td>
</tr>
<tr>
<td>Sundowner Wind**</td>
<td>2 to 3</td>
<td>Not Rated</td>
</tr>
</tbody>
</table>

** Note: The Diablo and Sundowner wind hazards are not present in San Bernardino County, and therefore are not rated for probability of future occurrence. They are included here for information purposes only.
Table 19-35: Severe Weather Hazard Probabilities of Future Occurrence for Riverside County and CSU San Bernardino – Palm Desert Campus.

<table>
<thead>
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</tr>
<tr>
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<td>Not Rated</td>
</tr>
<tr>
<td>Severe Weather Hazard</td>
<td>Highly Likely</td>
<td></td>
</tr>
</tbody>
</table>

** Note: The Diablo and Sundowner wind hazards are not present in Riverside County, and therefore are not rated for probability of future occurrence. They are included here for information purposes only.

Vulnerability to the Hazard

People, structures, and assets on both CSU San Bernardino campuses are all vulnerable to the impacts associated with severe weather. Infrastructure can be damaged or destroyed by hail, wind, tornadoes, thunderstorms, and lightning, which can result in service interruptions and outages. Structures can be damaged or destroyed by hail, wind, tornadoes, thunderstorms, and lightning. People can be injured or killed by lightning, flying debris, hail, or extreme wind events. The CSU San Bernardino campuses also has vehicles that are all vulnerable to a severe weather event.

Estimate of Potential Losses

Severe weather is a non-spatial hazard that affects the all areas of both CSU San Bernardino campuses. Each of the hazards associated with severe weather can result in losses throughout the planning area.

All CSU San Bernardino campus structures are at risk from severe weather. There are approximately 111 buildings at the main campus that could be damaged by wind, hail, and/or lightning. (Estimated facility costs at the Palm Desert campus are currently not
available.) If even a fraction of these assets were to be damaged, the resulting estimated losses would still be in the millions of dollars. The total replacement costs due to severe weather hazard are $626,694,141 for 80 buildings, and are unknown for the remaining 31 buildings. An analysis of projected dollar losses to campus buildings from severe weather as a percentage of building replacement costs is also not currently available, though CSU leadership may pursue such data in the future.

The population at both CSU San Bernardino campuses varies throughout the day. As of Fall, 2019, CSU San Bernardino had 20,311 students and 2,118 faculty and staff. All are at risk from severe weather events, with 22,429 being directly vulnerable in this scenario.

Vulnerability Assessment Conclusions

Severe weather presents a variety of hazards to both CSU San Bernardino campuses. People, assets, infrastructure, and vehicles can all be damaged by this hazard, and losses can quickly begin to rise. In the aggregate, severe weather is a frequently occurring hazard (mostly in the form of wind hazard events) that presents a variety of risks to CSU San Bernardino.

It is evident that CSU San Bernardino has vulnerabilities to and risks from severe weather hazard incidents, and that pre-event planning, communication, and mitigation efforts should be implemented. Public education and outreach regarding areas of shelter that could be used by campus populations during severe weather events is considered by campus leadership to be one viable mitigation option. The campus planning committee will continue to look for feasible and cost-effective options for the mitigation of severe weather risks going forward.

Identified Data Limitations

Numerous federal agencies maintain a variety of records regarding losses associated with hazards. Unfortunately, no single source is considered to offer a definitive accounting of all losses. The Federal Emergency Management Agency (FEMA) maintains records on federal expenditures associated with declared major disasters. The US Army Corps of Engineers (USACE) and the Natural Resources Conservation Service (NRCS) collect data on losses during the course of some of their ongoing projects and studies. Additionally, the National Oceanic and Atmospheric Administration’s (NOAA) National Centers for Environmental Information (NCEI) collects and maintains data about natural hazards in summary format, as well as occurrences, dates, injuries, deaths, and estimated costs for individual storm events. Many of these databases and other data collection

218 Retrieved on 07.19.2021 from https://www2.calstate.edu/csualumni/about-the-csu/facts-about-the-csu/enrollment/Pages/default.aspx
services, including the NCEI, have inherent data limitations when searching for information at a scale as small as a single campus.

The best available data and records have been used throughout this section. Where no data or records exist or could be located, that deficiency is noted.
19.4 Social Resilience Assessment

Overview

While every person is vulnerable to risk, individuals from diverse populations such as those with access and functional needs are disproportionately more vulnerable and may be at a higher risk to harm in a disaster event. In addition to physical vulnerabilities, the intersectionality between physical hazard risks and population social vulnerabilities must be considered to holistically address overall campus risk.

As inclusivity is a high priority for CSU, addressing campus risk and resilience must be done through the lens of inclusion and equity. Addressing social vulnerability is an increasingly critical requirement of state and national doctrines and described in Section 4.4 of the HVRA Base Plan. Every individual of the campus’s richly diverse population group needs to have the capacity, skills, and knowledge in order to understand, access, and participate in risk reduction and disaster response in ways that are meaningful to their own unique situation. In a campus community, having strong social support networks and active involvement in community disaster responses may negatively or positively impact these opportunities and reduce the resilience-building process. This section offers a glimpse into the CSU CAMPUS campus’s unique social construct, population demographics, strengths and concerns and presents a high-level assessment of the resilience, coping capacities and potential social vulnerabilities of students, staff and faculty. The research variables that were asked are often considered sensitive subjects, and few are traditionally included in emergency management/hazard mitigation planning.

This social resilience assessment of college campuses is the first of its kind in the nation. The research methodology unfolded as the interviews with campuses progressed. The assessment data presented are not definitive or authoritative. The answers, analysis, and suggested trends are strictly indicators for potential social risk. They do not represent an accurate data capture as limitations on the data gathering process influenced an ability to provide accuracy. This assessment provides indications of increased risk, not accuracy of response or a true reflection of the situation of the campus. The information presented is to be considered in the context of the more detailed system-wide CSU social vulnerability assessment that is included in the baseline HVRA.

Campus-Identified Populations of Concern

During the campus interview, the following responses were provided when asked, “In considering the diverse population group(s) amongst student body, faculty and staff, which are of the most concern in your emergency management planning?”
Table 19-36: High level summary of campus populations of concern

<table>
<thead>
<tr>
<th>Question</th>
<th>Campus Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>Which population groups amongst the student body, faculty, and staff, are of the most concern for physical and social vulnerabilities in emergency management planning?</td>
<td>Students from vulnerable socio-economic backgrounds</td>
</tr>
<tr>
<td>Which population groups are most difficult to reach in an event?</td>
<td>N/A</td>
</tr>
</tbody>
</table>
| Which population groups have little/limited support networks if impacted by an event? | • International students  
  • Students experiencing homelessness  
  • Populations from outside the region |

**Resilience Variables Related to Campus Emergency Management**

The interviewees were asked to reflect on a set of 12 variables for the campus populations of student, faculty and staff: homelessness (*housing insecurity*), food security, health and wellness, disability/access and functional needs (AFN), racial equity, digital equity, communications, international students, immigrants/immigration status issues (*undocumented, DACA, etc.*), LGBTQI (Lesbian Gay Bisexual Transgender Questioning (or queer) Intersex), and transportation dependency. They were also offered an opportunity to add any other factor they wanted to include. The following two questions were asked:

- Is this factor a particular issue of concern for emergency management on your campus? Responses were summarized as **Very High, High, Medium, Low**
- Is this factor reflected in the emergency plans and processes for your campus? Responses were summarized as **Yes, No, In Progress, NA**
In order to provide a high-level qualitative response for the answers, the approach of averaging response was taken. If conflicting answers were expressed by the interviewees, the answer (code) was averaged out. A detailed explanation of the response averaging approach is included in the base HVRA.

Table 19-37: Campus-specific emergency management issues of concern and inclusion in emergency management plans and processes.

<table>
<thead>
<tr>
<th>Issue of Concern</th>
<th>Plans &amp; Processes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Homelessness (Housing Insecurity)</td>
<td>High, No</td>
</tr>
<tr>
<td>Food Security</td>
<td>Very High, No</td>
</tr>
<tr>
<td>Health &amp; Wellness</td>
<td>High, In Progress</td>
</tr>
<tr>
<td>AFN</td>
<td>High, Yes</td>
</tr>
<tr>
<td>Racial Equity</td>
<td>Medium, No</td>
</tr>
<tr>
<td>Digital Equity</td>
<td>Low, No</td>
</tr>
<tr>
<td>Comms.</td>
<td>High, Yes</td>
</tr>
<tr>
<td>International Students</td>
<td>High, Yes</td>
</tr>
<tr>
<td>Immigrants / Immigration Status</td>
<td>Very High, In Progress</td>
</tr>
<tr>
<td>LGBTQI</td>
<td>High, No</td>
</tr>
<tr>
<td>Transportation Dependency</td>
<td>High, In Progress</td>
</tr>
</tbody>
</table>

Qualitative Narrative: Campus Overview of Potential Resilience Vulnerabilities

The following are interview notes of interest:

- Given a large-scale event, students would need a lot of Health and Wellness help. They would have a large portion of students who would reach out. Currently have one appendix for the student health center, and a small portion should be expanded. “Would love to delve more into this more.” It is based on the on-campus resources, it is reflected there, but very minimally.
- Have a CERT team, and they participate in exercises.
- Communications is a high issue of concern because people don’t even know they need to get the coms piece, for when new students come to campus. There is vulnerability across the board. They have a communications annex, and
emergency messaging was honed during the PSPS. A lot came up in the audit and the challenge is how to address. The auditor asked them to address in different language. They would like to put priority in that effort. Worked well to go back, look at the planning shortfalls when less students to look at [the messages].

- International students are of concern because they are not aware of the systems that are in place and there is a language barrier. There is a small accounting for this in the plan.
- Immigrants/immigration status issues (undocumented, DACA, etc.) is a definite issue of concern. It is “big on the campus.” would be great to have outreach to the groups and have resources. Developing plan is in process and it would be great to have plans and resources. There is not have enough manpower for all of these groups to having them knowing it is there and it is a shortfall of being able to get out there. While it is not a politically charged campus by nature (“not enough of me to go around – that is our downfall”) “What if the student doesn’t know, where do I go? Am I going to have to stop going to school?” They don’t know the resources.
- The LGBTQI population is of concern for them knowing what is out there; what they will need and what can be provided. If they must evacuate campus, “that is going to be a rough time / in a shelter / letting them know if that resource is there.” The auditor required them to have a line about some of the groups but not yet addressed.
- LGBTQI and DACA fall down the most – would be best of those two groups.
- Transportation dependency is an issue of concern and they are in the processes of addressing this as a planning issue. Started meeting with local school bus to put a contract into place to provide assistance to move off the campus but question is where to move them to? Senior administration doesn’t understand a block of room can’t be kept. Started planning and there are a lot of pieces to it.
- The power outages have been a “blessing in disguise” [for issue planning].

Campus High Hazards and Potentially Vulnerable Populations

This section provides a brief introduction to the link between socially vulnerable populations and a particular hazard type. While extensive research has been conducted on the impacts of hazards, not all linkages have been documented or published, and detail for finding them are beyond the scope of this assessment. It’s important to note, the intersectional nature of what makes an individual’s personal experience and resilience to an event is played out by unique factors for that individual or population. The nuanced social vulnerabilities often come from the social and physical environment in which a person is embedded.

In order to aid in further assessing campus resilience, below is a general description of the known impacts. From some hazards, the descriptions are robust, while others are only brief introductions.
Table 19-38: CSU San Bernardino *Highly Likely, Likely and Possible* Hazards

<table>
<thead>
<tr>
<th>Hazard</th>
<th>Future Occurrence Probability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Communicable Disease</td>
<td>Highly Likely</td>
</tr>
<tr>
<td>Drought</td>
<td>Highly Likely</td>
</tr>
<tr>
<td>Earthquake</td>
<td>Possible</td>
</tr>
<tr>
<td>Erosion</td>
<td>Likely</td>
</tr>
<tr>
<td>Extreme Temperature</td>
<td>Possible (Heat); Unlikely (Cold)</td>
</tr>
<tr>
<td>Hazardous Materials</td>
<td>Possible</td>
</tr>
<tr>
<td>Landslide</td>
<td>Likely</td>
</tr>
<tr>
<td>Power Outage</td>
<td>Likely</td>
</tr>
<tr>
<td>Wildfire</td>
<td>Likely (Fire); Possible (Smoke)</td>
</tr>
</tbody>
</table>

**Drought**

The 2012-2016 drought had severe effects on two vulnerable sectors of our population: those in low-income brackets, and those, especially Native Americans, who rely on subsistence fishing for their livelihoods.\(^{220}\) Water bills increased throughout the state. Due to rising water prices, for the working poor, many have paid four to five percent of their income for water. Since many CSU students are commuters, and many living with families, future drought impacts may potentially affect a percentage of non-resident students. NASA’s modeling shows that future droughts are likely to last longer and be more intense, even leading to “megadroughts” in the western states.\(^{221}\) Fresh water supplies are predicted to be full of extremes, with both droughts and extreme precipitation events being more severe. The interrelationship between drought and other hazard conditions may lead to a set of secondary impacts. Drought conditions lead to


water quality issues due to loss of drinking water, increased fire danger that leads to
drought-induced fires and elevated AQI levels, as well as extreme heat or prolonged heat
events.

**Earthquake**

Impacts on populations from earthquakes are complex, with long-term implications on
social stability for all populations. In addition to the physical impact exposure during a
no-notice earthquake event and the social and logistical challenges of a recovering
community, an earthquake can have lasting impacts long afterwards due to post
traumatic stress disorder (PTSD).

Socioeconomic vulnerabilities of populations at risk were analyzed in the hypothetical yet
scientifically realistic earthquake sequence that is being used to better understand
hazards for the San Francisco Bay region during and after a magnitude-7 earthquake
(mainshock) on the Hayward Fault and its aftershocks. In this study, the at-risk
populations located in areas of concentrated damage are anticipated to experience longer
recovery trajectories, increased long term housing displacement, and transportation
impacts due to dependencies on transit dependencies. When neighborhood schools
close, families with school age children may move to other areas to keep their children in
schools. Persons with access and functions needs are likely to be more dependent on
access to functioning medical, social and personal health care services that would be
overwhelmed by the event and therefore increasing their vulnerabilities. For the
homeless populations, the loss of social community services and damages to shelters
could add to protracted relocations. For the young and mobile populations who rent, the
major disruption to housing, jobs and transit will also drive relocation. Widespread
housing damage and preexisting housing market constraints will make it “extremely
challenging” for the socially and economically vulnerable populations to find alternative
housing near their home communities. Those who utilize interim and irregular housing
for months and years after a disaster are more vulnerable to physical, social, and mental
disorders, including suicide, substance abuse, and physical and verbal abuse. Aftershocks
and post disaster conditions delay population return and increase outmigration.

**Erosion**

Risk from erosion relates to earthen and infrastructural losses. The degree of vulnerability
to these events and their impacts depends on human behavior and the traditional social
factors such as situational awareness, prior knowledge of hazards, social capital and

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https://doi.org/10.3133/sir20175013v3, accessed 0162021
decision-making capabilities, as well as increased vulnerability due to social factors, such as racial and economic disparities.

**Extreme Temps**

People susceptible to respiratory ailments (asthma, lower and upper respiratory disease) disproportionately suffer from the effects of fire, smoke, air pollutants, allergens, heat and PSPS. Those with limited income or without resources are affected disproportionately due to the inability to provide safe shelter, air conditioning, cooling, air purification, medical care, and quality foods, and are also least able to obtain information related to climate risks and adaptation strategies.

**Heat**

Heatstroke, cardiovascular disease, respiratory disease and cerebrovascular disease are related to extreme heat events. Increased number of heat waves creates heat-related physical stress on populations and is exacerbated in the metropolitan areas where greater amounts of heat-absorbing surfaces (e.g., asphalt and concrete) trap heat and emit higher temperatures throughout the night.

The heat also extends the geographic range and the distribution of disease-carrying insects and pests. Health professionals are concerned that California’s warming climate will allow species to acclimate. Such vectors include such pests as ticks that carry Lyme disease, and mosquitoes that transmit Zika, dengue fever, West Nile, plague and tularemia. Some others, such as chikungunya, Chagas disease, and Rift Valley fever virus, are threats as well.

Some communities of color and some low-income, homeless, and immigrant populations are more exposed to heat waves, as these groups often reside in urban areas affected by heat island effects. In addition, these populations are likely to have limited adaptive capacity due to a lack of adequately insulated housing, inability to afford or to use air conditioning, inadequate access to public shelters such as cooling centers, and inadequate access to both routine and emergency health care. These social, economic, and health risk factors give rise to the observed increase in deaths and disease from extreme heat in some immigrant and impoverished communities.

Heat stroke, the most serious heat-related illness, occurs when the body is unable to control its temperature. Body temperature rises rapidly, the sweating mechanism fails, and the body cannot cool down. In extreme cases, heat stroke can cause confusion and unconsciousness, so the victim is unable to seek treatment without assistance.

There are several groups of people who are uniquely vulnerable to the effects of extreme heat, such as infants and children, older adults aged 65 and up, athletes and outdoor workers, low-income households, and individuals with certain chronic medical conditions.

When dealing with an extreme heat event, the most common impacts are those generally felt by the people living in the targeted area. For people in particular, heat can kill when the body is pushed beyond its limits. Most heat disorders occur because the victim has
been overexposed to heat. As discussed, the major human risks associated with extreme heat include dehydration, sunburn, fatigue, heat exhaustion, heat stroke, and in severe cases, death.

Some portions of the population are more at risk to the effects of extreme heat. The very young, the elderly, and certain groups with chronic medical conditions (such as asthma or other pulmonary illnesses, heart disease, poor blood circulation, neurological illnesses, and obesity) are generally more vulnerable to the effects of extreme heat, and are more likely to suffer illness or death as a result.

This is especially true if exposure is extended for a period of time and preventative measures are not taken immediately. Distributional implications of impacts, and even less on distributional implications of adaptation actions.” 223

**Hazardous Materials**

The severity of a hazardous materials release depends upon the type of material released, the amount of the release, and the proximity to populations or environmentally sensitive areas such as wetlands or waterways. The release of materials can lead to injuries or evacuation of nearby residents. Wind direction at the time of the release can also have a bearing on the severity (as well as the location and extent) of a hazardous materials release.

The primary threat from the hazardous materials incident hazard is to the structures located along transmission lines and transportation routes or near facilities that use or store hazardous materials. Minor incidents would likely cause no damage and little disruption, assuming they could be contained quickly. Major incidents could have fatal and disastrous consequences. The severity of a hazardous material release relates primarily to its impact on human safety and welfare and on the threat to the environment. Threats to human safety and welfare include:

- Poisoning of water or food sources and/or supply
- Presence of toxic fumes or explosive conditions
- Damage to personal property
- Need for the evacuation of people
- Interference with public or commercial transportation

Environmental risks are not uniformly distributed across groups of people. Age, poverty, and minority status place some groups at a disproportionately high risk for

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environmental disease. Poor access to health information and health care means less health promotion, less risk avoidance, a less healthy diet, and more adverse conditions that increase susceptibility to exposure. Delayed recognition of exposure, diagnosis, and treatment allows effects to accumulate.

**Landslides**

Although infrastructural losses are of secondary importance to the risk to humans themselves, research investigating the vulnerability of people to landslides is rare. The many reasons for this lack of data are related to the fact that the collapse of occupied buildings which makes it a function of structural vulnerability and therefore, indirect. The degree of vulnerability to landslides by an individual considered at high risk, or even the general populations, also depends on human behavior, including many of the traditional social factors that are difficult to measure such as situational awareness, prior knowledge of hazards, and decision-making capabilities.

Landslides can result in primary lifeline failures through the loss of roads or power and communication lines. Transportation routes are often expensive to clean up, and prolonged obstruction can disrupt the movement of people and goods. Risk from landslide relates to earthen and infrastructural losses. The degree of vulnerability to these events and their impacts depends on human behavior and the traditional social factors such as situational awareness, prior knowledge of hazards, social capital and decision-making capabilities, as well as increased vulnerability due to social factors, such as racial and economic disparities.

**Power Outage/Public Safety Power Shutdowns (PSPS)**

Loss of power creates economic hardship to a region experiencing regular PSPS events, such as those experienced throughout the state over the recent years. Many businesses close, including gas stations, grocery stores, and local retail establishments. These impacts may deeply impact students dependent on support jobs, as well impacting family members of campus staff and faculty. PSPS increases risks to the public due to inability to use medical devices, spoilage of food and medicines, and disruption to infrastructure, such as supply of clean water and electricity used to run home medical equipment, such as lift chairs and ventilators.

**Wildfire**

Increased wildfire threat occurs especially in the end of fall, when conditions are driest, but before the winter rains have come; an east-to-west wind gusts exacerbate fire risk.

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224 [https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3222496/](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3222496/)


Wildfire threats have the concomitant threat of Public Safety Power Shutoffs (PSPS). And, in the case of an actual wildfire, danger exists both from fire and from the smoke. Recent wildfires have demonstrated that some demographics are disproportionately affected. Native Americans are six times more likely to be affected than white people. Blacks and Hispanic people are 50 percent more vulnerable. These values take into account the likelihood of a community being affected and the greater difficulty of that community to recover. These statistics reflect the lack of access to resources to pay for insurance, to rebuild and recover, to implement fire safety measures, and to access other resources. Price gouging after a fire (such as documented in Sonoma County after the 2017 Tubbs Fire) further exacerbates the disparity. Furthermore, the disabled and the elderly are at particular risk from extreme wildfire conditions, as they are often not as able to effectively evacuate. Of the 85 people who died in the Camp Fire in Butte in 2018, 62 of them were at least 65 years old.

Smoke from wildfires creates a significant public health threat. Especially vulnerable are individuals who have heart or lung issues, such heart disease, lung disease or asthma. Those most vulnerable include the medically fragile, elderly and children. Air Quality Indexes track the level of the following: particulate matter, surface levels of ozone, carbon monoxide, sulfur dioxide, and nitrogen dioxide. All of these can cause respiratory distress and harm lungs.

The California Department of Public Health reports the increased public health risks, and risk indicators that include: heat-related ED visits, populations living in wildfire areas, adults with multiple chronic conditions, populations living in poverty, race/ethnicity, outdoor workers, public transit access, air conditioner ownership and tree canopy.

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Hazard Mitigation and Emergency Management Planning

The goal of this high-level assessment is to provide a starting point to encourage further exploring campus social risks and vulnerabilities, as well as to inform and to enhance holistic emergency management and hazard mitigation decision making, planning processes and future adaptive risk management strategies. By including the social resilience factors, mitigation investments may move beyond standardized planning and regulations, structure and infrastructure projects, and natural systems protections to embrace a more expanded, customized emergency operations plan and an education and outreach program unique to the campus.

A more robust social resilience inquiry is strongly encouraged to develop an accurate picture, based on methodical and scientific research-based data. Such an effort would be envisioned through both nuanced discussions with a variety of campus stakeholders and the invitation of nontraditional stakeholders to join in a collaborative resilience partnership. Such a forward-leaning effort would be directly in keeping with CSU’s commitment to inclusion and equity in risk reduction.
Section 20
San Diego State University

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20.1 University Profile

University History

San Diego State University (SDSU) is the oldest higher education institution in San Diego. SDSU was founded on March 13, 1897. San Diego State was originally known as the San Diego Normal School, where they provided training and education for school teachers. In 1921, the name changed to the San Diego State Teachers College and eventually unified with the San Diego Junior College campus. That union would only last through 1946. In 1931, the campus relocated to the Mission-Revival style genre buildings. Today that area is known as the Main Quad. In 1960, San Diego Teachers College would eventually join the California State University System. By 1971, the university would change its name to San Diego State University.

SDSU is designated as both a Hispanic-Serving Institution (HSI) and an Asian American and Native American Pacific Islander-Serving Institution (AANAPISI).

University Governance

The campus president is the chief executive officer who oversees the administration of the entire university. The president manages campus operations and fundraising, sets campus priorities, and oversees the hiring and support of staff and faculty. The president also maintains a close working relationship with the CSU’s systemwide office, reporting to the chancellor and participating in the systemwide Executive Council.

The provost is the chief academic officer of the university, overseeing all academic affairs and programs of the university. The provost reports directly to the president.

San Diego State University (SDSU) operates under a shared governance philosophy — where each member of the community (whether faculty, student, staff, or administrator) has an opportunity to weigh in on matters of policy and procedure. SDSU’s governing bodies include the Office of the President, the University Senate, and Associated Students.

The University Senate considers a wide range of issues like, policies with respect to the general welfare of the University, educational policy, the selection of administrative personnel, maintain adequate communication within the University community, appoint University Senate Committees and the ultimate authority to recommend approval of candidates for graduation.

University Mission

“The mission of San Diego State University is to provide research-oriented, high-quality education for undergraduate and graduate students and to contribute to the solution of problems through excellence and distinction in teaching, research, and service. The university strives to impart an appreciation and broad understanding of the human
experience throughout the world and the ages. This education extends to diverse cultural legacies and accomplishments in many areas, such as the arts and technology; the advancement of human thought including philosophy and science; the development of economic, political, and social institutions; and the physical and biological evolution of humans and their environment. San Diego State University pursues its mission through its many diverse departments and interdisciplinary programs in the creative and performing arts, the humanities, the sciences, and the social and behavioral sciences.”

University Location

SDSU is located in San Diego, CA, the second largest city in the state. San Diego has miles of sandy beaches along the Pacific Ocean and a short drive to the international border to Mexico. San Diego State is located in the mid-city region of San Diego

University Population

San Diego State’s population exceeded 33,000 with an overwhelming population of undergraduates making up 78% of the student population. White students make up 34.6% of the student population with Latinos second in population with 28.1%.

20.2 Interim Final Rule for Hazard Vulnerability and Risk Assessment

Requirement §201.6(c)(2): The plan shall include a risk assessment that provides the factual basis for activities proposed in the strategy to reduce losses from identified hazards. Local risk assessments must provide sufficient information to enable the jurisdiction to identify and prioritize appropriate mitigation actions to reduce losses from identified hazards.

Requirement §201.6(c)(2)(i): [The risk assessment shall include a] description of the type...location and extent of all natural hazards that can affect the jurisdiction. The plan shall include information on previous occurrences of hazard events and on the probability of future hazard events.

Requirement §201.6(c)(2)(ii): [The risk assessment shall include a] description of the jurisdiction’s vulnerability to the hazards described in paragraph (c)(2)(i) of this section. This description shall include an overall summary of each hazard and its impact on the community.

Requirement §201.6(c)(2)(ii): [The risk assessment] must also address National Flood Insurance Program (NFIP) insured structures that have been repetitively damaged floods.

Requirement §201.6(c)(2)(ii)(A): The plan should describe vulnerability in terms of the types and numbers of existing and future buildings, infrastructure, and critical facilities located in the identified hazard area.

Requirement §201.6(c)(2)(ii)(B): [The plan should describe vulnerability in terms of an]
estimate of the potential dollar losses to vulnerable structures identified in paragraph (c)(2)(ii)(A) of this section and a description of the methodology used to prepare the estimate ..

Requirement §201.6(c)(2)(ii)(C): [The plan should describe vulnerability in terms of] providing a general description of land uses and development trends within the community so that mitigation options can be considered in future land use decisions.

Requirement §201.6(c)(2)(iii): For multi-jurisdictional plans, the risk assessment must assess each jurisdiction’s risks where they vary from the risks facing the entire planning area.

20.3 Hazard Identification and Risk Assessment

Overview of San Diego State University History of Hazards

Numerous federal agencies maintain a variety of records regarding losses associated with hazards. Unfortunately, no single source is considered to offer a definitive accounting of all losses. The Federal Emergency Management Agency (FEMA) maintains records on federal expenditures associated with declared major disasters. The US Army Corps of Engineers (USACE) and the Natural Resources Conservation Service (NRCS) collect data on losses during the course of some of their ongoing projects and studies. Additionally, the National Oceanic and Atmospheric Administration’s (NOAA) National Centers for Environmental Information (NCEI) database collects and maintains data about natural hazards in summary format. The data includes occurrences, dates, injuries, deaths, and estimated costs. Many of these databases and other data collection services, including the NCEI, have inherent data limitations when searching for information at a university scale.

The best available data and records were used throughout this assessment.

Hazard Identification

As part of the initial hazard identification process, the Campus Assessment Team considered potential hazards with the most chance to significantly affect the planning area. The hazards include those that have occurred in the past and may occur in the future. A variety of sources were used to develop the list of hazards considered including national, regional, and local sources such as emergency operations plans, FEMA’s How-To Series, websites, published documents, databases, and maps, as well as discussion among the Campus Assessment Team members.

In the initial phase of the planning process, the Campus Assessment Team considered 14 hazards and the risks they create for the University and its material assets, population, and operations. The hazards initially considered, and the determinations as to the treatment of those hazards, are shown in Table 20-1 (following).

Table 20-1: Hazard Identification Determinations
<table>
<thead>
<tr>
<th>Hazard</th>
<th>Determination (Yes/No)</th>
<th>Reason for Determination</th>
<th>Future Occurrence Probability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Communicable Disease</td>
<td>Yes</td>
<td>Hazard of concern for campus</td>
<td>Highly Likely</td>
</tr>
<tr>
<td>Dam and Levee Failure</td>
<td>Yes</td>
<td>Hazard of concern for campus</td>
<td>Unlikely</td>
</tr>
<tr>
<td>Drought</td>
<td>Yes</td>
<td>Hazard of concern for campus</td>
<td>Highly Likely</td>
</tr>
<tr>
<td>Earthquake</td>
<td>Yes</td>
<td>Hazard of concern for campus</td>
<td>Possible</td>
</tr>
<tr>
<td>Erosion</td>
<td>Yes</td>
<td>Hazard of concern for campus</td>
<td>Likely</td>
</tr>
<tr>
<td>Extreme Temperature</td>
<td>Yes - Heat; No - Cold</td>
<td>Hazard of concern for campus</td>
<td>Highly Likely (Heat only)</td>
</tr>
<tr>
<td>Flood</td>
<td>Yes</td>
<td>Hazard of concern for campus</td>
<td>Unlikely</td>
</tr>
<tr>
<td>Hazardous Materials</td>
<td>Yes</td>
<td>Hazard of concern for campus</td>
<td>Unlikely</td>
</tr>
<tr>
<td>Landslide</td>
<td>Yes</td>
<td>Hazard of concern for campus</td>
<td>Highly Likely</td>
</tr>
<tr>
<td>Power Outage</td>
<td>Yes</td>
<td>Hazard of concern for campus</td>
<td>Likely</td>
</tr>
<tr>
<td>Sea Level Rise</td>
<td>No</td>
<td>Not a hazard of concern for campus</td>
<td>N/A</td>
</tr>
<tr>
<td>Tsunami</td>
<td>Yes</td>
<td>Hazard of concern for campus</td>
<td>Unlikely</td>
</tr>
<tr>
<td>Volcano</td>
<td>Yes</td>
<td>Hazard of concern for campus</td>
<td>Unlikely</td>
</tr>
<tr>
<td>Wildfire</td>
<td>Yes</td>
<td>Hazard of concern for campus</td>
<td>Possible (Fire); Possible (Smoke)</td>
</tr>
</tbody>
</table>

**Future Occurrence Probability**

In order to determine the probability of future occurrences of each hazard profiled, the following scale was developed:

- **Highly Likely**- 76%-100% that the hazard would occur annually.
- **Likely**- 50%-75% that the hazard would occur annually.
- **Possible**- 11%-49% that the hazard would occur each annually.
- **Unlikely**- 0%-10% that the hazard would occur each annually.
Communicable Disease

Description of the Hazard

Communicable diseases are illnesses that occur due to infectious agents or their toxic products and are infectious due to their potential of transmission from one person or species to another by a replicating agent. They may be transmitted from a reservoir to a susceptible host either directly as from an infected person or animal or indirectly through the agency of an intermediate plant or animal host, vector, or the inanimate environment. Communicable diseases are clinically evident illness resulting from the presence of pathogenic microbial agents, including pathogenic viruses, pathogenic bacteria, fungi, protozoa, multi-cellular parasites, and aberrant proteins known as prions. The degree of spread of a communicable disease depends on both the ability of an organism to enter, survive and multiply in the host and the comparative ease with which the disease is transmitted to other hosts.

Some ways in which communicable diseases spread are by:

1. Travel through the air, such as tuberculosis, measles, or COVID-19;
2. Physical contact with an infected person, such as through touch (staphylococcus), sexual intercourse (gonorrhea, HIV), fecal/oral transmission (hepatitis A), or droplets (influenza, TB, COVID-19);
3. Contact with a contaminated surface or object (Norwalk virus), food (salmonella, E. coli), blood (HIV, hepatitis B), or water (cholera); and
4. Bites from insects or animals capable of transmitting the disease (mosquito: malaria and yellow fever; flea: plague)

Collectively, the twenty-three (23) campuses and Chancellor’s Office of the California State University (CSU) system have identified nine (9) communicable disease hazards that that have had significant impacts on their respective student, faculty, and staff populations. Of these communicable diseases, COVID-19 is considered to be the most prominent and widespread agent across all CSU campuses. (See Table 20-2 below.)

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Table 20-2: Communicable Diseases at Identified CSU Campuses

<table>
<thead>
<tr>
<th>Collective List of Communicable Diseases Identified by All CSU Campuses</th>
<th>Number of CSU Campuses (Including Chancellor’s Office) Identifying Communicable Disease Having Significant Impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>COVID-19 (SARS-CoV-2)</td>
<td>24</td>
</tr>
<tr>
<td>Meningitis</td>
<td>7</td>
</tr>
<tr>
<td>Measles</td>
<td>6</td>
</tr>
<tr>
<td>Influenza (Including H1N1/Swine Flu)</td>
<td>6</td>
</tr>
<tr>
<td>Tuberculosis</td>
<td>5</td>
</tr>
<tr>
<td>Norovirus</td>
<td>4</td>
</tr>
<tr>
<td>Mumps</td>
<td>2</td>
</tr>
<tr>
<td>E. Coli</td>
<td>2</td>
</tr>
<tr>
<td>Sexually Transmitted Diseases (STDs)</td>
<td>2</td>
</tr>
</tbody>
</table>

(Source: Interviews with CSU campus staff at CSU campuses and at CSU Chancellor’s Office.)

With the exception of COVID-19, there is variability among CSU campuses regarding which communicable diseases have had the greatest impact on individual campus communities. Table 20-3 shows the communicable disease hazards that have had the greatest impact on each CSU campus.

Table 20-3: Communicable Disease Hazards at CSU Campuses with Greatest Impact

<table>
<thead>
<tr>
<th>CSU Campus</th>
<th>Identified Communicable Disease Hazards with the Greatest Impact on CSU Campus</th>
</tr>
</thead>
<tbody>
<tr>
<td>CSU Bakersfield</td>
<td>COVID-19, Meningitis</td>
</tr>
<tr>
<td>CSU Channel Islands</td>
<td>COVID-19, Measles</td>
</tr>
<tr>
<td>Chico State</td>
<td>COVID-19, Tuberculosis</td>
</tr>
<tr>
<td>CSU Dominguez Hills</td>
<td>COVID-19</td>
</tr>
<tr>
<td>Cal State East Bay</td>
<td>COVID-19, Meningitis</td>
</tr>
<tr>
<td>Fresno State</td>
<td>COVID-19, Meningitis, Tuberculosis</td>
</tr>
<tr>
<td>Cal State Fullerton</td>
<td>COVID-19, Influenza</td>
</tr>
<tr>
<td>Humboldt State</td>
<td>COVID-19, Measles, Norovirus, Influenza, STDs</td>
</tr>
</tbody>
</table>
(Source: Interviews with CSU campus staff at CSU campuses and at CSU Chancellor’s Office.)

**Descriptions of Identified Communicable Disease Hazards at San Diego State University**

San Diego State University (SDSU) has identified three (3) communicable disease hazards that have had the greatest impact on campus – COVID-19, Meningitis, and Mumps. The following are brief descriptions of the communicable disease hazards at SDSU.

**COVID-19 (SARS-CoV-2)**

Coronaviruses are a family of viruses that can cause illnesses such as the common cold, severe acute respiratory syndrome (SARS) and Middle East respiratory syndrome (MERS). In 2019, a new coronavirus was identified as the cause of a disease outbreak that originated in China. This virus is now known as the **severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2)**. The disease it causes is called Coronavirus Disease 2019 (COVID-19). In March 2020, the World Health Organization (WHO) declared the COVID-19 outbreak a pandemic.
Signs and symptoms of coronavirus disease 2019 (i.e., COVID-19) may appear two to 14 days after exposure. Common signs and symptoms can include fever, cough, and tiredness. Early symptoms of COVID-19 may also include a loss of taste or smell.

The virus that causes COVID-19 spreads easily among people, and more continues to be discovered over time about how it spreads. Data has shown that the COVID-19 virus spreads mainly from person to person among those in close contact (within about 6 feet, or 2 meters). The virus is transmitted by respiratory droplets being released when someone with the virus coughs, sneezes, breathes, sings or talks. These droplets can be inhaled or land in the mouth, nose or eyes of a person nearby. In some situations, the COVID-19 virus can spread by a person being exposed to small droplets or aerosols that stay in the air for several minutes or hours (i.e., airborne transmission). It’s not yet known how common it is for the virus to spread this way. The COVID-19 virus can also spread if a person touches a surface or object with the virus on it and then touches his or her mouth, nose or eyes; however, this is not considered to be a main way it spreads.

The severity of COVID-19 symptoms can range from very mild to severe. Some people may have only a few symptoms, and some people may have no symptoms at all. However, some people may experience worsened symptoms, such as worsened shortness of breath and pneumonia. People who are older have a higher risk of serious illness from COVID-19, and the risk increases with age. People who have existing medical conditions also may have a higher risk of serious illness from COVID-19. In some cases, the disease can cause severe medical complications and may even lead to death.  

**Meningitis**

Meningitis is an inflammation of the fluid and membranes (meninges) surrounding the brain and spinal cord. The swelling from meningitis typically triggers signs and symptoms such as headache, fever and a stiff neck. Early meningitis symptoms may mimic the flu (influenza). Symptoms may develop over several hours or over a few days.

Most cases of meningitis in the United States are caused by a viral infection, but bacterial, parasitic and fungal infections are other causes. Some cases of meningitis improve without treatment in a few weeks. Others can be life-threatening and require emergency antibiotic treatment. Bacterial meningitis is particularly serious and can be fatal within days without prompt antibiotic treatment. Delayed treatment also increases the risk of permanent brain damage or death. 

**Mumps**

Mumps is a viral infection that primarily affects saliva-producing (salivary) glands that are located near the ears. Mumps can cause swelling in one or both of these glands, and is

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contracted by breathing in saliva droplets from an infected person who has just sneezed or coughed. Mumps can also be contracted from sharing utensils or cups with someone who has mumps.

Complications of mumps, such as hearing loss, are potentially serious but rare. There's no specific treatment for mumps.

Mumps outbreaks far less common than they used to be, but can affect people who aren't vaccinated – especially in close-contact settings such as schools or college campuses.⁷

Location of the Hazard

Communicable diseases have the potential to affect the entire San Diego State University (SDSU) planning area equally. As a result, the communicable disease hazard can be found at the SDSU main campus located in San Diego, CA (San Diego County). The communicable disease hazard can also be found at the Brawley, CA and Calexico, CA (Imperial County) sites of the SDSU-Imperial Valley satellite campus.⁸ Because of the ubiquitous nature of many communicable diseases, students, faculty, staff at (and visitors to) three (3) SDSU locations are at risk of exposure to the communicable disease hazard.

CSU Student Housing Locations and Populations

Although CSU-campus-owned student housing opportunities have been severely limited due to the COVID-19 pandemic, this situation is temporary. Eventually, students will be allowed back on campus at full capacity, and many of these students will be living in campus-owned housing. When this occurs, over 53,000 students (i.e., just over 11% of the CSU total enrollment) will be at increased risk of exposure to communicable disease hazards, owing to the “close-quarters” living arrangements in student housing. For SDSU, approximately 15% of its 35,081 enrolled students (or 5,262 students) reside in student housing.⁹,¹⁰

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¹⁰ California State University. CSU Campus Match. Retrieved 04.30.2021 from: https://www2.calstate.edu/attend/campuses/campus-match/Pages/campus-match.aspx
Extent of the Hazard

Various communicable diseases are categorized by the Center for Disease Control and Prevention (CDC) by levels of containment called Biosafety Levels (or BSLs). The higher the BSL, the greater the level of containment and level of effort necessary to prevent transmission of the disease, and therefore the greater the hazard. Biosafety Levels prescribe procedures and levels of containment for a particular microorganism or material (including research involving recombinant or synthetic nucleic acid molecules) and procedures associated with that containment. BSLs also consider primary barriers (e.g., biosafety cabinets), secondary barriers, facility design, air handling, laboratory security, etc. BSLs are graded from 1 to 4; as the BSL increases so does the relative risk of the agent/procedures as well the stringency of procedures and facility design.

Figure 20-1 describes the different BSLs, and provides examples of communicable diseases that would typically fall in to these classifications, as well as the typical protections that would be necessary to prevent transmission of each of the diseases.

Figure 20-1: Biosafety Levels (BSLs)

The Extent of San Diego State University (SDSU) Communicable Disease Hazards Except COVID-19:

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Before the COVID-19 pandemic, there were cases of Meningitis and Mumps at San Diego State University (SDSU). Measles would be classified at the BSL-2 containment level, and Mumps would also be classified at the BSL-2 containment level.  

**The Extent of San Diego State University (SDSU) COVID-19 Communicable Disease Hazard:**

As a microorganism, the SARS-CoV-2 (COVID-19) virus requires a high level of containment. It is therefore classified at BSL-3.

**History of the Hazard**

Over an approximately one-year period, from mid-March, 2020 to March 23, 2021, there were a reported 121 cases of COVID-19 at SDSU. Each CSU campus is an integral part of the surrounding community. Any event that occurs on a CSU campus has an effect on both the adjacent areas of campus and on the community-at-large – and vice-versa. Communicable disease hazard events are no exception. Most communicable disease data are maintained by at the state and at the county levels and are not generally available at the municipal or campus levels, unless (a) the CSU campus falls under the jurisdiction of a city-level health department, or (b) a geographically specific outbreak occurs on campus or in the local community. The exception to this is the current COVID-19 pandemic, where both campus and County-level case data have been collected. As a result, it is important to provide COVID-19 case statistics for both CSU campuses and the counties where CSU campus assets are located.

Tables 20-5, 20-6, and 20-7 show campus-level and County-level COVID-19 case data for San Diego State (SDSU). These case data are updated on at least a weekly basis. (Please note that the COVID-19 case numbers here may not reflect the most recent updates.)

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### Table 20-4: Campus-level COVID-19 Case Data for SDSU (as of 03/18/2021)

<table>
<thead>
<tr>
<th>Case Type</th>
<th>Number of Cases</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cases On-Campus (Students)</td>
<td>92</td>
</tr>
<tr>
<td>Cases On-Campus (Faculty/Staff)</td>
<td>27</td>
</tr>
<tr>
<td>Cases On-Campus (Contractors)</td>
<td>2</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>121</strong></td>
</tr>
</tbody>
</table>

### Table 20-5: Confirmed COVID-19 Statistics for San Diego County (as of 03/20/2021)

<table>
<thead>
<tr>
<th>COVID-19 Statistic</th>
<th>Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cases</td>
<td>267,728</td>
</tr>
<tr>
<td>Deaths</td>
<td>3,494</td>
</tr>
</tbody>
</table>

### Table 20-6: Confirmed COVID-19 Statistics for Imperial County (as of 03/20/2021)

<table>
<thead>
<tr>
<th>COVID-19 Statistic</th>
<th>Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cases</td>
<td>24,934</td>
</tr>
<tr>
<td>Deaths</td>
<td>696</td>
</tr>
</tbody>
</table>

## Potential Impacts of the Hazard

Communicable disease outbreaks and pandemics have (and will continue to have) direct impact on life, health, and safety across the CSU system, including the SDSU campus. The extent of this impact is contingent on the type of infection or contagion, the severity of the outbreak, and the speed at which it is transmitted. Property and infrastructure integrity may be affected if large portions of the campus population contract communicable diseases at the same time and are therefore unable to perform maintenance, operations, and educational tasks. This would be particularly disruptive if those impacted are first responders or other essential personnel. Long-term outbreaks affecting large numbers of SDSU students could result in cancelled classes, delayed matriculation, or other disruptions to the CSU System’s mission. This has already

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occurred with the current COVID-19 pandemic and could occur again with more virulent strains of communicable diseases, including COVID-19.

Communicable disease hazards found across the CSU system (including SDSU) vary both by level of containment (BSL) (described previously) and by level of individual/public health risk, or Risk Group (RG) level. While BSLs describe the procedures and required levels of containment in a laboratory setting, Risk Groups (RGs) reflect the potential effects of disease exposure on humans or animals. Like BSLs, RGs range from Level 1 (RG1) to Level 4 (RG4), with Level 1 (RG1) posing minimal risk to healthy individuals and public health and Level 4 (RG4) posing a very serious or extreme risks to individuals and public. BSLs generally correlate with Risk Group (RG) Levels (e.g., a RG2 agent is worked with at BSL-2), but there are exceptions (e.g., production volumes, high-risk procedures, etc.).

The World Health Organization’s (WHO) Laboratory Biosafety Manual, 3rd ed., NIH Guidelines, categorizes Risk Groups (RGs) in the following way:

Table 20-7: WHO Risk Group Categorization

<table>
<thead>
<tr>
<th>Risk Group (RG)</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>RG1</td>
<td>Rarely associated with disease in healthy adult humans or animals and pose no-to-little public health risk (e.g., Saccharomyces cerevisiae, E. coli K-12 strain derivatives often used for recombinant/molecular biology, many environmental organisms)</td>
</tr>
<tr>
<td>RG2</td>
<td>Associated with mild to moderate disease for which preventative measures or post exposure treatments are often available; public health impact is limited (e.g., Streptococcus pyogenes, Salmonella, hepatitis B virus)</td>
</tr>
<tr>
<td>RG3</td>
<td>Associated with serious to lethal human disease for which preventative vaccines or post-exposure therapies may be scarce. Public health impact is limited-to-moderate (e.g., Mycobacterium tuberculosis, hantaviruses, West Nile virus, SARS)</td>
</tr>
<tr>
<td>RG4</td>
<td>Associated with serious to lethal human disease for which preventative vaccines or post exposure therapies are not usually available. Public health impact is high (e.g., Ebola virus, Marburg virus, smallpox virus, etc.)</td>
</tr>
</tbody>
</table>


Table 20-9 describes the four (4) Risk Group Levels (RGs), and provides examples of communicable diseases that would typically fall into these classifications, and the typical protections that would be necessary to prevent transmission of the disease. It is important to note that all but two (2) communicable disease hazards identified by CSU campuses fall under either the lower-risk RG1 or RG2 categories. COVID-19 and tuberculosis are the two (2) communicable diseases fall under the higher-risk RG3 category. However, with the advent of the recently-developed COVID-19 vaccine, and with the expectation of an increasingly robust vaccine supply, it is possible that the RG level for COVID-19 could be lowered in the future, thereby reducing both the extent and the potential impact of COVID-19.

Table 20-8: Risk Group Levels (RGs) with Example Diseases and Recommended Precautions

<table>
<thead>
<tr>
<th>Level</th>
<th>Examples</th>
<th>Typical Protection to Prevent Transmission</th>
</tr>
</thead>
<tbody>
<tr>
<td>RG 1</td>
<td>E. Coli</td>
<td>Precautions are minimal, most likely involving gloves and some sort of facial protection. Usually, contaminated materials are left in open (but separately indicated) waste receptacles. Decontamination procedures for this level are similar in most respects to modern precautions against everyday viruses (i.e.: washing one’s hands with anti-bacterial soap, washing all exposed surfaces of the lab with disinfectants, etc.).</td>
</tr>
<tr>
<td>RG 2</td>
<td>Chicken Pox, Hepatitis A, B, C, Lyme disease, Salmonella, Mumps, Measles, Malaria, Scrapie, Dengue Fever, HIV</td>
<td>These bacteria and viruses cause mild disease in humans or are difficult to contract via aerosol. Routine diagnostic work with clinical specimens can be done safely at BSL-2, using BSL-2 practices and procedures.</td>
</tr>
</tbody>
</table>

### RG 3

<table>
<thead>
<tr>
<th>Anthrax</th>
</tr>
</thead>
<tbody>
<tr>
<td>West Nile Virus</td>
</tr>
<tr>
<td>SARS Virus (Including COVID-19)</td>
</tr>
<tr>
<td>Tuberculosis</td>
</tr>
<tr>
<td>Typhus</td>
</tr>
<tr>
<td>Yellow Fever</td>
</tr>
<tr>
<td>Hantaviruses</td>
</tr>
<tr>
<td>Avian Flu</td>
</tr>
</tbody>
</table>

These bacteria and viruses cause severe to fatal
disease in human, but vaccines or other
treatments do exist to combat them. Laboratory
personnel have specific training in handling
pathogenic and potentially lethal agents and are
supervised by competent scientists who are
experienced in working with these agents. This is
considered a neutral or warm zone.

### RG 4

<table>
<thead>
<tr>
<th>H5N1 (Bird Flu)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dengue Hemorrhagic Fever</td>
</tr>
<tr>
<td>Marburg Virus</td>
</tr>
<tr>
<td>Ebola Virus</td>
</tr>
<tr>
<td>Smallpox</td>
</tr>
<tr>
<td>Lassa Fever</td>
</tr>
<tr>
<td>Crimean-Congo Hemorrhagic Fever</td>
</tr>
<tr>
<td>Other Hemorrhagic Diseases</td>
</tr>
</tbody>
</table>

These viruses and bacteria cause severe to fatal
disease in humans, for which vaccines or other
treatments are *not* available. When dealing with
biological hazards at this level the use of a Hazmat
suit and a self-contained oxygen supply is
mandatory. The entrance and exit of a BSL-4 lab
will contain multiple showers, a vacuum room, an
ultraviolet light room, autonomous detection
system, and other safety precautions designed to
destroy all traces of the biohazard. Multiple
airlocks are employed and are electronically
secured to prevent both doors opening at the
same time. All air and water service going to and
coming from a BSL-4 lab will undergo similar
decontamination procedures to eliminate the
possibility of an accidental release.

**Probability of Future Occurrence of the Hazard**

There are significant data limitations regarding non-COVID-19 communicable disease
cases, as the information thereof is outdated, anecdotal, and/or inadequate. As a result, it
is not feasible to provide quantitative probabilities of future occurrence for non-COVID-19
communicable disease hazards. However, based on the limited data, it is feasible to
present qualitative probabilities of future occurrence based on ranges of communicable
disease frequency. Table 20-10 shows a probability scale of future occurrence for the nine
(9) communicable disease hazards profiled in this assessment. This scale is divided into
four (4) levels of probability:
Table 20-9: Likelihood of Future Hazard Occurrence

<table>
<thead>
<tr>
<th>Likelihood</th>
<th>Parameters for Determining Likelihood</th>
</tr>
</thead>
<tbody>
<tr>
<td>Highly Likely</td>
<td>76 – 100% probability that hazard will occur annually (high to very high frequency)</td>
</tr>
<tr>
<td>Likely</td>
<td>50 – 75% probability that hazard will occur annually (moderate to high frequency)</td>
</tr>
<tr>
<td>Possible</td>
<td>11 – 49% probability that hazard will occur annually (low to moderate frequency)</td>
</tr>
<tr>
<td>Unlikely</td>
<td>0 – 10% probability that hazard will occur annually (very low to low frequency)</td>
</tr>
</tbody>
</table>

Due to significant data limitations surrounding non-COVID communicable diseases, the probability of future occurrence of CSU-system-wide communicable disease is measured by the proportion of campuses that have identified a particular communicable disease as having an impact on the campus community. In this measure, the more frequent a communicable disease is seen as impactful CSU-wide, the greater the probability of future occurrence. Note: Each communicable disease’s probability of future occurrence ranking CSU-system-wide reflects the ranking at the individual CSU campus level unless

Table 20-10: Probability of Future Occurrence of Communicable Disease Hazard for CSU System

<table>
<thead>
<tr>
<th>Collective List of Communicable Diseases Identified by All CSU Campuses</th>
<th>Number of CSU Campuses (Including Chancellor’s Office) Identifying Communicable Disease Having Significant Impact</th>
<th>Proportion of CSU Campuses Identifying Communicable Disease as Having Significant Impact System-Wide</th>
<th>CSU System-Wide Probability Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>COVID-19 (SARS-CoV-2)</td>
<td>24</td>
<td>1.00</td>
<td>Highly Likely</td>
</tr>
<tr>
<td>Meningitis</td>
<td>7</td>
<td>0.29</td>
<td>Possible</td>
</tr>
<tr>
<td>Measles</td>
<td>6</td>
<td>0.25</td>
<td>Possible</td>
</tr>
<tr>
<td>Influenza (Including H1N1/Swine Flu)</td>
<td>6</td>
<td>0.25</td>
<td>Possible</td>
</tr>
<tr>
<td>Tuberculosis</td>
<td>5</td>
<td>0.21</td>
<td>Possible</td>
</tr>
<tr>
<td>Norovirus</td>
<td>4</td>
<td>0.17</td>
<td>Possible</td>
</tr>
<tr>
<td>Mumps</td>
<td>2</td>
<td>0.08</td>
<td>Unlikely</td>
</tr>
<tr>
<td>E. Coli</td>
<td>2</td>
<td>0.08</td>
<td>Unlikely</td>
</tr>
</tbody>
</table>
Vulnerability to the Hazard

Vulnerability to a communicable diseases hazard resides in the population of a given area – both human and animal – not in the infrastructure or physical assets. While CSU assets and infrastructure could be impacted indirectly by the communicable disease hazard, these impacts would be secondary to the impact that the communicable disease hazard would have on students, faculty, staff, and visitors at the SDSU campus.

CSU campus settings are geographically diverse, with locations ranging from small towns to medium-sized cities to densely populated urban areas. Hundreds of thousands of people work, study, and/or pass through CSU campuses on any given day. (As of Fall 2019, the CSU System had 480,541 students and 53,763 faculty and staff.) Each of these persons is vulnerable to communicable disease, particularly if it is a pathogen that individual has not been immunized against, or for which no immunization exists. Prolonged outbreaks could result in a loss of services, failure of infrastructure (from lack of operators or maintenance), and closure of facilities. This exact scenario has played out in the current COVID-19 pandemic on the SDSU campus.

Estimate of Potential Losses

COVID-19 Pandemic Health Impact on CSU Campuses and Surrounding Communities

The most prescient metric for estimating losses from COVID-19 is loss of life. The nationwide campus-related COVID-19 death rate of 0.02% remains well below the average COVID-19 death rate in the U.S. However, due to data limitations, there is no information on CSU-campus-specific deaths by COVID-19 or by any other communicable diseases. In fact, COVID-19 is the only communicable disease for which case reports have been readily available for CSU campuses.

At some point in the future, CSU campuses will return to full capacity. Without adequate surveillance regarding campus access and student and employee interaction, CSU campuses (including SDSU) are at risk of developing an extreme incidence of COVID-19,

20 The California State University. Enrollment. Retrieved 05.03.2021 from: https://www2.calstate.edu/csu-system/about-the-csu/facts-about-the-csu/enrollment/Pages/default.aspx

21 The California State University. Employee Head Count by Campus. Retrieved 05.03.2021 from: https://www2.calstate.edu/csu-system/faculty-staff/employee-profile/csu-workforce/Pages/employee-headcount-by-campus.aspx
and may become “super-spreaders” for adjacent communities. The emergence of more virulent COVID-19 variants would only add to the potential for high negative impacts on life safety, operations, and service delivery across the CSU system. (Other communicable diseases would also re-emerge, but with low to moderate negative impacts on life safety, operations, and service delivery.)

**Economic Impact of COVID-19 Pandemic on CSU Financial Health**

During the first few months of the COVID-19 pandemic in 2020, the CSU system suffered tremendous negative fiscal impacts. From March through July of 2020 alone, over $146 million worth of revenue losses were sustained across the CSU system due to refunds to students for parking, housing and dining service fees during Spring Semester, 2020. (See Figure 20-2 below for the economic impact to the campus.) Several CSU campuses saw refund losses surpass $10 million. (See Table Figure 20-2.)

Figure 20-2: CSU COVID-19 Cost Tracking Showing Revenue Refund Losses and Increased Costs

![Figure 20-2: CSU COVID-19 Cost Tracking Showing Revenue Refund Losses and Increased Costs](image)

**Mitigative Relief from Federal Assistance**


The $1.5 billion in total federal assistance sent to the CSU system will help relieve the losses of revenues from services like dorms, parking and dining services during a year of mainly empty campuses. (See Table CD.10) However, because of staggering COVID-related revenue losses, the CSU system is planning for three (3) years of fiscal duress.

### Table 20-11: Total Federal Assistance to CSU for COVID-19 Related Losses, 2020 – 2021

<table>
<thead>
<tr>
<th>Institution</th>
<th>December 2020 Stimulus</th>
<th>CARES Act</th>
<th>APLU Projection of HEERF Total ARP Act Funding Allocation</th>
<th>Total Estimated Federal COVID Relief Funding</th>
</tr>
</thead>
<tbody>
<tr>
<td>California Polytechnic State University</td>
<td>$20,752,799</td>
<td>$14,725,000</td>
<td>$37,000,928</td>
<td>$72,478,727</td>
</tr>
<tr>
<td>California State Polytechnic University, Pomona</td>
<td>$48,614,353</td>
<td>$31,102,000</td>
<td>$86,044,649</td>
<td>$165,761,002</td>
</tr>
<tr>
<td>California State University Channel Islands</td>
<td>$14,288,099</td>
<td>$8,512,000</td>
<td>$24,915,170</td>
<td>$47,715,269</td>
</tr>
<tr>
<td>California State University Maritime Academy</td>
<td>$1,381,700</td>
<td>$1,204,000</td>
<td>$2,472,622</td>
<td>$5,058,322</td>
</tr>
<tr>
<td>California State University - Sacramento</td>
<td>$59,891,260</td>
<td>$35,643,000</td>
<td>$104,900,133</td>
<td>$200,434,393</td>
</tr>
</tbody>
</table>

---


<table>
<thead>
<tr>
<th>Institution</th>
<th>Operating Budget</th>
<th>Nonoperating Income</th>
<th>Total Expenditures</th>
<th>Total Revenue</th>
</tr>
</thead>
<tbody>
<tr>
<td>California State University, Bakersfield</td>
<td>$22,855,632</td>
<td>$12,483,000</td>
<td>$40,285,565</td>
<td>$75,624,197</td>
</tr>
<tr>
<td>California State University, Chico</td>
<td>$31,603,856</td>
<td>$20,019,000</td>
<td>$51,624,856</td>
<td>$107,377,934</td>
</tr>
<tr>
<td>California State University, Dominguez Hills</td>
<td>$31,843,563</td>
<td>$18,312,000</td>
<td>$50,155,563</td>
<td>$106,070,973</td>
</tr>
<tr>
<td>California State University, East Bay</td>
<td>$24,243,652</td>
<td>$14,394,000</td>
<td>$38,637,652</td>
<td>$81,566,860</td>
</tr>
<tr>
<td>California State University, Fresno</td>
<td>$52,725,317</td>
<td>$32,557,000</td>
<td>$85,282,317</td>
<td>$178,208,911</td>
</tr>
<tr>
<td>California State University, Fullerton</td>
<td>$67,736,949</td>
<td>$41,088,000</td>
<td>$108,824,949</td>
<td>$229,684,833</td>
</tr>
<tr>
<td>California State University, Long Beach</td>
<td>$67,421,424</td>
<td>$41,202,000</td>
<td>$108,623,424</td>
<td>$228,131,753</td>
</tr>
<tr>
<td>California State University, Los Angeles</td>
<td>$61,905,561</td>
<td>$40,067,000</td>
<td>$102,972,561</td>
<td>$210,516,233</td>
</tr>
<tr>
<td>California State University, Monterey Bay</td>
<td>$13,455,716</td>
<td>$8,705,000</td>
<td>$22,160,716</td>
<td>$46,083,484</td>
</tr>
<tr>
<td>California State University, Northridge</td>
<td>$74,004,088</td>
<td>$47,458,000</td>
<td>$121,462,088</td>
<td>$252,483,538</td>
</tr>
<tr>
<td>California State University, San Bernardino</td>
<td>$42,438,131</td>
<td>$27,924,000</td>
<td>$60,362,131</td>
<td>$145,344,590</td>
</tr>
<tr>
<td>California State University, San Marcos</td>
<td>$26,602,684</td>
<td>$15,542,000</td>
<td>$42,144,684</td>
<td>$88,641,492</td>
</tr>
<tr>
<td>California State University, Stanislaus</td>
<td>$22,007,207</td>
<td>$12,928,000</td>
<td>$34,935,207</td>
<td>$73,571,598</td>
</tr>
<tr>
<td>Humboldt State University</td>
<td>$16,130,016</td>
<td>$11,146,000</td>
<td>$27,276,016</td>
<td>$56,107,635</td>
</tr>
</tbody>
</table>
Vulnerability Assessment Conclusions

Before the COVID-19 pandemic, populations at all CSU campuses and CSU-affiliated facilities were substantial. Collectively, as of Fall 2019, CSU campuses had 480,541 students and 53,763 faculty and staff. All were at risk from the communicable disease events, with 534,304 people being directly vulnerable. The COVID-19 pandemic has caused campus population numbers to plummet to a small fraction of full capacity.

At some point in the future, campus population numbers will return to their pre-pandemic levels, and students, faculty, and staff will again be vulnerable to the communicable disease hazard. *If just 10% of the total CSU population were to become ill with a highly infective communicable disease like influenza or another strain of SARS, this would mean that approximately 53,430 people would be sick at the same time. This scenario would likely overwhelm available on-campus medical services could even overwhelm portions of the larger community’s medical resources – especially if there were large numbers of infected people with immune system compromises or other underlying health problems.*

See Table 20-13 below for the “10% outbreak scenario” projections both for each CSU campus and for the entire CSU system.

Table 20-12: Scenario of Communicable Disease Hazard Affecting 10% of the CSU Population.

<table>
<thead>
<tr>
<th>CSU Campus</th>
<th>Approximate Enrollment</th>
<th>Approximate Total FT/PT Faculty/Staff Population (Fall 2019)²⁸</th>
<th>10% Outbreak Scenario (Students and Faculty/Staff Combined)</th>
</tr>
</thead>
<tbody>
<tr>
<td>San Diego State University</td>
<td>$45,914,127</td>
<td>$30,394,000</td>
<td>$80,592,385</td>
</tr>
<tr>
<td>San Francisco State University</td>
<td>$47,404,409</td>
<td>$30,000,000</td>
<td>$83,075,470</td>
</tr>
<tr>
<td>San Jose State University</td>
<td>$46,631,939</td>
<td>$30,977,000</td>
<td>$82,976,130</td>
</tr>
<tr>
<td>Sonoma State University</td>
<td>$13,980,795</td>
<td>$9,153,000</td>
<td>$24,732,994</td>
</tr>
<tr>
<td><strong>CSU System-Wide Totals</strong></td>
<td><strong>$853,833,277</strong></td>
<td><strong>$535,535,000</strong></td>
<td><strong>$1,507,325,177</strong></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Institution</th>
<th>Enrollment 2019</th>
<th>Undergraduate 2019</th>
<th>Total 2019</th>
<th>Graduates 2019</th>
</tr>
</thead>
<tbody>
<tr>
<td>CSU Bakersfield</td>
<td>11,199</td>
<td>1,277</td>
<td>12,476</td>
<td>1,248</td>
</tr>
<tr>
<td>CSU Channel Islands</td>
<td>7,093</td>
<td>994</td>
<td>8,087</td>
<td>809</td>
</tr>
<tr>
<td>Chico State</td>
<td>17,019</td>
<td>1,969</td>
<td>18,988</td>
<td>1,899</td>
</tr>
<tr>
<td>CSU Dominguez Hills</td>
<td>17,027</td>
<td>1,761</td>
<td>18,788</td>
<td>1,879</td>
</tr>
<tr>
<td>Cal State East Bay</td>
<td>14,705</td>
<td>1,764</td>
<td>16,469</td>
<td>1,647</td>
</tr>
<tr>
<td>Fresno State</td>
<td>24,139</td>
<td>2,534</td>
<td>26,673</td>
<td>2,667</td>
</tr>
<tr>
<td>Cal State Fullerton</td>
<td>39,868</td>
<td>3,736</td>
<td>43,604</td>
<td>4,360</td>
</tr>
<tr>
<td>Humboldt State</td>
<td>6,983</td>
<td>1,171</td>
<td>8,154</td>
<td>815</td>
</tr>
<tr>
<td>Cal State Long Beach</td>
<td>38,074</td>
<td>4,004</td>
<td>42,078</td>
<td>4,208</td>
</tr>
<tr>
<td>Cal State LA</td>
<td>26,361</td>
<td>2,821</td>
<td>29,182</td>
<td>2,918</td>
</tr>
<tr>
<td>Cal Maritime</td>
<td>911</td>
<td>329</td>
<td>1,240</td>
<td>124</td>
</tr>
<tr>
<td>CSU Monterey Bay</td>
<td>7,123</td>
<td>1,059</td>
<td>8,182</td>
<td>818</td>
</tr>
<tr>
<td>CSUN (Northridge)</td>
<td>38,391</td>
<td>3,832</td>
<td>42,223</td>
<td>4,222</td>
</tr>
<tr>
<td>Cal Poly Pomona</td>
<td>27,914</td>
<td>2,650</td>
<td>30,564</td>
<td>3,056</td>
</tr>
<tr>
<td>Sacramento State</td>
<td>31,156</td>
<td>3,228</td>
<td>34,384</td>
<td>3,438</td>
</tr>
<tr>
<td>Cal State San Bernardino</td>
<td>20,311</td>
<td>2,118</td>
<td>22,429</td>
<td>2,243</td>
</tr>
<tr>
<td><strong>San Diego State</strong></td>
<td><strong>35,081</strong></td>
<td><strong>3,702</strong></td>
<td><strong>38,783</strong></td>
<td><strong>3,878</strong></td>
</tr>
<tr>
<td>San Francisco State</td>
<td>28,880</td>
<td>3,401</td>
<td>32,281</td>
<td>3,228</td>
</tr>
<tr>
<td>San José State</td>
<td>33,282</td>
<td>3,568</td>
<td>36,850</td>
<td>3,685</td>
</tr>
<tr>
<td>Cal Poly San Luis Obispo</td>
<td>21,242</td>
<td>2,871</td>
<td>24,113</td>
<td>2,411</td>
</tr>
<tr>
<td>CSU San Marcos</td>
<td>14,519</td>
<td>1,687</td>
<td>16,206</td>
<td>1,621</td>
</tr>
<tr>
<td>Sonoma State</td>
<td>8,649</td>
<td>1,338</td>
<td>9,987</td>
<td>999</td>
</tr>
<tr>
<td>Stanislaus State</td>
<td>10,614</td>
<td>1,276</td>
<td>11,890</td>
<td>1,189</td>
</tr>
</tbody>
</table>

While the case numbers of COVID-19 have been significantly lower (about 1% of the total CSU population) than those in the 10% scenario, the degree of virulence and resultant morbidity and mortality caused by COVID-19 have led to widespread campus shutdowns, educational disruption, and economic harm to the CSU system (including San Diego State). In short, the real-time COVID-19 communicable disease outbreak scenario has proven far more devastating than the 10% simulated scenario.

**Identified Data Limitations**

There is a wealth of technical information available for communicable disease. However, there is also limited non-COVID-19 communicable disease data available regarding risk or vulnerability of specific populations throughout the CSU. Much of the data that does exist is protected by privacy policies, and therefore cannot be obtained for more specific populations. As a result, performing a detailed quantitative assessment for this hazard is difficult.

Data that could be collected prior to the next update in order to improve this methodology includes:

- Data regarding infection rates at the campus level and for specific populations;
- Data regarding communicable disease case numbers and outcomes, by CSU campus;
- Data regarding projected population changes;
- Data regarding absenteeism; and
- Data regarding increased operating costs as a result of absenteeism (i.e., temporary shifting of duties resulting in business interruption).

**Dam and Levee Failure**

**Description of the Hazard**

A dam failure represents the structural collapse of a dam that stores water in a reservoir behind the dam. These failures are typically the result of structural age, damage to the structure caused by earthquake or flooding, inadequate discharge or spillway capacity, inadequate maintenance, improper construction materials, or extreme inflow of water.
into the reservoir. Prolonged precipitation may result in overtopping of the dam resulting in structural compromise. The tremendous energy generated by a sudden breach of the dam will have significant downstream effects. Flood damage resulting from dam failures potentially will result in economic losses, environmental damage, destruction of agriculture, and human casualties. This type of incident is extremely dangerous as it can occur rapidly, with no warning resulting in an inability to effectively evacuate threatened communities.

A levee failure is similar to dam failures as the result will be a breach causing flooding on the dry side of the levee. Levees are embankments whose primary purpose is to furnish flood protection from seasonal high water or divert the flow of water. Most levees in California are intended to withstand peak water levels generated by heavy precipitation or rapid snowmelt in a watershed. Other levees are designed to withstand fluctuating water levels on a continuous basis such as those in the California Delta exposed to tidal influences. Levees routinely extend for lengthy distances immediately protecting communities. Levees can be found throughout the state but are most prominent in the Sacramento and San Joaquin Valleys.

Levee failures can vary from overtopping to small uncontrolled discharge to catastrophic failure. Areas downstream of the failure will be subject to inundation dependent on the volume of water released. These levee failures are also typically the result of structural age, damage to the structure caused by earthquake or flooding, slumping, seepage underneath the levee, high velocity flows eroding the levee, inadequate capacity, inadequate maintenance, improper construction materials, or extreme inflow of water into the system. Flood damage resulting from levee failures potentially will result in economic losses, environmental damage, destruction of agriculture, and human casualties.

Dam or levee failure flooding will vary depending on a number of factors including the extent of the collapse or breach, the volume of water behind the structure, and the nature of the exposed downstream features. This unpredictable flooding presents a threat to life and property in addition to critical infrastructure. Lifelines and supply routes will likely be damaged or made impassible by flood erosion or standing water. Water quality and health concerns would likely be cascading effects of dam or levee failures.

**Location of the Hazard**

San Diego County is home to a number of flood control facilities mostly located at the base of the hills and mountains of the county. There are few levee systems mostly in the coastal plains and valleys region including along the San Diego River and the south county. The San Diego River drains the mountains east of San Diego, San Vincente Reservoir, and El Capitan Reservoir. Levees have been constructed to protect the banks of

the San Diego River downstream past where the channel extends past the campus. Levees are also used in containment of flood channels in areas of level topography on the valley floor. The levees that line the San Diego River are located downstream from the campus. In short, there are no levees in the area of San Diego State University campus and the campus is not located within a designated levee protected zone identified in the National Levee Database30.

The primary hazard dam for the San Diego State University (SDSU) campus is Murray Dam located 1 ½ miles east of the campus. The dam feeds the Chaparral Creek which passes by the campus. The campus is elevated on a bluff from the river valley. The campus does have parking lot 16, parking lot 17, Building A, the SDSU Garage, and Villa Alvarado Residences that are located on the valley floor within the dam inundation zone for Murray Dam.

The San Diego River is a seasonal river providing flood control and drainage that extends through populated areas. The river feeds into the Pacific Ocean after extending 30 miles through San Diego County. The San Vicente Reservoir and El Capitan Reservoir feed into the San Diego River. The river is an unregulated channel from the dams to the ocean. The San Diego State University campus is situated higher in elevation on a hillside from the San Diego River channel. The distance from the river to the campus boundary is just over a half of a mile.
Figure 20-4: Murray Dam Breach Inundation Map

31 California Department of Water Resources, Dam Breach Inundation Map Publisher, https://fmds.water.ca.gov/webgis/?appid=dam_prototype_v2
Figure 20-5: El Capitan Dam Breach Inundation Map
Extent of the Hazard

Dams are classified according to the hazard that they pose to life and property in the event of failure, rather than the likelihood of that failure.

- High hazard potential dams may result in loss of human life, and will likely result in economic, environmental, or lifeline losses.
- Significant hazard potential dams are not expected to result in loss of life, but are expected to cause economic, environmental, and lifeline losses.
- Low hazard potential dams are not expected to result in loss of life, and there is a low expectation of economic, environmental, or lifeline losses. What losses do occur are generally limited to the dam owner.

Dams classified as high hazard are required to have Emergency Action Plans (EAP). EAPS are formal documents that identify potential emergency conditions at the dam and specify preplanned actions to be followed in case of failure. An EAP is required for all high hazard dams and is recommended for all significant hazard dams.
Table 20-13: San Diego County Dams in Proximity to San Diego State University

<table>
<thead>
<tr>
<th>River</th>
<th>Dam</th>
<th>Storage</th>
<th>Hazard Severity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chaparral</td>
<td>Murray</td>
<td>4,818af</td>
<td>High Hazard</td>
</tr>
<tr>
<td>San Diego</td>
<td>El Capitan</td>
<td>112,800af</td>
<td>High Hazard</td>
</tr>
<tr>
<td>San Diego</td>
<td>San Vicente</td>
<td>245,000af</td>
<td>High Hazard</td>
</tr>
</tbody>
</table>

The San Diego State University campus lies outside of the inundation zone of the dams listed above with the exception of the facilities located in the lower elevations of the valley floor next to Interstate 8. In the event of a catastrophic failure of the identified dams, most of the San Diego State University campus is expected to remain out of the inundation area. The inundation area is expected to spread water across the Chaparral Creek valley floor including across Interstate 8. There are multiple transportation corridors that lie within the dam inundation zones that could compromise transportation routes and areas the campus community reside or work. Based on the above factors, the planning committee ranks the extent of the hazard as Low to Moderate.

**Extent – Levee Failure**

The levees that line the San Diego River are located downstream from the campus. In short, there are no levees in the area of San Diego State University campus and the campus is not located within a designated levee protected zone. Based on these factors, the planning committee ranks the extent of the hazard as Low.

**History of the Hazard**

There are no records of dam or levee failures in areas that present a threat to the San Diego State University campus. Additionally, there have been no occurrences of dam failure threatening the Imperial Valley Campus in Imperial County. San Diego County has experienced the following dam failures:

Table 20-14: San Diego County Dam Failures

<table>
<thead>
<tr>
<th>Date</th>
<th>Dam</th>
<th>Release</th>
<th>Damage</th>
</tr>
</thead>
<tbody>
<tr>
<td>1/27/1916</td>
<td>Lower Otay</td>
<td>770af</td>
<td>Extensive, Infrastructure, 11 fatalities</td>
</tr>
<tr>
<td>1/30/1916</td>
<td>Sweetwater</td>
<td>Unknown</td>
<td>Extensive; Infrastructure</td>
</tr>
</tbody>
</table>

**Potential Impacts of the Hazard**

Dam Failure Impacts - Water that is released due to a dam that has failed generates tremendous energy and force causing a flood that will be catastrophic to life and property. Water levels from the failed dam could be significantly higher than those

---

experienced in worst case scenario flood events. Areas closer to the failed dam will be more likely to experience complete devastation while other areas within the inundation zone will see varying levels of flood waters. The extent of the impacts of a failed dam would vary based on a number of factors such as the volume of water released, the base flow of the river, the time of the failure, the amount of warning provided, and the distance from the dam. Impacts resulting from a dam failure include:

- Loss of life
- Property destruction or damage
- Villa Alvarado Residence Halls flooding and damages
- Displaced residents from residence halls
- Loss of property contents
- Infrastructure damage
- Flooding to Building A and SDSU Garage
- Flooded or destroyed lifelines/supply routes
- Damaged or destroyed utilities
- Loss of community economic base
- Employment losses
- Agricultural (crops and livestock) damages or destruction
- Environmental damage
- Floods generating threats to public health
- Flood generated debris

Levee Failure Impacts

A levee failure may result in substantial amounts of water to enter into developed areas protected by the levee. The force and volume of water that is generated by a levee failure may cause extensive structural damage in close proximity to the breach and effects of flooding spreading well beyond the point of the failure. The extent of the impacts would vary based on a number of factors such as the volume of water released, the time of the failure, the amount of warning provided, the location of the breach, elevation, and distance from the breach. Potential impacts resulting from a levee failure include:

- Loss of life
- Property destruction or damage
- Loss of property contents
- Infrastructure damage
- Public health hazards resulting from mold, mildew, and disease due to flood water
- Flooded or destroyed lifelines/supply routes
- Damaged or destroyed utilities
- Loss of community economic base
- Employment losses
- Agricultural (crops and livestock) damages or destruction
- Environmental damage
- Prolonged periods of necessary dewatering
- Disruptions to education delivery to community

Probability of Future Occurrence of the Hazard

San Diego County is determined to be at risk from dam and levee failure in many parts of the county. The location of the San Diego State University campus is downstream 1.4 miles to the southeast of the Murray Dam and Reservoir but elevated by 100-150 feet on a bluff overlooking the San Diego River channel demonstrating that the remote potential exists for future dam or levee related issues. However, the dam inundation zone does include lower elevation sites: the Villa Alvarado Residence Hall complex, parking lot 17, parking lot 16, and central receiving. There are no identified levees in proximity to the campus and thus the campus is outside of any levee protected zone. There are no official recurrence intervals that have been calculated for dam or levee failures. Based on historical experience and occurrences, the likelihood of this hazard is low.

The San Diego State University, Imperial Valley campus is not within proximity to any dams nor within any dam inundation zone. There are no identified levees in proximity to the Imperial Valley campus and thus the campus is outside of any levee protected zone. The probability of future occurrence for both dam and levee failures is Unlikely.

Vulnerability to the Hazard

The San Diego State University campus is subject to the potential effects of flooding resulting from compromised dams and levees. The effects of dam failure would likely be indirect affecting members of the campus community and regional transportation networks and services. Some flood control channels are lined by levees intended to protect the surrounding areas from rises in water level. In the case of dam failure, the amount of time to respond to the needs of the campus community prior to inundation will be limited.

The most significant challenge regarding dam failures is they generally result in catastrophic outcomes. Any breach along a levee is impossible to predict where a failure may occur. It is likely that response action will not be fully implemented until the incident situational intelligence provides adequate information as to compromised locations.
These variables place all those working and living within the dam inundation and flood protection zones in vulnerable locations.

The distributed placement of levees, most near development may expose significant vulnerabilities to other areas of the region even if the campus is unaffected. There is potential the campus community will be affected as a breach may cause flooding and damages to the homes of students, faculty, and staff or to access/supply routes, utilities, or other critical services. The potential for flood damaged structures being left uninhabitable including campus residence halls will result in numerous displaced individuals and households. The lack of flood insurance will cause extreme financial burdens on those affected.

Vulnerability to a dam or levee failure on the San Diego State University campus will vary depending on when the failure was to occur. The risk to the campus population will be lessened during periods when classes are not in session or during periods of breaks. Conversely, during the days and hours that classes are in session and staff are at their workplaces, the human vulnerability increases. However, in region-wide events this vulnerability may be shared with the homes and workplaces of members of the campus community and their families.

Certain campus populations will experience greater challenges to a post-flood / failure environment. Vulnerable populations will likely need to navigate through flood generated debris, face extreme health safety issues from flood waters, experience extreme stresses of a disaster, an inability to communicate to or gain access to support networks, and find difficulty in accessing equipment or supplies to aid in a specific need.

Estimate of Potential Losses

Estimates of potential losses will be influenced by a variety of factors. The volume and force of the water will determine the scale of damages affecting campus infrastructure, equipment, and other impacted features. The proximity to the failure and elevation above flood waters will affect the level of damage and individuals exposed. The time of the academic year, the day of week, and hour in which the failure was to occur will influence the number of people on campus and potential casualties. Losses will be generated by the physical damages, the loss of revenue, loss of academic research, loss of building contents, and community wide economic reductions.

Based on estimate replacement costs of facilities and structures on campus, the total replacement costs due to earthquake are $726,584,983. However, it is unlikely for a dam or levee failure event to cause catastrophic destruction at San Diego State.

Vulnerability Assessment Conclusions

While the occurrence of dam and levee failures have not been historically relevant near the San Diego State campuses, the potential for hazards related to the region’s levees and dams still exist. However, the presence of earthquake faults in proximity to the existing dam and levee structures presents a valid danger to downstream locations in the event of an earthquake. The consequences of a dam failure would generate catastrophic results to
downstream communities. The potential for dam or levee failure further generates the added potential for a number of cascading effects such as disruptions to the local economy, utility failures, disruptions to providing for the needs of the community, and development of public health hazards. These effects would be exacerbated by effects of seasonal flooding, ongoing heavy precipitation, or excessive run-off from the watershed contributing to the river system. The potential for widespread flooding and damage of structures due to the force of water has exponentially powerful impacts on particular populations among the campus community including those with access or functional needs, international students, the homeless, and students residing in the residence halls.

Identified Data Limitations

Data limitations include missing campus structural replacement costs, and an incomplete inventory of both building construction features and mitigation efforts to lessen the impact due to flood inundation.
**Drought**

**Description of the Hazard**

Drought is defined as a condition where moisture levels fall significantly below normal for an extended period of time over a large area that adversely affects plants, animal life, and humans. Drought is a gradual phenomenon. Although droughts are sometimes characterized as emergencies, they differ from typical emergency events. Most natural disasters, such as floods or forest fires, occur relatively rapidly and afford little time for preparing for disaster response. Droughts occur slowly, over a multi-year period, and it is often not obvious or easy to quantify when a drought begins and ends.

Throughout California, one dry year does not normally constitute a drought. California’s extensive system of water supply infrastructure (reservoirs, groundwater basins, and conveyance assets) mitigates the effect of short-term dry periods for most water users. Defining when a drought begins is a function of drought impacts to water users. Drought in one location may not constitute a drought for all water users, as some users in relative proximity may have a different water supply. For example, individual water suppliers may use a combination of sources such as rainfall/runoff, water in storage, or expected supply from a water wholesaler to define their water supply conditions.

Drought can be characterized as one or more of the following types:

- **Meteorological drought** is defined on the basis of the degree of dryness (in comparison to some “normal” or average amount) and the duration of the dry period. A meteorological drought must be considered as region-specific since the atmospheric conditions that result in deficiencies of precipitation are highly variable from region to region.

- **Hydrological drought** is associated with the effects of periods of precipitation (including snowfall) shortfalls on surface or subsurface water supply (e.g., streamflow, reservoir and lake levels, ground water). The frequency and severity of hydrological drought is often defined on a watershed or river basin scale. Although all droughts originate with a deficiency of precipitation, hydrologists are more concerned with how this deficiency plays out through the hydrologic system. Hydrological droughts are usually out of phase with or lag the occurrence of meteorological and agricultural droughts. It takes longer for precipitation deficiencies to show up in components of the hydrological system such as soil moisture, streamflow, and ground water and reservoir levels. As a result, these impacts are out of phase with impacts in other economic sectors.

- **Agricultural drought focus** is on soil moisture deficiencies, differences between actual and potential evaporation, reduced ground water or reservoir levels, and so forth. Plant water demand depends on prevailing weather conditions, biological characteristics of the specific plant, its stage of growth, and the physical and biological properties of the soil.
- **Socioeconomic drought** refers to when physical water shortage begins to affect health, well-being, and quality of life of people, or when the drought starts to affect the supply and demand of an economic product that relies on water.

The drought issue in California is further compounded by water rights. The central challenge is how to prioritize water usage among a broad variety of contexts. It is for this reason that water is a commodity possessed and utilized under a variety of legal doctrines. As such, many competing sets of interests create a dynamic prioritization process between, for example, farming and federally protected fish habitats and water supply for municipal/public use (including usage for San Diego State University (SDSU)) versus water usage for wildfire abatement or natural resource protection.

**Location of the Hazard**

Drought conditions have been identified in San Diego County and the City which surround the SDSU campus. Drought is not a location-specific hazard and affects the entire campus planning area equally. Drought location is not isolated to the campus footprint but occurs as a geographic sub-set of drought conditions occurring at larger scales. From 2000-2020, drought conditions existed continuously somewhere in the state, with 80-100% of the state impacted for 12 of the last 20 years. ³³

**Extent of the Hazard**

Given the historical occurrence of severe drought impacts throughout the region, county and city surrounding the planning area, and the potential future impact exacerbated by climate change, the CSU Planning Committee recognizes that drought will continue to pose a high degree of risk statewide, potentially impacting crops, livestock, water resources, the natural environment at large, buildings and infrastructure (from land subsidence), and local economies. In addition, although drought affects the entire CSU 23-campus system, the potential impacts may be variable and specific to each campus/jurisdiction, depending on contextual factors such as the degree of assets and activities, historically or potentially impacted by drought within each jurisdiction.

In addition, drought-related land subsidence has occurred throughout the state and will continue in areas where the groundwater basin has been subject to overdraft and long-term recharge is inadequate to maintain the water table elevation, leaving underground voids. Subsidence levels in California have been measured up to 30-feet with subsidence bowls covering hundreds of square miles. As such, drought-related subsidence may result in serious structural damage to buildings, roads, irrigation ditches, underground utilities, and pipelines. Though such effects have not been reported on campus, they remain issues of concern for the campus over the long term.

The U.S. Drought Monitor developed tables of impacts reported during past droughts in California in order to depict the extent of drought risk for each level of drought on the U.S. These possible extent conditions for California complement the general impacts column of the U.S. Drought Monitor Classification Scheme.

Although the campus planning team identifies the extent of the hazard as Low (qualitatively) which corresponds to D0 – D1 on the Extent scale (below), San Diego County has experienced more severe drought conditions for 15 of the past 20 years, including 5 years of D4 levels. As such, the campus planning team recognizes that while historic impacts shaping the extent of drought on campus have been minimal, the potential impacts are tied to trends across larger geographic areas, and, therefore, the committee recognizes that the extent of drought on campus has the potential to increase in the future.

Table 20-15: Impacts of Drought Levels as Determined by US Drought Monitor\(^ {34} \)

<table>
<thead>
<tr>
<th>Category</th>
<th>Impact</th>
</tr>
</thead>
</table>
| D0       | Soil is dry; irrigation delivery begins early  
          | Dryland crop germination is stunted  
          | Active fire season begins  
          | Winter resort visitation is low; snowpack is minimal |
| D1       | Dryland pasture growth is stunted; producers give supplemental feed to cattle  
          | Landscaping and gardens need irrigation earlier; wildlife patterns begin to change  
          | Stock ponds and creeks are lower than usual  
          | Grazing land is inadequate  
          | Producers increase water efficiency methods and drought-resistant crops |
| D2       | Fire season is longer, with high burn intensity, dry fuels, and large fire spatial extent; more fire crews are on staff  
          | Wine country tourism increases; lake- and river-based tourism declines; boat ramps close  
          | Trees are stressed; plants increase reproductive mechanisms; wildlife diseases increase  
          | Water temperature increases; programs to divert water to protect fish begin |

<table>
<thead>
<tr>
<th>River flows decrease; reservoir levels are low and banks are exposed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Livestock need expensive supplemental feed, cattle and horses are sold; little pasture remains, producers find it difficult to maintain organic meat requirements</td>
</tr>
<tr>
<td>Fruit trees bud early; producers begin irrigating in the winter</td>
</tr>
<tr>
<td>Federal water is not adequate to meet irrigation contracts; extracting supplemental groundwater is expensive</td>
</tr>
<tr>
<td>Dairy operations close</td>
</tr>
<tr>
<td>Marijuana growers illegally tap water out of rivers</td>
</tr>
<tr>
<td>Fire season lasts year-round; fires occur in typically wet parts of state; burn bans are implemented</td>
</tr>
<tr>
<td>Ski and rafting business is low, mountain communities suffer</td>
</tr>
<tr>
<td>Orchard removal and well drilling company business increase; panning for gold increases</td>
</tr>
<tr>
<td>Low river levels impede fish migration and cause lower survival rates</td>
</tr>
<tr>
<td>Wildlife encroach on developed areas; little native food and water is available for bears, which hibernate less</td>
</tr>
<tr>
<td>Water sanitation is a concern, reservoir levels drop significantly, surface water is nearly dry, flows are very low; water theft occurs</td>
</tr>
<tr>
<td>Wells and aquifer levels decrease; homeowners drill new wells</td>
</tr>
<tr>
<td>Water conservation rebate programs increase; water use restrictions are implemented; water transfers increase</td>
</tr>
<tr>
<td>Water is inadequate for agriculture, wildlife, and urban needs; reservoirs are extremely low; hydropower is restricted</td>
</tr>
<tr>
<td>Fields are left fallow; orchards are removed; vegetable yields are low; honey harvest is small</td>
</tr>
<tr>
<td>Fire season is very costly; number of fires and area burned are extensive</td>
</tr>
<tr>
<td>Many recreational activities are affected</td>
</tr>
<tr>
<td>Fish rescue and relocation begins; pine beetle infestation occurs; forest mortality is high; wetlands dry up; survival of native plants and animals is low; fewer wildflowers bloom; wildlife death is widespread; algae blooms appear</td>
</tr>
<tr>
<td>Policy change; agriculture unemployment is high, food aid is needed</td>
</tr>
<tr>
<td>Poor air quality affects health; greenhouse gas emissions increase as hydropower production decreases; West Nile Virus outbreaks rise</td>
</tr>
<tr>
<td>Water shortages are widespread; surface water is depleted; federal irrigation water deliveries are extremely low; junior water rights are ...</td>
</tr>
</tbody>
</table>
curtailed; water prices are extremely high; wells are dry, more and deeper wells are drilled; water quality is poor;

History of the Hazard

Historically, drought has been so prevalent in California that its presence is almost continuous, including San Diego County, and the city of San Diego which includes the SDSU footprint. Although no drought occurrences have been reported specifically for the campus, according to the US Drought Monitor, Time Series data, San Diego County has experienced 6 periods of drought between 2000 and 2021, encompassing 15 of the last 20 years, including the most severe and prolonged drought from 2012 – 2020.

Figure 20-7: Periods of Drought in San Diego County, California, 2000 – 2021

According to the Department of Water Resources, droughts exceeding three years are relatively common in Southern California, but relatively rare in Northern California - the region is the geographic source of much of the state’s developed water supply. The 1929-34 drought established the criteria commonly used in designing storage capacity and yield of large Northern California reservoirs.

According to the US Drought Monitor’s time series data, from 2000-2021 (with the exception of a 2–3-month period in 2000 and 2011), some degree of drought conditions have been in effect in California. In fact, 80% - 100% of the state has been subjected to drought conditions for 12 of the last 20 years, with the most severe drought being the 100% state-wide event from 2012-2017.


Given the extent of the drought risk in California, the following drought event was selected as an exemplar due to its broad and significant impacts on the state and on the SDSU campus planning area:

Note: San Diego County experienced drought for 3 additional years (2012 – 2020).

2012 – 2017 – Drought produced severe impacts to water wells throughout the state of California, with a high number of wells running dry. Land subsidence due to increased groundwater pumping also occurred in numerous areas of the state such as the San Joaquin and Central Valleys. Crop damage was widespread as well. Water allotments were drastically reduced in many towns and water agencies, with extremely high costs for procuring water. In addition, job loss occurred with many families requiring food supply assistance, and water supply assistance provided to home-owners with dry wells. According to a report released by UC Davis Center for Watershed Sciences, the 2012-2017 period of the California drought cost the state's agriculture industry about $1 billion in lost revenue, with a total statewide economic cost of the drought calculated to be $2.2 billion. The report says, ‘it is responsible for the greatest water loss ever seen in California agriculture - about one third less than normal’. The report calls the groundwater situation in California "a slow-moving train wreck." Spring snowpack at Donner Summit reached record low levels in 2014, exceeded in 2015 by a remarkable April 1 snow-water-equivalent value of only 5% of average. Decreased precipitation since contributed to near-record low levels in the Shasta Reservoir. The ongoing drought has contributed to declines in crop values across the state. For example, crops including cotton, corn silage and barley (the field crop category) fell by 42 percent.  

Potential Impacts of the Hazard

Drought impacts are wide-reaching and may be economic, environmental, and/or societal. This assessment of its impact recognizes that historic occurrences of drought throughout the planning area are a sub-set of larger and inter-connected local and


regional droughts, and that the (related) historic impacts provide a sound basis for understanding potential (future) impacts.

The most significant potential impact associated with drought across the SDSU campus planning area is a potential reduction in water availability for the municipal area tied to each campus. Other impacts include crop loss and damage to trees and other natural resources (See Tree Mortality below). The footprint of SDSU to some extent includes these vulnerable resources based on the campus landscape (trees) and the presence (and footprint size) of any agricultural research crops and/or field stations.

As a secondary impact of drought, wildfire is directly attributable to dry atmospheric conditions. Wildfires almost always coincide with drought in California, though not limited to such. 39 However, the wildfire hazard is analyzed separately in this plan. (See below for coverage of the wildfire hazard).

In reviewing the occurrences of drought for San Diego County and the City, the US Drought Monitor and the National Drought Mitigation Center report that tens of millions of trees died during the (2012-2017) state-wide drought disaster. Though data sources do not provide data for tree mortality specific to SDSU, the broad geographic extent of the impact makes it likely that tree mortality occurred to some degree on the campus. Due to the lasting and ongoing effects of drought on the landscape, trees will continue to be impacted within the municipalities, counties and regions wherein lies the CSU campus system as long as drought conditions continue to occur in the future.

Given the absence of data, in order for the CSU Committee to assess the impact of tree mortality, it is useful to view it as a risk sub-set to the probability, location, extent, severity and duration of the drought hazard within each campus-located municipality, county and region. Regarding potential impacts, standing dead trees could fall, posing a risk to people, buildings, power lines, roads and other infrastructure. In addition, drought-impacted trees become susceptible to diseases and insect infestations (bark beetle) further adding to the risk of tree mortality and related potential impacts. No data is currently available for tree mortality on campus; however, the CSU Planning Team will pursue data on this issue in the future.

As a potential tertiary impact, prolonged and repeated drought conditions over time can produce land subsidence and the risk of damage to building foundations and infrastructure on campus resulting from ground instability and collapse. Land subsidence is defined as the vertical sinking of the land over manmade or natural underground voids. Subsidence is often the direct result of groundwater over-extraction in response to drought conditions, as well as oil and gas extraction. Weight can accelerate the process of subsidence resulting from surface development and infrastructure such as roads and buildings, vibrations from construction blasting and heavy truck or train traffic. For example, the State Water Project’s 444-mile-long California Aqueduct has required repairs


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such as the raising of canal linings, bridges, and water control structures on the Aqueduct – in the Central Valley a five-mile reach of the Eastside Bypass was impacted by subsidence, and the Department of Water Resources estimated that it may cost in the range of $250 million to acquire flowage easements and levee improvements to restore the design capacity of the subsided area. ⁴⁰

At present, drought related damage to campus buildings and infrastructure at SDSU has not been reported, but the potential for such impacts is possible. With regard to overall potential impact, water supply/availability for SDSU is ultimately tied to broader interdependent, and more intensive modes of water use at local and regional scales such as agriculture and ranching, wildfire protection, larger metropolitan/municipal usage, manufacturing and commerce, tourism, recreation, and wildlife preservation. During drought periods, the State of California’s regulated water allocations are modified and often reduced, which can result in reduced water availability for all usage contexts, including SDSU. A reduction of electric power generation and water quality deterioration are also potential impact factors.

Table 20-16: Summary of Drought Impacts on Water Resources⁴¹

<table>
<thead>
<tr>
<th>Resource</th>
<th>Type of Impact</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sea Level</td>
<td>Direct</td>
<td>Sea level is rising and will likely impact coastal areas</td>
</tr>
<tr>
<td>Soil Moisture</td>
<td>Direct</td>
<td>Prolonged dry seasons can lead to decreases in soil moisture; drier vegetation</td>
</tr>
<tr>
<td>Vegetation</td>
<td>Indirect</td>
<td>Longer and more intense fire season with increased extent of area burned</td>
</tr>
<tr>
<td>Stream Conditions</td>
<td>Direct</td>
<td>Increases in water temperature; potential effects on fish</td>
</tr>
<tr>
<td>Snowpack</td>
<td>Indirect</td>
<td>Increases in temperature will lead to decreases in snowpack</td>
</tr>
<tr>
<td>Runoff</td>
<td>Direct</td>
<td>Warmer temperatures are likely to lead to a shift in peak runoff from spring to winter and a likely decrease in summer base flow</td>
</tr>
</tbody>
</table>


### Hydropower
- **Type**: Indirect
- **Impact**: Decreased summer flows resulting from earlier snowmelt and a shift in peak runoff could affect hydropower generation during summer months

### Precipitation
- **Type**: Direct
- **Impact**: Warmer winter temperatures will result in a greater percentage of precipitation falling as rain rather than as snow

### Groundwater
- **Type**: Indirect
- **Impact**: Reduction in snowpack and extended periods of drought are likely to increase dependency on groundwater

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**Probability of Future Occurrence of the Hazard**

**Highly Likely** — The US Drought Monitor’s time series data (2000-2020) state-wide indicates that some degree of drought has nearly a 100% probability of occurrence in the state in any given year. Given that SDSU lies within a drought impacted region, as made evident by the Time Series data for the county, it is prudent to extend this likelihood of occurrence to the planning area.

**Vulnerability to the Hazard**

In California, rising temperatures are projected to increase the average lowest elevation at which snow falls, reducing water storage in the snowpack, particularly at those lower mountain elevations which are now on the margins of reliable snowpack accumulation. Higher spring temperatures will also result in earlier melting of the snowpack. The shift in snow melt to earlier in the season is critical for California’s water supply because flood control rules require that water be allowed to flow downstream and that water cannot be stored in reservoirs for use in the dry season. As such, state-level drought risk factors that have led to drought’s state-wide severity and extent, and potential impacts also create drought vulnerabilities at the level of the SDSU campus.

Moreover, climate change will likely adversely impact the vulnerability of watersheds and ecosystems in their ability to deliver important ecosystem services. These changes may limit the natural capacity of healthy forests to capture water and regulate stream flows. Sierra Nevada mountain winters and springs are warming, and on average, precipitation as snowfall relative to rain is decreasing. A warming climate with reduced snowpack will result in earlier snowmelt and will subsequently reduce downstream water availability during summer and early fall.

As such, the state and the SDSU planning area stakeholders potentially have less capacity to address future drought risks due to projected temperature increases and shortages in water; ground-water withdrawals have been occurring at a deficit rate of 1 – 2-million-acre feet per year, where the impacts of drought include decreased availability of water.
for agriculture and environmental uses. In forested and other vegetated areas, prolonged drought decreases the moisture content of forest fuels and increases the risk of high severity wildfires.

It should be pointed out that California is the single most productive agricultural state and its agricultural industry relies heavily on reservoir water supplied by snowmelt and rainfall runoff. Yearly variations in snowpack depths have implications for water availability as snowmelt from the winter snowpack feeds a network of reservoirs. Spring snowpack at Donner Summit reached record low levels in 2014, exceeded in 2015 by a remarkable April 1 snow-water-equivalent value of only 5% of average. Decreased precipitation since 2011 has contributed to near-record low levels in the Shasta Reservoir.

**Vulnerability of Populations**

Drought vulnerabilities on California’s population include agricultural sector job loss, secondary economic losses to local businesses and public recreational resources, increased cost to local and state government for large-scale water acquisition and delivery, and water rationing and water wells running dry for individuals and families. As drought is often accompanied by prolonged periods of extreme heat, negative health impacts such as dehydration can also occur, where children and elderly are most susceptible. Air quality often declines in times of drought which can affect those with respiratory ailments. These same vulnerability measures apply to the students, faculty and staff of the SDSU campus.

**Property Vulnerability**

Drought vulnerabilities for property include crop loss, injury and death of livestock and pets, and damage to infrastructure, homes and other buildings resulting from the secondary drought impact of land subsidence. The related drought impacts of tree mortality and land subsidence pose risks to vulnerable critical infrastructure and property. These same vulnerabilities apply to the properties of the SDSU campus.

**Natural Environment Vulnerability**

Drought vulnerabilities for the natural environment are widespread throughout public and private lands within the state, including tree mortality, impacts to all flora and fauna, and destabilization (subsidence) of land along streams and rivers, and within watersheds.

The core issue shaping the impact of drought throughout California is water supply and demand. Several factors play into the issue including groundwater basins, surface water run-off, public and agricultural demand, and surface water storage water sheds. A USGS

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led analysis was first conducted in 2010 through the Forest and Rangeland Assessment and ongoing through the USGS Forest and Rangeland Ecosystem Science Center to identify threats and assets where water supply would benefit from environmental management designed to protect or enhance water resources, the key effort which, in part, both defines and mitigates the severity of drought risk and vulnerabilities.

With regard to overall threat and asset findings shaping the potential severity of drought, the watersheds in the Sierra region contribute most greatly to the state’s water supply, but are under threat from climate change, wildfire and development. In addition, groundwater basins in the San Joaquin Valley and Sacramento Valley bioregions are an abundant resource that is heavily threatened by over pumping.

**Critical Facilities Vulnerabilities**

Drought impacts to state and SDSU’s critical facilities include water shortfalls for facility operations and critical functions, and potential structural destabilization and damage resulting from land subsidence.

**Estimate of Potential Losses**

An estimate of potential losses from drought has not been calculated for the campus or the CSU system as a whole. However, drought related losses to the City of San Diego and the surrounding region such as crop loss and cost increases for water resources have re-occurred over time. Please consult city and county level government, and/or state agricultural agencies for data on the financial impacts from drought.

**Vulnerability Assessment Conclusions**

The CSU Planning Committee understands that the high degree of vulnerability posed by drought will be exacerbated by greater climate variation in the future and therefore greater variation and uncertainty regarding the availability of water supplies which are already under tremendous stress. In response to such vulnerability, state legislation passed in 2014 requires local governments to regulate pumping and recharge to better manage groundwater supplies, and groundwater-dependent regions are required to halt overdraft and bring basins into sustainable levels of pumping and recharge by the early 2040s. That said, the Committee will continue to work with local, regional and state partners and stakeholders to explore solutions for mitigating the drought hazard on its campuses by accessing the best available data and resources on climate change and its

**Identified Data Limitations**

Data is limited concerning campus-related agricultural assets as well as data on campus tree mortality.
Earthquake

Description of the Hazard

An earthquake is a sudden motion or shaking caused by the release of pressure accumulated along the edge of tectonic plates covering the earth. These huge plates are constantly moving and move ever so slowly under, over, or by passing one another. This movement is gradual however the plates may lock together accumulating enormous amounts of energy. When this energy builds, stress develops, and the adjoining plates will eventually break free and result in ground shaking – an earthquake.

Large earthquakes may result in fissuring, ground settlement, and/or vertical or horizontal displacement. Earthquakes occur without warning and can result in extensive damages and human casualties. Damages associated to earthquake generated ground shaking is normally confined to a narrow area along fault trend from the earthquake epicenter. However, seismic waves may generate ground shaking resulting in damages in areas outside of the fault trend.

Fault Rupture – The rupture of faults is the differential movement of the two sides of the earth’s plates at the point of the fault. Horizontal or vertical displacement may be significant and occur over great distances. The movement and energy that occurs along a fault is released in waves resulting in ground shaking. The intensity of ground shaking varies based on the magnitude of the earthquake, the proximity to the earthquake epicenter, the composition of the ground sediment or rock the waves travel through, and the depth of the earthquake.

Liquefaction – In addition to the primary fault rupture that occurs right along a fault during an earthquake, the ground many miles away can also fail during intense shaking. As seismic waves travel through saturated granular soil; the soil begins to liquefy and act as a fluid. Soil strength and stability is lost causing the effects of ground shaking to intensify and for ground deformation to occur. These water saturated soils when shaken quickly lose the ability to support buildings, bridges, utilities, and other structures. Areas susceptible to liquefaction include places where sandy sediments have been deposited by rivers along their course or by wave action along beaches. The greater the magnitude of an earthquake and longer duration of strong ground shaking will result in an enhanced potential for liquefaction to occur. Settlement can cause damage when the amount settlement varies significantly across the length of a structure. Lateral spreading occurs when liquefaction occurs on gently sloping ground and the liquefied material at depth allows the area to slide, often toward a vertical discontinuity or “free face” such as a creek or stream channel. Liquefaction can occur in susceptible soils below bodies of water, and settlement and lateral spreading can damage structures built on or adjacent to these areas. Transportation bridges across water bodies, wharves, piers and other structures at ports and harbors, and underwater utility lines can be severely damaged by this hidden hazard.

Subsidence - Changes in the local environment that cause subsidence or sinkholes are called triggering mechanisms. Water is the primary factor that affects the local
environment and causes subsidence. Water level decline, changes in groundwater flow, increased loading, and deterioration (such as abandoned mines) are all triggering mechanisms. Water level decline may occur naturally, or it may be the result of human action. Factors that lead to water decline are pumping (from wells), localized drainage (for construction activities), dewatering, or drought. Changes in groundwater flow can result from an increase in the velocity of groundwater movement, and increase in the frequency of water table fluctuations, and changes in discharge (either increase or decrease). Increased loading can cause pressure in the soil, leading to the failure of underground cavities and space, such as caves. Vibrations from earthquakes, heavy machinery, and blasting may result in structural collapse, followed by surface resettlement.

Location of the Hazard

The State of California is particularly vulnerable to earthquake activity due to California’s location residing between two large tectonic plates. San Diego State University is located in central San Diego east of Mission Valley. In general, fault systems surround and traverse through San Diego County including the area of San Diego State University. Throughout the valleys the ground is saturated with sediment eroded from the mountains and foothills via multiple stream and river channels and resulting in liquefaction zones scattered across the region.

The Pacific Plate and the North American Plate come together at the San Andreas Fault 85-90 miles east of the San Diego State University campus. In addition to the San Andreas Fault, San Diego County is home to or near additional fault systems with the potential to generate strong ground shaking. The Elsinore Fault extends across the northern portions of the county in a southeast to northwest direction 35 miles northwest of the campus. The Rose Canyon Fault is another southeast to northwest fault 7-8 miles west of the campus traversing through downtown San Diego then paralleling the coastline. The Coronado Bank Fault extends offshore approximately 20-25 miles west of the campus. There are numerous additional faults in the area on all sides of the campus.

The Calexico campus is located in proximity to a number of active faults capable of producing strong earthquake. The campus is 7 miles west of the Imperial Fault. The Cerro Prieto Fault is 7 miles southwest of the Calexico campus in Mexico. The Superstition Hills Fault is 12 miles north of the campus. The campus is 12 miles south of the Brawley Fault which extends through the Salton Sea to the San Andreas Fault. The San Andreas Fault is 50 miles north of the campus and extend to the northeast towards Palm Springs.
The San Diego State University campus does not reside within areas designated to be liquefaction zones. However, substantial areas of the community surrounding the campus reside within the liquefaction zones including access routes into and out of the campus. These zones are mostly following the creek channels including the San Diego River and Mission Valley. The affected transportation corridors include Interstate 8, Interstate 15, College Avenue, and San Diego Metropolitan Transit Light Rail. The liquefaction zone generally follows the Mission Valley floor.

Extent of the Hazard

The extent or severity of earthquake damage is expressed in terms of magnitude, intensity, and duration. The amount of energy released during an earthquake is normally conveyed as a magnitude measured from a seismogram. Magnitude is expressed in numbers and decimals representing the physical size of the earthquake. The strength and effect of the shaking on the surface of the earth is classified as the intensity. Intensity is further defined from the effects the earthquake has on people, structures, and the natural environment. The intensity of an earthquake in terms of measuring magnitude and
evaluating its effects is generally expressed using the Modified Mercalli (MM) Intensity Scale.

The Richter magnitude scale was developed in 1935 by Charles F. Richter of the California Institute of Technology as a mathematical device to compare the size of earthquakes. The Richter Scale is the best-known scale for measuring the magnitude of earthquakes. The magnitude value is proportional to the logarithm of the amplitude of the strongest wave during an earthquake. A recording of 7, for example, indicates a disturbance with ground motion 10 times as large as a recording of 6. The energy released by an earthquake increases by a factor of 31 for every unit increase in the Richter scale.

Table 20-17: Earthquake Intensity and Frequency Comparisons

<table>
<thead>
<tr>
<th>Magnitude</th>
<th>Mercalli Intensity</th>
<th>Potential Damage</th>
<th>Global Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 2.0</td>
<td>I</td>
<td>None</td>
<td>Continually</td>
</tr>
<tr>
<td>2.0 - 2.9</td>
<td>I to II</td>
<td>None</td>
<td>&gt; IM per year</td>
</tr>
<tr>
<td>3.0 - 3.9</td>
<td>II to IV</td>
<td>Light</td>
<td>&gt; 100,000 per year</td>
</tr>
<tr>
<td>4.0 - 4.9</td>
<td>IV to VII</td>
<td>Light</td>
<td>10K to 15 K per year</td>
</tr>
<tr>
<td>5.0 - 5.9</td>
<td>VI to VII</td>
<td>Moderate</td>
<td>1K to 1,500 per year</td>
</tr>
<tr>
<td>6.0 - 6.9</td>
<td>VII to X</td>
<td>Heavy</td>
<td>100 to 150 per year</td>
</tr>
<tr>
<td>7.0 - 7.9</td>
<td>VII &lt;</td>
<td>Very Heavy</td>
<td>10 - 20 per year</td>
</tr>
<tr>
<td>8.0 - 8.9</td>
<td>VII &lt;</td>
<td></td>
<td>1 per year</td>
</tr>
<tr>
<td>&gt; 9.0</td>
<td>VII &lt;</td>
<td></td>
<td>1 per 10-50 years</td>
</tr>
</tbody>
</table>

The Modified Mercalli Intensity Scale provides descriptive values of earthquake intensity that may provide greater meaning to the broader population as the description of intensity refers to the effects actually experienced. This scale uses an arbitrary ranking based on observed earthquake effects. The scale is composed of increasing levels of intensity ranging from shaking that is not recognizable to intense shaking resulting in catastrophic damages and casualties. The Modified Mercalli Intensity Scale is demonstrated below:

Table 20-18: Modified Mercalli Intensity Scale

<table>
<thead>
<tr>
<th>Intensity</th>
<th>Shaking</th>
<th>Description / Damage</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Level</th>
<th>Intensity</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Not felt</td>
<td>Not felt except by a very few under especially favorable conditions.</td>
</tr>
<tr>
<td>II</td>
<td>Weak</td>
<td>Felt only by a few persons at rest, especially on upper floors of buildings.</td>
</tr>
<tr>
<td>III</td>
<td>Weak</td>
<td>Felt quite noticeably by persons indoors, especially on upper floors of buildings. Many people do not recognize it as an earthquake. Standing motor cars may rock slightly. Vibrations similar to the passing of a truck. Duration estimated.</td>
</tr>
<tr>
<td>IV</td>
<td>Light</td>
<td>Felt indoors by many, outdoors by few during the day. At night, some awakened. Dishes, windows, doors disturbed; walls make cracking sound. Sensation like heavy truck striking building. Standing motor cars rocked noticeably.</td>
</tr>
<tr>
<td>V</td>
<td>Moderate</td>
<td>Felt by nearly everyone; many awakened. Some dishes, windows broken. Unstable objects overturned. Pendulum clocks may stop.</td>
</tr>
<tr>
<td>VI</td>
<td>Strong</td>
<td>Felt by all, many frightened. Some heavy furniture moved; a few instances of fallen plaster. Damage slight.</td>
</tr>
<tr>
<td>VII</td>
<td>Very strong</td>
<td>Damage negligible in buildings of good design and construction; slight to moderate in well-built ordinary structures; considerable damage in poorly built or badly designed structures; some chimneys broken.</td>
</tr>
<tr>
<td>VIII</td>
<td>Severe</td>
<td>Damage slight in specially designed structures; considerable damage in ordinary substantial buildings with partial collapse. Damage great in poorly built structures. Fall of chimneys, factory stacks, columns, monuments, walls. Heavy furniture overturned.</td>
</tr>
<tr>
<td>IX</td>
<td>Violent</td>
<td>Damage considerable in specially designed structures; well-designed frame structures thrown out of plumb. Damage great in substantial buildings, with partial collapse. Buildings shifted off foundations.</td>
</tr>
<tr>
<td>Extreme</td>
<td>Some well-built wooden structures destroyed; most masonry and frame structures destroyed with foundations. Rails bent.</td>
<td></td>
</tr>
</tbody>
</table>

The graph below illustrates the increasing intensity of energy that is released and as the measured magnitude increases. While each whole number increases in magnitude represents a tenfold increase in the measured amplitude, it represents an increasing rate of 32 times more energy released in the same increase in magnitude. As the magnitude of an earthquake is measured higher, the intensity of the earthquake worsens progressively from one category to the next.
San Diego State is surrounded by liquefaction zones. In addition, powerful fault systems traverse and surround the campus, and the area has experienced numerous powerful and damaging events, though no major damages have been recorded since the 1979 Imperial Valley event. That said, the potential for severe impacts remains. The impacts of a major earthquake would be felt beyond the campus and have long reaching effects. The risk of casualties and damages would likely extend to the homes and workplaces of members of the campus community including students, staff, and faculty. As such, the planning committee ranks the extent of the hazard as Moderate.

History of the Hazard

The State of California has a long history of chronic and destructive earthquakes throughout the state. On average, earthquakes strong enough to result in structural damages occur three to four times a year in California, while earthquakes Magnitude 6.0 to 6.9 occur once every two to three years. San Diego County also has a long history of earthquake activity. The entire area of San Diego County is at risk to seismic activity and has a history of significant earthquakes resulting in damages.

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Table 20-19: Historic Earthquakes Near San Diego, CA

<table>
<thead>
<tr>
<th>Date</th>
<th>Location</th>
<th>Magnitude</th>
<th>Damages</th>
</tr>
</thead>
<tbody>
<tr>
<td>5/27/1862</td>
<td>Rose Canyon</td>
<td>±6.0</td>
<td>Minor</td>
</tr>
<tr>
<td>2/23/1892</td>
<td>Laguna Salada (Mexico)</td>
<td>7.0</td>
<td>Minor, Structural</td>
</tr>
<tr>
<td>6/22/1915</td>
<td>Imperial Valley</td>
<td>6.3</td>
<td>Moderate, 6 fatalities</td>
</tr>
<tr>
<td>5/18/1940</td>
<td>Imperial Valley</td>
<td>6.9</td>
<td>Extensive, 8 fatalities</td>
</tr>
<tr>
<td>4/8/1968</td>
<td>Borrego Mountain</td>
<td>6.5</td>
<td>Structural, Utilities</td>
</tr>
<tr>
<td>7/13/1986</td>
<td>Coronado Bank Fault</td>
<td>5.3</td>
<td>Moderate, 1 fatality</td>
</tr>
<tr>
<td>10/15/1979</td>
<td>Imperial Valley</td>
<td>6.4</td>
<td>Extensive structural, 91 injuries</td>
</tr>
<tr>
<td>6/15/2004</td>
<td>San Diego Trough</td>
<td>5.7</td>
<td>Minor</td>
</tr>
<tr>
<td>4/4/2010</td>
<td>Baja California (Mexico)</td>
<td>7.2</td>
<td></td>
</tr>
<tr>
<td>8/26/2012</td>
<td>Brawley</td>
<td>5.4</td>
<td>Minor</td>
</tr>
<tr>
<td>6/10/2016</td>
<td>Borrego Springs</td>
<td>5.2</td>
<td>Minor</td>
</tr>
</tbody>
</table>

The May 18, 1940 Imperial Valley Earthquake became the largest seismic event in the Imperial Valley at the time. The Imperial Valley Earthquake resulted in 8 people being killed, multiple injuries, and $6 million in damages. The earthquake caused extensive damage to structures, the transportation infrastructure, utility systems, irrigation systems, and critical facilities. The Imperial Fault displayed a surface rupture extending of at least 25 miles. The earthquake was felt as far away as Los Angeles and Tucson.

The April 8, 1968 Borrego Mountain Earthquake shook a large part of southern California. The earthquake caused extensive damage across southern California. The earthquake resulted in extensive infrastructure damages, power lines being severed, roadway damages, and structural damages. Ground displacement was found along the Superstition Hills Fault miles from the epicenter. The earthquake was felt as far away as Yosemite Valley, Fresno, and Las Vegas.

Potential Impacts of the Hazard

The shaking of the ground from earthquakes can result in building collapse, bridge failure, utility disruptions and other structural collapse. Large earthquakes can additionally cause natural gas lines to break resulting in structure fires. The proximity to the unstable soils to the north of the campus along the San Diego River presents a potential for liquefaction creating greater ground instability during seismic events. Major transportation routes servicing the campus exist in these areas. A major earthquake in the San Diego area would likely result in region-wide social disruptions in addition to structural damages. The region-wide structural damages may disrupt lifelines and supply chain routes limiting the campus from effective evacuation routes and receiving necessary supplies or equipment.

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46 San Diego County Multi-Jurisdictional Hazard Mitigation Plan, October, 2017
Most injuries resulting from earthquakes are from collapsing walls, flying glass, or other objects moved by ground shaking. The lack of warning allows individuals minimal time to react and find areas of safety. A moderate earthquake occurring near San Diego could cause injuries or fatalities to members of the campus community or support networks the campus relies on. These earthquake effects might be aggravated by collateral incidents such as fire, flooding, hazardous material spills, dam/levee compromises, and other cascading events. A catastrophic earthquake near San Diego could result in extensive casualties, expansive structural damages, panic, widespread utility outages, communication failures, and secondary emergencies such as fire. A catastrophic earthquake would certainly affect the broader San Diego County region limiting immediate assistance that the campus may normally expect.

Local impacts to San Diego State University campus caused by an earthquake could include:

- Damage and secondary fires to industrial buildings to the west of campus
- Potential hazardous material releases on and off campus
- Infrastructure damage to freeway and road system
- Damage to underground transit
- Structural damage to bridges
- Landslides to hills on north side of campus
- Physical Plant located on hillside
- Potential liquefaction damage to areas near the San Diego River and Alvarado Creek
- Potential isolation among on-campus residents
- Structural damage to flood control and drainage systems
- Damage to the Lake Murray Dam
- Structural damage to campus academic and support buildings
- Structural damage to parking structure
- Structural damage to residence halls resulting in displaced student populations
- Potential isolation among on-campus residents
- Structural damage to nearby residences and apartment complexes
- Community members arriving on campus for refuge from damaged homes
- Damaged university communications, computer systems, and networks
- Considerable stress and fear among community
- Closure or reduction of service to campus operations
- Reduction of campus revenue

**Probability of Future Occurrence of the Hazard**

The Working Group on California Earthquake Probabilities (WGCEP), a collaboration between the United States Geological Survey (USGS), the Southern California Earthquake Center (SCEC), and the California Geological Survey (CGS) develops Uniform California Earthquake Forecasts (UCERFs) using the best currently available science and technology. The UCERF version 3 provides a three-dimensional view of the likelihood a region in California will experience a Magnitude 6.7 or greater earthquake in the next 30 years. The likelihood for the San Diego County fault systems surrounding San Diego is included in the following table.
Table 20-21: Major Potentially Active Faults in Proximity to San Diego State University

<table>
<thead>
<tr>
<th>Fault Zone</th>
<th>Recurrence</th>
<th>Maximum Magnitude</th>
<th>UCERF3 Likelihood</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coronado Bank</td>
<td>Historic: Holocene</td>
<td>6.0 to 7.7</td>
<td>2-3%</td>
</tr>
<tr>
<td>Earthquake Valley</td>
<td>Historic: Holocene</td>
<td>6.0 to 7.0</td>
<td>2-3%</td>
</tr>
<tr>
<td>Elsinore</td>
<td>Historic: 250 years</td>
<td>6.0 to 7.2</td>
<td>1-2%</td>
</tr>
<tr>
<td>Newport-Inglewood</td>
<td>Historic: Unknown</td>
<td>6.0 to 7.4</td>
<td>1%</td>
</tr>
<tr>
<td>Rose Canyon</td>
<td>Historic: Quaternary</td>
<td>6.0 to 7.2</td>
<td>1-2%</td>
</tr>
<tr>
<td>San Andreas</td>
<td>Varies: 100-300 years</td>
<td>6.8 to 8.0</td>
<td>18-20%</td>
</tr>
<tr>
<td>San Jacinto</td>
<td>Varies: 100-300 years</td>
<td>6.5 to 7.5</td>
<td>4-5%</td>
</tr>
</tbody>
</table>

Based on the earthquake shaking potential in the San Diego County region, the proximity to the above listed fault systems, the probability of seismic ground shaking generating damage is considered Possible.

Vulnerability to the Hazard

A considerable challenge regarding earthquakes is they generally occur without warning. The fault systems surrounding the region all cross major transportation routes potentially reducing the availability of access and the supply chain. The geographic location of San Diego State University places the campus in a suburban community near residential, commercial, and industrial areas that is moderately populated. Earthquake effects experienced in the neighboring local community will likely spill over onto the campus.

The known fault systems generating the threat to San Diego generally surround the city and some cross into the city including near the San Diego State University campus. The proximity and potential for large earthquake development from these surrounding systems expose significant vulnerabilities. The potential for earthquake damaged structures being left uninhabitable including campus residence halls will result in numerous displaced individuals and households. The lack of earthquake insurance will cause extreme financial burdens on those affected.

Elements of the vulnerability to a major earthquake on the San Diego State University campus will vary depending on when the earthquake were to strike. The primary basis of

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47 San Diego County Multi-Jurisdictional Hazard Mitigation Plan, October 2017

48 Southern California Earthquake Center, Earthquake Information, https://scedc.caltech.edu/earthquake/faults.html#I

vulnerability is based on the population affected and the built environment exposed. In general, newer construction will be more earthquake resistant than older buildings as building codes and construction technology have improved. A locally centered earthquake, even from moderate events, would have the potential for more damaging results when associated with the moderate liquefaction zones of the area. This would particularly be seen with greater damages to unreinforced masonry buildings.

The risk to the campus population will be lessened during periods when classes are not in session or during periods of breaks. Conversely, during the days and hours that classes are in session and staff are at their workplaces, the human vulnerability increases. Generally, people are safer when at home in wood frame structures as earthquakes tend to generate less structural damage to wood construction than in commercial or industrial facilities. The greater number of people on campus at the time of an earthquake will result in more people being exposed to effects from damaged campus facilities or equipment and require greater evacuation assistance. However, in region-wide events this vulnerability may simply shift to the homes and workplaces of members of the campus community and their families.

The aftermath of a major earthquake will likely result in widespread search and rescue operations for trapped and injured individuals. The demand on emergency services will be great, potentially requiring the campus community to be prepared for these scenarios and initiate response actions as needed. There will be needs for emergency medical care, shelter, water, and food for individuals who have been displaced by the earthquake. In earthquakes causing significant damages, there may be a necessity to provide assistance with identification and support to local agencies in mass fatality management.

There may be a need to evacuate members of the campus community from the campus and to other locations that are deemed to be safer locations. As the San Diego State University campus is downstream from dam facilities, the decision to evacuate will need to take into account whether flood control facilities are filled with water and the actual threat to the dam or levees.

Certain campus populations will experience greater challenges to a post-earthquake environment. Vulnerable populations will likely need to navigate through earthquake generated debris, extreme stresses of a disaster, an inability to communicate to or gain access to support networks, and find difficulty in accessing equipment or supplies to aid in a specific need.

**Estimate of Potential Losses**

Estimates of potential losses will be influenced by a variety of factors. The intensity of the earthquake will determine what scale of damages affecting campus infrastructure, equipment, and other impacted features. Losses will be generated by the physical damages, the loss of revenue, loss of academic research, loss of building contents, and community wide economic reductions.

Based on estimate replacement costs of facilities and structures on campus, the maximum total replacement costs due to earthquake are $726,584,983.
Table 20-20: HAZUS Peak Ground Acceleration Zone (PGA) Estimated Losses

<table>
<thead>
<tr>
<th>PGA Zone Designation</th>
<th>Intensity</th>
<th>No of Buildings</th>
<th>Maximum Replacement Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Extreme</td>
<td>X+</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Violent</td>
<td>IX</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Severe</td>
<td>VIII</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Very Strong</td>
<td>VII</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Strong</td>
<td>VI</td>
<td>147</td>
<td>$726,584,983</td>
</tr>
<tr>
<td>Moderate</td>
<td>V</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Light</td>
<td>IV</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Weak</td>
<td>II-III</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Not Felt</td>
<td>I</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>NA</td>
<td>NA</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

No Building Value Data Provided* | NA | 68 | Unknown

*Buildings with no value defined are also included in the respective Zones they are found in.

The table above includes 14 facilities located at the Calexico based San Diego State University, Imperial Valley campus. The provided cost estimates for the Imperial Valley campus includes $18,144,214. However, 12 facilities do not have costs included.

Vulnerability Assessment Conclusions

It is difficult to predict the severity of casualties, property, and cascading impacts generated by future seismic events affecting the greater San Diego and Imperial County regions and the San Diego State University campus. Each of the earthquake generated effects will vary widely based on the intensity of the earthquake, location of the epicenter, proximity to people and development, time of day and year, the soil composition under the impacted structures, building construction, among others. In any case, the potential for a major earthquake exists affecting the campus and causing extensive challenges to the San Diego State University campus and community.

In the event that a major earthquake was to strike along the many fault systems surrounding San Diego, the effects could be significant to the campus community and campus operations. The widespread impacts generated by a major earthquake would extend the effects of casualties, damages, and other impacts to the broader San Diego County region creating large-scale regionwide needs for critical assistance and a heavy demand on limited emergency resources. The threat and impacts presented to the campus will be shared with the campus community from their homes and places of work. The campus will likely be required to address critical needs independently during early phases of the disaster.

The campus population is additionally vulnerable to the effects of major ground shaking that are far reaching. The psychological and social impacts a major earthquake will give rise to will potentially harm individuals and cause tremendous fear. The willingness to return indoors may be hampered especially as after-shocks continue. These effects are
magnified for populations having specific vulnerabilities or access limitations. Populations having various limitations or specific needs may be vulnerable to reduced or eliminated access to essential services that have been rendered incapable to respond.

**Identified Data Limitations**

Data limitations include missing campus structural replacement costs, and lack of a complete inventory of building construction types to include status of earthquake retrofitting. HAZUS generated analysis is focused on the broader community level versus fine-tuning the analysis to the micro-level for facilities such as a university campus.

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**Erosion**

**Description of the Hazard**

The US Geological Survey (USGS) defines erosion as “the process whereby materials of the earth’s crust are loosened, dissolved, or worn away and simultaneously moved from one place to another.”\(^{50}\) Erosion may occur in areas of streams and rivers, along bluffs, around immovable objects (such as buildings or bridge abutments), or as a cascading result of other natural hazards, such as earthquakes or wildfires. When erosion occurs along bodies of water, the removal of material causes the shore to move further landward.

Forces such as sea level rise and changes in sediment supply impact erosion gradually and can be difficult to recognize. In contrast, the impacts of short-term events, such as storms and flooding, can be severe and are immediately recognizable. Along the Pacific coast, rain, wind, and waves can induce significant short-term erosion.

**Location of the Hazard**

Erosion is a severe hazard in coastal communities, where sea level rise and storms contribute to de-sedimentation and the retreat of coastal cliffs, bluffs, and beaches. While coastal erosion can happen in any storm, it is more likely during El Nino events, which occur every 5-7 years. For the purpose of this campus-level analysis, the erosion hazard poses an equal risk across the terrain of the SDSU campus.

Other incidents of erosion, such as occurs around buildings, is relatively non-spatial and can occur in any locations with conducive soil structure and a source of movement, such as water or wind. An area’s potential for erosion is determined by several factors, including rainfall, topography, soil characteristics, and vegetative cover. An effort to identify specific erosion prone locations on campus has not been conducted, but campus leadership may consider doing so in the future.

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Extent of the Hazard

Erosion is occurring on the Pacific coastline west of San Diego State University (SDSU). While there is no published scale of severity or extent for this geologic hazard on the SDSU campus, erosion is likely to occur if conditions are favorable. As such, for the purpose of this campus-level analysis, the erosion hazard poses a consistent risk across the terrain of the SDSU campus with erosion-prone characteristics. No erosion locations have been identified on campus, and no history of erosion is present on campus. As such, the planning committee ranks the extent of the hazard as **Low**.

History of the Hazard

Coastal cliff erosion has been ongoing in San Diego. In 2000, a woman was killed by a coastal landslide in Encinitas, caused by eroded and unstable cliffs. However, there have been no recorded incidences of erosion on the SDSU campus.

Potential Impacts of the Hazard

Erosion causes instability in soil. During high-intensity rain events, for example, eroded areas will continue to erode, resulting in additional loss of soil and ground stability in the area. This removal of sediment can result in damage to infrastructure, public health, and safety. On campus, areas of erosion can create pedestrian and transportation hazards, and structures may become unsafe if erosion is not controlled.

Probability of Future Occurrence of the Hazard

Erosion is an on-going and dynamic process that occurs regularly. As climate change raises sea levels and induces more frequent and intense weather events, coastal and other erosion may generally become more widespread or severe. As a result, and in consideration of the potential extent of erosion, the probability of at least a limited degree of erosion occurring somewhere on the campus in the future is **High** over the long term.

Vulnerability to the Hazard

Topography, soil structure, land use, and precipitation are all factors of erosion. SDSU infrastructure and buildings located on steep slopes, in areas with little vegetation, or in areas with conducive soil types are more vulnerable to erosion. CSU leadership would consider performing an analysis to identify such at-risk buildings, infrastructure, slopes and soil types in the future.

In the wider San Diego community, erosion vulnerabilities include agricultural sector job loss, degradation of riverine ecosystems and coastlines, and loss of water quality.

Estimate of Potential Losses

The historic and potential impacts of erosion on property statewide include reduced agricultural productivity, lower surface water quality, and damaged drainage networks.

Current modeling is not precise enough to allow for an assessment of potential losses to buildings and infrastructure on campus.
Vulnerability Assessment Conclusions

While the ability to predict future erosion on the SDSU campus is limited, the core issues shaping erosion vulnerability on campus are flora and landscaping. If left unchecked, erosion can cause significant damage to campus infrastructure and the surrounding environment.

Identified Data Limitations

The complex interactions between soil erosion factors make predictive modeling, determination of hazard areas, and quantification of loss difficult. Localized data on this hazard is also limited, resulting in more generalized findings.

**Extreme Temperatures (Includes Extreme Cold and Extreme Heat)**

Description of the Hazard

What is considered an excessively hot temperature varies according to the normal climate for that region. However, when temperatures are extremely high, people are at higher risk for heat-related illnesses, such as dehydration, heat exhaustion, heat stroke, and in severe cases, death.\(^5^1\)

Hazards from extreme heat are made worse when high temperatures are accompanied by high levels of humidity, which is defined as the amount of moisture in the air.\(^5^2\) As the temperature climbs, the air is able to hold more moisture. High humidity prevents the human body from cooling down naturally, which leads people to perceive that the temperatures “feel” hotter. The combination of temperature and humidity is known as the heat index.\(^5^3\)

Heat stroke, the most serious heat-related illness, occurs when the body is unable to control its temperature. Body temperature rises rapidly, the sweating mechanism fails, and the body cannot cool down.\(^5^4\) In extreme causes, heat stroke can cause confusion and unconsciousness, so the victim is unable to seek treatment without assistance.

There are several groups of people who are uniquely vulnerable to the effects of extreme heat, such as infants and children, older adults aged 65 and up, athletes and outdoor


\(^5^3\) Ibid.

workers, low-income households, and individuals with certain chronic medical conditions.  

**Location of the Hazard**

Extreme heat events are a non-spatial hazard and may occur throughout the San Diego State campus.

**Extent of the Hazard**

Extreme heat has a wide range of extent and severity markers and characteristics. Monthly average maximum temperatures in June through October range approximately from the low 70s to the high 70s in San Diego. According to data from the National Climatic Data Center (NCDC), the highest daily temperature recorded at the San Diego International Airport was 100° F. This high temperature was even more unusual considering that the airport thermometer usually benefits from a sea breeze.

The National Weather Service issues a Heat Advisory when the heat index value is expected to reach 100° – 104° F within the next 12 to 24 hours. Excessive Heat Warnings are issued when there is an anticipated heat index of 105° F or greater that will last for two (2) or more hours. Excessive Heat Warnings are issued by the county when any location in the county is expected to reach those criteria. In anticipation of an Excessive Heat Warning, an Excessive Heat Watch may be issued 1 to 2 days in advance, when the Heat Warning criteria is 50 – 79% likely to occur. Given the frequent occurrence of excessive heat events over the last 13 years along with the related vulnerabilities, the planning committee ranks the extent of the hazard as **Moderate**.

Figure 20-11 (following) depicts the National Weather Service’s methodology for determining the heat index, using the % humidity and the actual temperature.

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56 The San Diego Union Tribune. *Sunday’s Temperatures Ranged from 100 in San Diego to 122 in Borrego Springs*. Print. Retrieved 01.29.21 from: https://www.sandiegouniontribune.com/weather/story/2020-09-06/the-temperature-is-currently-100-or-higher-from-san-diego-to-borrego-springs

As the heat index rises, so does the potential danger to people and animals. Table 2-23 (following) shows the health hazards associated with extreme heat.

Table 20-21: Health Risks Associated with Heat Index

<table>
<thead>
<tr>
<th>Category</th>
<th>Heat Index</th>
<th>Health Hazards</th>
</tr>
</thead>
<tbody>
<tr>
<td>Extreme Danger</td>
<td>130° F or higher</td>
<td>Heat stroke / sunstroke is likely with continued exposure.</td>
</tr>
<tr>
<td>Danger</td>
<td>105° – 129° F</td>
<td>Sunstroke, heat cramps, and/or heat exhaustion is likely with prolonged exposure and/or physical activity.</td>
</tr>
<tr>
<td>Extreme Caution</td>
<td>90° – 104° F</td>
<td>Sunstroke, heat cramps, and/or heat exhaustion is possible with prolonged exposure and/or physical activity.</td>
</tr>
<tr>
<td>Caution</td>
<td>80° – 89° F</td>
<td>Fatigue is possible with prolonged exposure and/or physical activity.</td>
</tr>
</tbody>
</table>

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History of the Hazard

Based on data gathered from the National Centers for Environmental Information (NCEI) Storm Events Database, there have been 29 excessive heat events that have affected San Diego, just in the last 13 years, with more events occurring within the last few years. These events are listed in Table xx (following)


<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>July 4, 2007</td>
<td>June 29, 2013</td>
<td>June 20, 2017</td>
</tr>
<tr>
<td>September 1, 2007</td>
<td>June 30, 2013</td>
<td>July 7, 2017</td>
</tr>
<tr>
<td>September 2, 2007</td>
<td>July 2, 2013</td>
<td>August 28 – 29, 2017</td>
</tr>
<tr>
<td>September 3, 2007</td>
<td>July 3, 2013</td>
<td>September 1 – 2, 2017</td>
</tr>
<tr>
<td></td>
<td></td>
<td>October 23 – 25, 2017</td>
</tr>
<tr>
<td></td>
<td></td>
<td>July 6, 2018</td>
</tr>
<tr>
<td></td>
<td></td>
<td>June 9, 2019</td>
</tr>
<tr>
<td></td>
<td></td>
<td>August 2, 2019</td>
</tr>
<tr>
<td></td>
<td></td>
<td>August 14, 2019</td>
</tr>
<tr>
<td></td>
<td></td>
<td>August 21, 2019</td>
</tr>
<tr>
<td></td>
<td></td>
<td>September 13, 2019</td>
</tr>
<tr>
<td></td>
<td></td>
<td>October 21 – 22, 2019</td>
</tr>
<tr>
<td></td>
<td></td>
<td>April 24, 2020</td>
</tr>
<tr>
<td></td>
<td></td>
<td>May 5, 2020</td>
</tr>
<tr>
<td></td>
<td></td>
<td>May 26, 2020</td>
</tr>
<tr>
<td></td>
<td></td>
<td>June 2, 2020</td>
</tr>
</tbody>
</table>

Total # of Events: 4  Total # of Events: 4  Total # of Events: 21

Potential Impacts of the Hazard

San Diego State may experience impacts from extreme heat due to cancelled classes or postponed outdoor events in order to protect students, faculty, and staff from the weather.

In addition to the threat extreme heat poses to humans, high temperatures also pose a threat to utility production, which in turn threaten facilities and operations that rely on utilities. As temperatures rise, more people stay indoors, increasing the demand for air
conditioning, fans, and other electronics. This puts a strain on the electrical grid, which can cause temporary outages. These outages can impact operations throughout campus, resulting in interruptions and delays in service. Outages may also negatively impact research efforts on campus, as the inability to maintain a steady, constant temperature may impact research specimens and experimental results.

Probability of Future Occurrence of the Hazard

Extreme heat events have occurred annually in San Diego for the past three years, with an average of over 2 events per year over the last 13 years. It is Highly Likely that the hazard will occur annually.

Vulnerability to the Hazard

When dealing with an extreme heat event, the most common impacts are those generally felt by the people living in the targeted area. For people in particular, heat can kill when the body is pushed beyond its limits. Most heat disorders occur because the victim has been overexposed to heat. As discussed, the major human risks associated with extreme heat include dehydration, sunburn, fatigue, heat exhaustion, heat stroke, and in severe cases, death.

Some portions of the population are more at risk to the effects of extreme heat. The very young, the elderly, and certain groups with chronic medical conditions (such as asthma or other pulmonary illnesses, heart disease, poor blood circulation, neurological illnesses, and obesity) are generally more vulnerable to the effects of extreme heat, and are more likely to suffer illness or death as a result.59 This is especially true if exposure is extended for a period of time and preventative measures are not taken immediately.

San Diego State is aware of the potential for extreme heat events, particularly for its satellite campus in the Imperial Valley, where the potential for extreme heat events is even greater. In the Imperial Valley, summertime temperatures can reach well into the 100s. However, Imperial Valley is not a residential campus, so the university is not responsible for providing 24/7 access to air-conditioned housing. The campus also has contingency plans in place for providing water to the campus community during excessive heat events.

San Diego State is susceptible to power/utility outages that could affect their ability to air-condition buildings and facilities. While they are not at risk for public safety power shut-offs, they have experienced localized outages and have had to bring in portable toilets, lighting, and transportation assistance to residence halls. The campus has also closed and/or canceled classes due to outages.

The campus experiences heat events regularly. With the potential for longer-lasting and more frequent heat waves, the campus may want to consider additional strategies for handling the risks and vulnerabilities.

**Estimate of Potential Losses**

Based on the previous historical occurrences, annualized losses are considered to be negligible. In an extreme heat event, loss of human life or health impacts are a greater concern than is property damage.

**Vulnerability Assessment Conclusions**

While the ability to predict future heat events at the San Diego State campuses is limited, the effects of climate change may provide some information. According to the Environmental Protection Agency (EPA), Southern California has warmed about three degrees on average over the last century, with less rainfall. This may lead to stronger and more frequent heat events, drought, and an increased risk of wildfires.\(^\text{60}\)

**Identified Data Limitations**

Numerous public and private actors conduct research, acquire data and disseminate meteorological information and forecasting to the general public, including the CSU university system. Currently, it is assumed that, apart from regular access to climate change models on changes to temperature extremes over time, the CSU community maintains sufficient access to the data needed to plan for, respond to, and mitigate the effects of extreme heat and cold.

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**Flood**

**Description of the Hazard**

The incredible geographic diversity in California presents tremendous challenges for flood planning and response. The state is home to extensive mountain ranges such as the Sierra Nevada, Cascades, Klamath, Coastal Ranges, and the Southern California Transverse Range all creating tremendous watersheds. Large river systems drain the mountains traveling through populated communities including the Sacramento and San Joaquin Rivers draining into the California Delta. The state has a complex system of reservoirs, dams, and levees providing water storage and flood protection. Finally, California’s 840-mile coastline exposes the coastal regions to tidal influences.

Floods are characterized by the rising and overflowing of excess water from a water source such as a stream, river, lake, canal, or coastal body onto an area of normally dry floodplain. A floodplain is a lowland area downstream and adjacent to water bodies that are subject to flood events. Flooding is a naturally occurring event that become hazardous when populations and property are affected.

Flooding can result from excessive precipitation from weather systems generating prolonged rainfall, excessive snowmelt from watersheds upstream from the floodplain, infrastructure failure, exceeding the capacity of dams or levees, tidal influences, or a combination from any of the previous factors.

Flooding represents one of the costliest and most frequent natural disasters that influences human suffering and economic impact in the United States. Flooding will likely result in significant damage to structures, infrastructure, utilities, landscapes, and the environment. Erosion of stream banks, roadways, other features may result from the movement of flood waters. The saturated ground resulting from standing flood waters may cause ground instability, collapse, erosion, or other damages. Further, floods will often generate substantial debris that will accumulate and be deposited throughout the flooded areas.

Flooding can be either slow-rise or rapid onset floods. With slow rise floods, there is often warning preceding water rise by hours or days before dangerous conditions present themselves. Slow rise floods that are expected to enter into populated areas generally allow for some time to initiate evacuation and sand bagging efforts. Flooding that occurs rapidly conversely are water events that present with extremely limited warning times and a limited ability to take response actions until flooding has already begun to occur.

Flooding may take on different forms:

- **Flash Flooding** – Flash flooding is typically characterized by a rapid rise, short duration, and large volume of water in a localized area. Heavy rainfall in areas that have limited drainage capacities often contribute to flash flooding conditions. These flooding events frequently occur with limited notice requiring immediate evacuation or rapid response efforts such as sand bagging. Flash flooding may arrive with fast moving water creating added hazardous conditions.

- **Riverine Flooding** – Riverine flooding is usually caused by prolonged rainfall or rainfall combined with heavy snowmelt. When soils are already saturated, the ability for the ground to absorb water is minimized. In a riverine flood, the water way exceeds channel capacity and extends into areas outside of the channel, often in developed communities. In California, riverine flooding is most likely to occur from November through April. The duration of riverine floods may vary from a period of hours to weeks.

- **Localized Flooding** – Localized flooding is commonly the result of stormwater drainage systems being overwhelmed by unusually heavy rainfall. These flooding events frequently occur in areas that are urbanized or developed with greater
amounts of impervious surfaces not allowing ground absorption. This generates added runoff into the drainage systems and onto roadways creating backups.

- **Infrastructure Failure** – Failures of dams or levees presents a serious flooding concern for areas downstream from the compromised structure. This situation may result in a catastrophic flood with limited warning time and widespread areas affected.

- **Coastal Flooding** – Coastal flooding can occur in multiple areas along the California coastline. Flooding may result from intense storms coming from the Pacific Ocean that generate elevated water levels or storm surge. The size, duration, winds generated, and intensity of the storm will influence the effect the waves will have on the shoreline. Periods of high tide can aggravate the conditions allowing greater wave impingement into coastal areas.

**Atmospheric Rivers**

California, including the location of this campus, is subject to the effects of a phenomenon referred to as atmospheric rivers. These weather events consist of long, narrow regions in the atmosphere transporting tremendous amounts of water vapor from the tropics. These weather regions behave like rivers in the sky. They can carry heavy volumes of water vapor compared to the amount of water flow at the mouth of the Mississippi River. As these atmospheric rivers arrive into California, they tend to generate significant rain and snow.

Atmospheric rivers can arrive in many different shapes and sizes. The larger events are able to generate extreme rainfall amounts resulting in flooding. They can stall over watersheds vulnerable to flooding, often saturated with heavy snow amounts. The atmospheric rivers known as a “Pineapple Express” coming from the tropics and arriving with warmer air may produce heavy rains that will melt ground snow adding to the water volume that will be added in the flood runoff.

These events can produce heavy amounts of precipitation creating extensive damages. However, these events may present as weaker systems that produce precipitation that is enough to be beneficial for the local water supply. At the higher elevations in the California mountains, these events have the potential to generate a tremendous snowpack providing a source of water during the dry summer months.

Figure 20-12: Introduction to Atmospheric Rivers

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Location of the Hazard

San Diego is located at the southwestern corner of the state. San Diego is comprised of a diverse geography including coastline, dense urban areas, suburban neighborhoods, heavy industry, and vegetation filled valleys. Along the northern edges of San Diego State University campus are a series of ravines filled with dense vegetation. These ravines drain the bluff that the campus sits on into the San Diego River Valley below. There are a number of flood control reservoirs and flood control channels upstream from the San Diego State University campus that contribute to the potential for flooding in the lower portions of the campus. The area surrounding the campus is a combination of developed suburban environments predominately consisting of residential and commercial land uses and open hillsides. The San Diego State University campus is entirely located in a designated Zone X: Area of Minimal Flood Hazard with the exception of the lower parking areas. The lower elevations areas of the campus are found in Zone AE: 1% Annual Chance Flood Hazard.
The San Diego State University campus is located ¼ mile south of the Chaparral Creek that flows from Lake Murray into the San Diego River through Mission Valley towards the ocean. The Chaparral Creek and San Diego River receive the majority of their water from precipitation during the winter months. The Chaparral Creek does not contribute to a direct flood hazard to the campus except for the facilities in the lower sections of the campus and may also compromise access routes to the campus. The Lake Murray drainage extends to the west towards the ocean.

Extent of the Hazard

The San Diego State University campus is entirely located in a designated Zone X: Area of Minimal Flood Hazard with the exception of the lower parking areas. The lower elevations areas of the campus are found in Zone AE: 1% Annual Chance Flood Hazard. The access routes into and out of the campus are found in areas primarily designated as Zone X: Area of Minimal Flood Hazard, however the portion of Interstate 8 immediately north of the campus is designated as Zone X: 0.2% Annual Chance Flood Hazard. The San Diego State University, Imperial Valley Campus is entirely located in a designated Zone X:
Area of Minimal Flood Hazard as are all access routes into and out of the campus. Based on the campus mostly being located in Zon X, but also with isolated ponding occurring in low lying areas (Zone AE) where a residence halls and parking lots are located, the planning committee ranks the extent of the hazard as **Low to Moderate**.

In support of the NFIP, FEMA identifies those areas that are more vulnerable to flooding by producing Flood Hazard Boundary Maps (FHBM), Flood Insurance Rate Maps (FIRM), and Flood Boundary and Floodway Maps (FBFM). Several areas of flood hazards are commonly identified on these maps, including the 1% annual chance flood zone. Flood zones are further delineated by risk and are assigned a letter signifier. The flood zone designations are defined and described in the following table.

**Table 20-23: Flood Zone Designations and Descriptions**

<table>
<thead>
<tr>
<th>Zone Designation</th>
<th>Percent Annual Chance of Flood</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Zone V</td>
<td>1%</td>
<td>Areas along coasts subject to inundation by the 1% annual chance of flooding with additional hazards associated with storm-induced waves. Because hydraulic analyses have not been performed, no BFEs or flood depths are shown.</td>
</tr>
<tr>
<td>Zones VE and V1-30</td>
<td>1%</td>
<td>Areas along coasts subject to inundation by the 1% annual chance of flooding with additional hazards associated with storm-induced waves. BFEs derived from detailed hydraulic analyses are shown within these zones. (Zone VE is used on new and revised map in place of Zones V1-30.)</td>
</tr>
<tr>
<td>Zone A</td>
<td>1%</td>
<td>Areas with a 1% annual chance of flooding and a 26% chance of flooding over the life of a 30-year mortgage. Because detailed analyses are not performed for such areas, no depths or base flood elevations are shown within these areas.</td>
</tr>
<tr>
<td>Zone AE</td>
<td>1%</td>
<td>Areas with a 1% annual chance of flooding and a 26% chance of flooding over the life of a 30-year mortgage. In most instances, BFEs derived from detailed analyses are shown at selected intervals within these zones.</td>
</tr>
</tbody>
</table>
Areas with a 1% annual chance of flooding where shallow flooding (usually areas of ponding) can occur with average depths between 1 – 3 feet.

Areas with a 1% annual chance of flooding, where shallow flooding average depths are between 1 – 3 feet.

Represents areas between the limits of the 1% annual chance flooding and 0.2% chance flooding.

Areas outside of the 1% annual chance floodplain and 0.2% annual chance floodplain, areas of 1% annual chance sheet flow flooding where average depths are less than one (1) foot, areas of 1% annual chance stream flooding where the contributing drainage area is less than one (1) square mile, or areas protected from the 1% annual chance flood by levees. No BFEs or depths are shown within this zone.

History of the Hazard

Flooding in San Diego and the broader San Diego County region have typically occurred during the winter months when Pacific storms are more common. The occurrences of significant flooding typically have been the result of successive intense storms with heavy precipitation. The region has experienced flood events that have caused tens of millions of dollars in damages and casualties. The following provides insight into information of past flooding events that are significant to the San Diego State University campus. Records of specific flood events on campus are not available, but reports from staff indicate that isolated ponding occurs in low lying areas during heavy rainfall events.

Table 20-24: Historic Flooding Events in San Diego County

<table>
<thead>
<tr>
<th>Date</th>
<th>Event</th>
<th>Declaration</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>March 1962</td>
<td>Flood</td>
<td>DR-122-CA</td>
<td>Countywide</td>
</tr>
<tr>
<td>October 1962</td>
<td>Flood</td>
<td>DR-138-CA</td>
<td>Countywide</td>
</tr>
<tr>
<td>February 1963</td>
<td>Flood; Heavy Rains</td>
<td>DR-145-CA</td>
<td>Countywide</td>
</tr>
<tr>
<td>February 1973</td>
<td>Flood; Winter Storms</td>
<td>DR-364-CA</td>
<td>Countywide</td>
</tr>
<tr>
<td>February 1978</td>
<td>Flood; Winter Storms</td>
<td>DR-547-CA</td>
<td>Countywide</td>
</tr>
<tr>
<td>February 1980</td>
<td>Flood; Winter Storms</td>
<td>DR-615-CA</td>
<td>Countywide</td>
</tr>
<tr>
<td>December 1988</td>
<td>Winter Storms</td>
<td>DR-812-CA</td>
<td>Countywide</td>
</tr>
<tr>
<td>January 1993</td>
<td>Winter Storms</td>
<td>DR-979-CA</td>
<td>Countywide</td>
</tr>
</tbody>
</table>

62 San Diego County Multi-Jurisdictional Hazard Mitigation Plan, October 2017
<table>
<thead>
<tr>
<th>Date</th>
<th>Hazard Description</th>
<th>Report No.</th>
<th>Affected Area</th>
</tr>
</thead>
<tbody>
<tr>
<td>January 1995</td>
<td>Flash Flood; Heavy Rains</td>
<td>DR-1044-CA</td>
<td>Countywide</td>
</tr>
<tr>
<td>March 1995</td>
<td>Flash Flood; Heavy Rains</td>
<td>DR-1046-CA</td>
<td>Countywide</td>
</tr>
<tr>
<td>February 1998</td>
<td>Flood; Winter Storms</td>
<td>DR-1203-CA</td>
<td>Countywide</td>
</tr>
<tr>
<td>January 2005</td>
<td>Flood; Winter Storms</td>
<td>DR-1577-CA</td>
<td>Countywide</td>
</tr>
<tr>
<td>February 2005</td>
<td>Flood; Debris Flows</td>
<td>DR-1585-CA</td>
<td>Countywide</td>
</tr>
<tr>
<td>March 2011</td>
<td>Flood; Heavy Rains</td>
<td>DR-1952-CA</td>
<td>Countywide</td>
</tr>
<tr>
<td>January 2017</td>
<td>Flood; Winter Storms</td>
<td>DR-4305-CA</td>
<td>Countywide</td>
</tr>
</tbody>
</table>

**Potential Impacts of the Hazard**

A flood will potentially result in extensive amounts of water entering onto developed areas. The force and volume of water that is generated by a flood may cause extensive structural damage in areas subject to standing or moving water. The effects of flooding may spread over significant distances covering large areas of land. The extent of the impacts would vary based on a number of factors such as the volume of water flooding, the time of the flood event, the amount of warning provided, the location and extent of the flood boundary, facility elevation, and distance from the flood source. Potential impacts resulting from flooding include:

- Injuries or loss of life
- Property destruction or damage
- Loss of property contents
- Infrastructure damage including roadways, bridges, other transportation means
- Public health hazards resulting from mold, mildew, and disease due to flood water
- Flooded or destroyed lifelines/supply routes
- Damaged or destroyed utilities
- Loss of community economic base
- Employment losses
- Agricultural (crops and livestock) damages or destruction
- Environmental damage
- Prolonged periods of necessary dewatering
- Flooding erosion may alter natural drainage channels
- Societal and community impacts
- Psychological impacts of impacted populations
- Disruptions to education delivery to community
- Damage or destruction of academic materials, fine arts, and research
- Damage or destruction of university computer systems and networks
- Damaged university infrastructure
- Inability for campus operations to resume
- Reduced or eliminated student engagement with academic programs
- Reductions in campus revenues

Additionally, individuals who were unable to evacuate in time or refused to leave will likely need assistance or rescue from the flooded area. Remaining in or being trapped by flood waters places individuals in significant risk of injury or death. The impacts extend beyond the danger placed upon the affected individual and places greater resource demands on agencies and organizations making efforts to rescue trapped individuals.

Probability of Future Occurrence of the Hazard

San Diego County is determined to have considerable portions of the county to be at high risk from flooding. The repeated historic occurrences have shown that the region is subject to flooding in any given year. Floods can occur at any time but are most common in the San Diego area with winter storms that are saturated with subtropical moisture. The area surrounding the San Diego State University campus does not generally promote conditions for flood waters to accumulate. The majority of the campus is elevated on a bluff. However, portions of the campus in the valley floor such as the Villa Alvarado Residence Hall complex, parking lot 17, parking lot 16, and central receiving are all located within the Zone AE Special Flood Hazard Area (Area Inundated by 1% Annual Chance of Flooding). There are specific buildings and areas of the campus located in Zone AE have a greater risk for isolated flooding. The remainder of the campus is located within a Zone X (Area of Minimal Flood Hazard). However, there is a historic record of isolated urban or street flood events provides a demonstration of potential flood activity.

The probability of future occurrence for flooding on campus is **Unlikely** in Zone X locations, but **Possible** in Zone AE areas.

Vulnerability to the Hazard

The San Diego State University campus is subject to the effects of isolated flooding and ponding resulting primarily from excessive precipitation and isolated strong storms. There is a more remote potential for flooding and damage on campus due to overflow or damage to flood control systems. The channels and extending irrigation channels that surround the campus have limited storage or volume capacities. The campus and the campus community are vulnerable to the effects generated by flooding from these systems, especially those assets (residence hall, parking lots and central receiving) located in Zone AE.

Vulnerability to flooding on the San Diego State University campus will vary depending on when the flood were to occur. The risk to the campus population will be lessened
during periods when classes are not in session or during periods of breaks. Conversely, during the days and hours that classes are in session and staff are at their workplaces, the human vulnerability increases. Members of the campus community may become trapped on campus depending on the level and location of isolated flooding occurring on surface streets, especially those persons working or residing in Zone AE assets. However, in rare, region-wide events this vulnerability may be extended to the homes and workplaces of members of the campus community and their families.

San Diego State University is in proximity to a variety of industrial and commercial facilities in the surrounding communities. When these facilities are inundated with flood water, the potential for chemical release exists presenting possible exposures to individuals from the campus community. These facilities additionally line many of the primary access routes in and out of the campus.

The campus sits on land that is elevated on a bluff overlooking ravines that are situated behind the university limiting the effects of widespread flooding. During low probability, severe flood events, some campus buildings and infrastructure might be vulnerable to localized flooding if it reaches the university, especially Zone AE assets. Campus utilities and communication capabilities might be impacted by flood waters rendering them disabled. A flood covering a large portion of the city would likely affect communication capabilities well beyond the boundaries of the campus. Remaining flood waters will leave behind molds and other health concerns in affected campus buildings and facilities likely requiring extensive restoration or demolishing. The residents of the on-campus residence halls may have transportation limitations requiring evacuation and alternative housing procedures to be implemented if populated. Flood waters may result in damage to campus equipment, communication systems, protected documents, artwork, academic materials, computer systems, research, and other critical activities on lower levels of buildings.

Certain campus populations will experience greater challenges to a post-flood / failure environment. Vulnerable populations will likely need to navigate through flood generated debris, face extreme health safety issues from flood waters, experience extreme stresses of a disaster, an inability to communicate to or gain access to support networks, and find difficulty in accessing equipment or supplies to aid in a specific need. Students remaining on campus such as those residing in the residence halls would be particularly vulnerable especially those without access to adequate transportation.

**Estimate of Potential Losses**

Estimates of potential losses will be influenced by a variety of factors. The volume and force of the water will determine the scale of damages affecting campus infrastructure, equipment, and other impacted features. The location and elevation above flood waters will affect the level of damage and individuals exposed. The time of the academic year, the day of week, and hour in which the flooding was to occur will influence the number of people on campus and potential casualties. The severity of the storms producing precipitation, the speed of the storms moving across the area, the level of snowpack in
the higher elevations, and amount of resulting snowmelt will produce varying effects on damages produced and costs incurred. Losses will be generated by the physical damages, the loss of revenue, loss of academic research, loss of building contents, and community wide economic reductions.

Based on estimate replacement costs of facilities and structures on campus, the maximum total replacement costs due to flood are $726,584,983. However, it is unlikely for flood to cause destructive losses to the entire campus.
Table 20-25: Special Flood Hazard Area (SFHA) Estimated Losses

<table>
<thead>
<tr>
<th>Zone Designation</th>
<th>No of Buildings</th>
<th>Maximum Replacement Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Zone V</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Zone VE &amp; V 1-30</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Zone A</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Zone AE</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Zone AH</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Zone AO</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Zone X .2%</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Zone X Minimal Risk</td>
<td>147</td>
<td>$726,584,983</td>
</tr>
<tr>
<td>Not in a SFHA</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>No Building Value Data Provided*</td>
<td>68</td>
<td>Unknown</td>
</tr>
</tbody>
</table>

*Buildings with no value defined are also included in the respective Zones they are found in.

The table above includes 14 facilities located at the Calexico based San Diego State University, Imperial Valley campus. The provided cost estimates for the Imperial Valley campus includes $18,144,214. However, 12 facilities do not have costs included.

Vulnerability Assessment Conclusions

While the campus is mostly located in an area of minimal flood potential (Zone X), the primary vulnerabilities to flood on campus are people and assets in Zone AE exposed to mostly localized flooding and ponding from overflow of campus creeks or isolated or large-scale storms that produce heavy amounts of precipitation directly over the campus and surrounding neighborhoods.

The proximity to the San Diego River and Chaparral Creek further presents an additional risk factor for the campus.

The potential for unlikely but severe flooding on campus generates the potential for a number of cascading effects such as disruptions to the local economy, utility failures, disruptions to providing for the needs of the community, and development of public health hazards. These effects would be exacerbated by effects of seasonal flooding, ongoing heavy precipitation, or excessive run-off from the watershed contributing to the river system. The potential for widespread flooding and damage of structures due to the force of water, while unlikely, has exponentially powerful impacts on particular segments of the campus community including those with access or functional needs, international students, the homeless, and students residing in the residence halls.
Identified Data Limitations

Data limitations include missing campus structural replacement costs, and an incomplete inventory of both building construction features and mitigation efforts to lessen the impact due to flood inundation. HAZUS generated analysis is focused on the broader community level versus fine-tuning the analysis to the micro-level for facilities such as a university campus.

Hazardous Materials

Description of the Hazard

A hazardous material is defined in California’s State Hazardous Materials Incident Contingency Plan (1991) as “a substance or combination of substances which, because of quantity, concentration, physical, chemical, or infectious characteristics may: cause, or significantly contribute to an increase in deaths or serious illnesses; and/or pose a substantial present or potential hazard to humans or the environment.” Hazardous materials are one or more of the following: flammable, corrosive or an irritant, oxidizing, explosive, toxic (poisonous or infectious), thermally unstable or reactive, or radioactive. Hazardous materials are ubiquitous in modern society and may be found at all stages of production, consumption, and disposal.

Federal and state laws permit the intentional release of some hazardous materials into the environment such that the risk to human health and the environment is thought to be acceptable. However, sometimes releases are unintentional, resulting from leaks, accidents, or natural hazards. This section focuses on such accidental releases and fall into the following key categories:

Fixed Hazardous Materials Incident: A fixed hazardous materials incident is the accidental release of chemical substances or mixtures during production or handling at a fixed facility.

Transportation Hazardous Materials Incident: A transportation hazardous materials incident is the accidental release of chemical substances or mixtures during highway, waterway or air transport. Populations, built and natural environments are potentially impacted.

Pipeline Incident: A pipeline transportation incident occurs when a break in a pipeline creates the potential for an explosion or leak of a dangerous substance (oil, gas, etc.) possibly requiring evacuation. An underground pipeline incident can be caused by environmental disruption, accidental damage, or sabotage. Incidents can range from a small, slow leak to a large rupture where an explosion is possible. Inspection and

maintenance of the pipeline system along with marked gas line locations and an early warning and response procedure can lessen the risk to those near the pipelines.

Hazardous materials can also be classified according to worker safety and health. Information provided by California Division of Safety and Health includes guidelines related to:

- **Safety hazards**: fire and fire byproducts, electricity, flammable gases, unstable structures, demolition, sharp or flying objects, excavations
- **Health hazards**: carbon monoxide ash, soot and dust; asbestos; hazardous liquids; other hazardous substances; heat illness

**Natural-Technological Incidents (Natechs)**: During the past two decades, increasing attention has been given to hazardous materials releases resulting from Natechs or a natural disaster event that triggers a technological hazard event. Natechs are of particular concern for the following reasons:

- They can produce a simultaneous effect on many industrial facilities
- Can overwhelm response capacity
- Containment systems may fail
- May produce cascading disasters
- Response may be hindered by a disaster’s impact on the physical environment

**Location of the Hazard**

Hazardous materials and infrastructure such as fuel tanks, rail lines, chemicals, hazardous waste sites and gas pipelines to varying degrees are located within the CSU system and/or within its surrounding communities. Please refer to Annex ? for the map identifying the types and locations of hazardous materials and infrastructure on or near the SDSU campus. The planning committee indicates that chemicals are located in science labs on campus, and possibly some stored chemicals elsewhere. Mapping indicates that a gas line comes into the campus from the main line. Otherwise, no

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hazardous materials or infrastructure is located near campus. At larger scales (beyond the campus planning area) hazardous materials and infrastructure are located throughout the city and county of San Diego, and reflect different types, configurations and scales dispersed across these geographic areas.

Extent of the Hazard

There is no comprehensive statewide vulnerability assessment available at this time. As such, the true extent of the hazardous materials risk in California and its communities is not known, meaning no overarching conclusions have been reached which have been able to integrate all qualitative and quantitative risk factors to produce a comprehensive measure of the extent of the hazard.

For the SDSU planning committee, chemicals are managed in campus science labs, and no events have taken place on campus. A rail line and a gas pipeline are about one mile north and south of campus, and chemical sites and hazardous waste sites are further away from the campus. Based on these factors, the extent of the hazard for the SDSU campus is Low, but to consider worst case scenarios as the main driver of policy in order to fully mitigate all possible hazardous materials event outcomes.

For example, according to the 2018 CA State Hazard Mitigation Plan, 400 hazardous materials problems are tied to 32 past earthquakes, including over 150 problems from the Loma Prieta Earthquake alone. That said, the plan indicates that it is likely that many such hazardous materials releases have received little attention in the past because public authorities, the media, and the public have overlooked them in the rush to address and recover from immediate disaster threats, and that responsible parties may have an incentive to understate the extent of releases or not to report them at all.

History of the Hazard

According to the CA Governor’s Office of Emergency Services’ Hazardous Materials Spill Report, the state experiences from 10 to 30 spill events daily. As of April 20, 2021 a total of 2,096 spill events had occurred. Such events have occurred in all the cities and/or counties where CSU campuses are located.

According to the campus planning committee, no events have taken place on campus.

Potential Impacts of the Hazard

A large hazardous materials release could affect an entire community or city under certain conditions related to direction of air flow (air-based chemical release) and population density or the contamination of a community’s main water supply. Either type


of release could necessitate large scale evacuation. By contrast, in the rural unincorporated areas where population densities are low, even in the event of a large release, the number of homes that may need to be evacuated would be significantly lower than in an urban environment. The occurrence of a hazmat incident can also result in the shut-down of transportation corridors which can last for hours at a time while the impacted area is stabilized.

The release of some toxic gases may cause immediate death, disablement, or sickness if absorbed through the skin, injected, ingested, or inhaled. Contaminated water resources become unsafe and unusable, depending on the amount of contaminant. Some chemicals cause painful and damaging burns if they come in direct contact with skin. Prolonged and concentrated exposure to such chemicals can produce severe long-term impacts to respiratory, endocrine and nervous systems, heart and brain health.

The potential impacts of chemicals and toxic gases discussed here also to some degree apply to the students, staff and environment on the SDSU campus.

With regard to the natural environment overall, contamination of air, ground, or water may result in harm to fish, wildlife, livestock, and crops. The release of hazardous materials into the environment may cause debilitation, disease, or birth defects over a long period of time. Loss of livestock and crops may lead to economic hardships within the community.

Recent California examples include the 2016 Aliso Canyon methane gas leak, which caused evacuation of nearby residents, many of whom experienced temporary health problems such as difficulty breathing and eye irritation; and the 2016 Fruitland metal recycle plant fire in Maywood, which released heavy metals such as lead, magnesium, copper, aluminum, antimony, calcium, iron, sulfur, tin, potassium, and zinc which pose severe risks to public health. Health effects from exposure to these metals included short-term symptoms such as irritation to the eyes, nose, throat, and lungs.

**Potential Impact of the Hazards (Natechs)**

Natural disasters, including earthquake, flood, and fire also pose risks to public health and the environment. For example, following the Northridge Earthquake, California State University (CSU) Northridge laboratories and chemical storage rooms experienced multiple chemical spills. Such incidents, triggered by a natural disaster, pose a significant risk to students, faculty, staff, and first responders. At a minimum, all CSU campuses with a science lab (including SDSU) is at risk of potential impact from a natural-technological (combined impact) event.

In a severe flood event, floodwaters are often contaminated with hazardous materials posing a threat to public and animal health, groundwater, and other parts of the environment. These hazardous materials may be released from damaged or flooded underground tank sites (e.g., gas stations or chemical storage facilities), propane tanks,

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manure or human waste handling facilities, fertilizer and pesticide storage, agricultural sites, and household hazardous waste.

In a fire event, (such as the October 2017 Northern California firestorms which destroyed approximately 6,000 residences) entire neighborhoods can be burned to the ground. Hazardous material release creates public health concerns which can delay the initial steps of fire recovery, including reopening burned areas to residents and initiating debris removal activities. The post-fire “toxic sweep” poses a risk of coming into contact with toxic substances due to the presence of synthetic and hazardous materials.

Probability of Future Occurrence of the Hazard

The probability of occurrence for a hazmat event on the SDSU campus can be viewed in two different ways: the history of occurrence serves as a sound predictor of future probability assuming current risk and vulnerability factors remain somewhat constant. For the purposes of the current estimate, no current data clearly indicates otherwise. As such, the probability of occurrence is Low - the campus has not experienced a hazmat event on campus. In addition, hazardous materials and infrastructure are a mile or more away which may slightly increase vulnerability and the probability of a campus-related event. Moreover, hazmat occurrences are largely based on human error, and any changes in risk and vulnerability factors such as a decreased vigilance in materials oversight and handling practices or changes in the amount of chemicals or exposure will likely increase the probability on campus.

Vulnerability to the Hazard

Hazardous materials pose a risk to the SDSU campus. As identified by the campus planning committee and on the hazmat map (see section X), the following vulnerabilities are present on campus: chemicals are managed in campus science labs. A rail line and a gas pipeline are about one mile north and south of campus, and chemical sites and hazardous waste sites are further away from the campus. Gases and chemicals or hazardous waste, if spilled or released, could impact human health and campus operations.

Although it is quite difficult to produce a quantitative measure of vulnerability because (unlike natural hazards) the probability of occurrence is dependent on human error, which itself is variable based upon a fluctuating set of interrelated factors, some of which lack prediction or control, given the complexity of how all natural and built environments and hazmat risks factors interrelate at the local or campus level, it is prudent to assume for planning purposes that the campus’ vulnerability is a sub-set of the larger community’s vulnerability. As such, the SDSU leadership maintains vigilance to mitigate the campus’ vulnerabilities identified above at a minimum.

Estimate of Potential Losses

As discussed previously, it is difficult if not impossible to produce an accurate quantitative measure of vulnerability because of the variable nature of a hazardous materials spill. For example, the release of a toxic airborne chemical in a populated area
has severe impact potential, whereas the impact potential of a small chemical spill in a remote or rural area is most likely limited to remediation of soil. And, in both cases, the probability of occurrence is dependent on human error, which itself is variable based upon a fluctuating set of interrelated factors, some of which lack prediction or control. In all cases, different types and amounts of hazardous materials interact with fluctuating combinations of human error to produce different event outcomes with variable impact costs.

Vulnerability Assessment Conclusions

It is well understood that with regards to hazmat vulnerability, each campus and its surrounding community (including SDSU) operates through a complex and dynamic interaction between industrial and commercial inputs and outputs and the natural and built environment. Such activity produces hazardous materials that move through the environment along both convergent and divergent routes and across all levels of land-use from site to campus to city and county and beyond. It is also clear from a review of the San Diego County hazard mitigation plan and Cal OES’ records of hazardous material spills, that such events occur with great frequency and varying degrees of severity across jurisdictions statewide. As such, in assessing the vulnerability of the SDSU campus, campus-level risks and vulnerabilities are not discreet or isolated but can become exacerbated or augmented through connections to broader community-level hazmat risks and vulnerabilities.

Finally, in order to draw conclusions on vulnerability, it should be noted that any identified vulnerabilities at the campus level and/or community level are circumscribed and potentially reduced by targeted policy and program interventions. Numerous policies and programs have been established in recent years in response to California’s widespread and complex and integrated hazardous materials risks - California established the Unified Program which consolidates and integrates the administrative requirements, permits, inspections, and enforcement activities of the following environmental and emergency response programs: the Aboveground Petroleum Storage Act (APSA) Program, Area Plans for Hazardous Materials Emergencies, the California Accidental Release Prevention (CalARP) Program, the Hazardous Materials Release Response Plans and Inventories (Business Plans), Hazardous Material Management Plan (HMMP) and Hazardous Material Inventory Statement (HMIS) requirements (California Fire Code), the Hazardous Waste Generator and Onsite Hazardous Waste Treatment (tiered permitting) Programs, and the Underground Storage Tank Program.

Identified Data Limitations

The SDSU planning committee has provided information on campus-level hazmat materials and risks. Data limitations pertain to a comprehensive understanding of human activity and error related to materials control over the long term.
**Landslide**

**Description of the Hazard**

A landslide is a down-slope movement of soil, rock, or other debris, and can also be referred to as a mass movement or slope failure.\(^1\) These geological hazards can range in size from a few feet to over a mile in length and width and, when heavy and rapidly moving, can cause serious damage and loss of life.

Landslides are classified based on the type of material and type of movement involved. They can range from slow-moving earth flows to fast-moving debris flows, though many large slope failures involve more than one type of movement. The primary natural triggers of slope failures are water, seismic activity, and volcanic activity. Slope saturation by water can occur from intense rainfall, snowmelt, changes in ground-water levels, and surface-water level changes along coastlines. In winter months, El Nino storms or other high rainfall events may saturate soils and trigger slope failure.

**Deep-Seated Landslides**

Deep-seated landslides, ranging in depth from ten to several hundred feet, occur as a result of geologic and hydraulic changes, such as earthquakes or increased levels of groundwater. These landslides can move slowly or quickly and can cause extensive property damage, but rarely result in loss of life.

**Debris Flows Related to Shallow Landslides**

Shallow landslides may mobilize into rapidly moving debris flows and typically occur after sudden saturation of the ground. These types of debris flows are typically more dangerous because they move rapidly, causing both property damage and loss of life.

Debris flows may also occur as a result of post-fire conditions, where wildfires have left barren ground exposed to heavy rainfall. Intense rainfall, generally greater than .5 inch per hour, has the potential to trigger a post-fire debris flow.\(^2\) These landslides may impact lives and properties within its deposition zone, and can result in downstream flooding. These post-fire debris flows often occur during the fall and winter following major summer fires.

**Location of the Hazard**

The susceptibility of an area to landslides depends on several variables, including magnitude of slope gradients, water content, ground cover, presence of erosion, and slope material and structure. However, landslides are most prevalent in terrain with weak


material and steep slopes, and the highest risk is found in areas with high rainfall or high earthquake potential. Slope failures are also most likely to occur in areas where they have occurred in the past. In California, the most landslide-prone areas are found along the coast and in the northern Franciscan Formation.

General landslide vulnerability can be estimated from the distribution of weak rocks and steep slopes as seen in Figure 20-15. Based on the Figure below, the campus appears to be adjacent or possibly connected to areas susceptible to landslide.

Figure 20-14: Deep-seated Landslide Susceptibility

Extant of the Hazard

Landslide risk in San Diego County is concentrated along canyons near the coastal areas with steep slopes. Landslides also occur throughout the western portion of the County and in the mountains to the east. Mitigation measures have stabilized many but not all landslides in urban areas. The indirect impacts of landslides in the region may cover a larger geographical extent than that of direct impacts. Based on the campus’ close proximity to a moderately susceptible landslide zone, and the history of significant impacts in the county, the planning committee ranks the extent of the landslide hazard for the campus as **Moderate**.
History of the Hazard
FEMA has declared twelve major disasters involving landslides, mudslides, mud flows, or debris flows since 1978 in San Diego County. NOAA recorded twenty-nine debris flow events from 2003 to 2019. Several significant landslides have occurred proximal to the campus, including in Mission Gorge, Santee, and El Cajon. No landslides have occurred on or immediately adjacent to the campus.

Potential Impacts of the Hazard
San Diego State University (SDSU) may be impacted by the disruption of services as a result of landslides in the region. Landslides can result in physical damage to buildings and property and have the potential to significantly effect infrastructure. As a landslide moves, it distresses structural foundations by settlement, cracking, and tilting. Fast-moving flows can remove entire structures in one instance, while other types of flows can cause damage gradually.

Transportation and utility infrastructure are particularly vulnerable to landslides, since the failure of any component can disrupt service over a large area. The loss of power and communication and disruption of transportation can have cascading effects throughout an area, including impaired disposal of sewage, contamination of water supplies, and the release of flammable fuels. Transportation routes are also often expensive to clean up, and prolonged obstruction can disrupt the movement of people and goods for long periods of time.

Probability of Future Occurrence of the Hazard
Slope failures are often triggered by other natural hazards such as heavy rainfall and earthquakes, so landslide frequency is often related to the frequency of these other hazards. As climate change impacts the frequency and intensity of triggers such as rain events, fires, and coastal erosion, landslides may generally occur more often. Historically, landslides have occurred frequently in San Diego County and therefore are highly likely to occur in the future. Given the location of the campus adjacent to the landslide zone, and the occasional occurrence of landslides in the county, the planning committee ranks the probability of the landslide hazard in some way affecting the campus or campus access routes as Possible

Vulnerability to the Hazard
The vulnerability of the built environment to landslides depends on exposure and is more likely to incur damage as a result of proximity, rather than inferior structural design. The structures most vulnerable to landslides are buildings and utility/transportation lifelines, which can be impacted by either impact or ground deformation. Utilities and transportation infrastructure are particularly vulnerable, due to their geographic extent and susceptibility to physical distress. Any population proximal to a landslide when it occurs is vulnerable to its impacts. The campus and/or its surrounding transportation
routes may be vulnerable to some degree. See the landslide location map with campus location adjacent to landslide severity zones identified.

Estimate of Potential Losses

There are no current models for estimating potential losses from a landslide directly impacting the campus.

Although the economic impact of landslide damage can exceed that of the direct repair costs, there are currently no applicable methods for estimating indirect costs related to SDSU.

Vulnerability Assessment Conclusions

Community exposure to landslides varies depending on their physical locations – whether in flat plains or on steep hillsides – and on their dependence on critical infrastructure located in landslide hazard zones.

Landslides could impact the campus in a variety of ways, primarily related to indirect impacts to transportation and utilities. Utility outages can impact health, particularly for vulnerable populations, and can cause interruptions in operations. Interruptions may impact student and employee’s ability to travel to campus and the delivery of classes and events.

Identified Data Limitations

The ability to predict future landslides at the SDSU campus is limited. However, the USGS estimates that climate change-induced shifts in weather will increase the frequency of post-wildfire landslides, which are expected to occur almost every year in California.13

Power Outage

Description of the Hazard

San Diego is one of California’s largest metropolitan cities and the nation’s fifth most populous city. It is also the home of San Diego State University (SDSU). The city is known for its mild year-round climate, natural deep-water harbor, extensive beaches and parks, long association with the United States Navy and Marine Corps, and recent emergence as a healthcare and biotechnology development center. San Diego County also borders the country of Mexico making it a crossing point for the shipment of international goods.

Most aspects of modern life, and almost all aspects of urban life, rely on the availability of reliable utilities, such as electricity, water, and natural gas. An interruption in the supply or distribution of these commodities can leave highly populated areas like San Diego without basic services, such as electricity or sanitation. These interruptions can be cascading effects from other hazard events, such as windstorms, floods, wildfires and earthquakes, or they can be caused by intentional disruptions of transmission lines.
A power outage event can interrupt day-to-day operations of the SDSU campus, like in-person classes, impede or limit digital, telephonic or radio communications, create traffic jams around the busy avenues and boulevards surrounding the campus, close the student health center, and close restaurants around campus and outside the campus. Additionally, thousands of SDSU student residents in on-campus housing would also be affected by a power outage on campus and in the area. Additionally, a severe outage to the city of San Diego or San Diego County would also directly affect the campus and the community.

Electric power disruptions and outages fall into two categories: intentional and unintentional. The four types of intentional disruptions are:

- **Planned:** Some disruptions are intentional and can be scheduled based on maintenance or upgrading needs.
- **Unscheduled:** Some intentional disruptions must be done "on the spot" in response to an emergency.
- **Demand-Side Management:** Some customers (i.e., on the demand side) have entered into an agreement with their utility provider to curtail their demand for electricity during periods of peak system loads.
- **Load Shedding:** When the power system is under extreme stress due to heavy demand and/or failure of critical components, it is sometimes necessary to intentionally interrupt the service to selected customers to prevent the entire system from collapsing. These intentional interruptions result in rolling blackouts.

Unintentional or unplanned disruptions are outages that come with essentially no advance notice or warning. This type of disruption is the most problematic. The following are categories of unplanned disruptions:

- Accident by the utility, utility contractor, or others.
- Malfunction or equipment failure.
- Equipment overload (utility company or customer).
- Reduced capability (equipment that cannot operate within its design criteria).
- Tree contact other than from storms.
- Vandalism or intentional damage.
- Weather, including lightning, wind, earthquake, flood, and broken tree limbs taking down power lines.
- Wildfire that damages transmission lines.

**Location of the Hazard**

Although power outages can take place within a certain area, it has the potential to affect the entire planning area equally.
Extent of the Hazard

In order to anticipate outage conditions and reduce impacts, campus facility managers and others keep track of conditions and data provided by the media, municipal utilities and the California Independent System Operator (CAISO). CAISO is tasked with managing the power distribution grid that supplies most of California, except in areas served by municipal utilities, and is thus the entity that coordinates statewide flow of electrical supply. CAISO uses a series of stage alerts to the media based on system conditions. The alerts are:

- Stage 1 - reserve margin falls below 7 percent.
- Stage 2 - reserve margin falls below 5 percent.
- Stage 3 - reserve margin falls below 1.5 percent.

Rotating blackouts become a possibility when Stage 3 is reached. Utility agencies aim to advise affected areas approximately 48 hours in advance of a potential PSPS event and will attempt notification again approximately 24 hours before power is shut off. Campus staff respond accordingly.

Given the prevalence of rolling blackouts and other power outages in California, the campus maintains safety precautions, situational awareness, access to emergency power generators and other protocols for managing campus power outages. Given that recorded outages have taken place on campus, the planning committee ranks the extent of the power outage hazard as **Moderate**.

History of the Hazard

San Diego State reported experiencing power outages in recent years, especially those due to extreme weather events. The Mt. Laguna satellite campus lies in the area of Southern California Edison’s Public Safety Power Shut-off mitigation areas. PSPS efforts has led to the closure of campus, cancellation of classes and temporarily interrupting campus operations. Additionally, the campus can be affected for multiple days if high wind, extreme weather environments continue for multiple days.

The main campus is not susceptible to PSPS mitigation efforts but has experienced loss of power events. Failures on the main campus are due to localized outages creating an impact requiring a need to bring in lighting alternatives, port-a-potties, transports to resident halls, unscheduled dismissing classes, and campus activities.

The university has mitigation efforts in place for power outages by creating four electric substations and plant for regenerating power temporarily to the campus, as the efforts to return power capabilities to the campus continue.

Potential Impacts of the Hazard

Instructors, campus residents, staff, and administration rely on electricity for basic operations. During a widespread power failure, it may take anywhere from several hours to days to restore operations if a significant event occurs. Electrical power may be the
only cooling source for many individuals around the campus and its community, and long-term outages can potentially put people’s health and life at risk. Disruptions in the supply of heating fuel may put people and property at risk during extremely cold weather if it relies on electric generation or heating mechanisms instead of gas. Additionally, many medical devices, communications devices, and security rely on power to maintain their functions.

**Climate Change and Energy Shortage**

Climate change is expected to bring more frequent and intense natural disasters. These changes have created a variability at a rate that makes historical data a poor predictor of future climate. For example, the warmest years on record in California occurred in 2014, 2015, and 2016. The 2016-2017 year broke the record as the wettest ever recorded in the northern Sierra Nevada Mountains.

Changes in temperatures, precipitation patterns, extreme events, and sea-level rise have the potential to decrease the efficiency of thermal power plants and substations, decrease the capacity of transmission lines, render hydropower less reliable, spur an increase in electricity demand, and put energy infrastructure at risk of flooding.

With climate warming, higher costs from increased demand for cooling in the summer are expected to outweigh the decreases in heating costs in the cooler seasons. Hotter temperatures in California will mean more energy (typically measured in “cooling-degree days”) needed to cool homes and businesses both during heat waves and on a daily basis, during the daytime peak of the diurnal temperature cycle. During future heat waves, historically cooler coastal cities (e.g., San Francisco and San Diego) are projected to experience greater relative increases in temperature, such that areas that never before relied on air conditioning will experience new cooling demands.

Secondary impacts of energy shortages are most often felt by vulnerable populations. For example, those who rely on electric power for life-saving medical equipment, such as respirators, are extremely vulnerable to power outages. Also, during periods of extreme heat emergencies, the elderly and the very young are more vulnerable to the loss of cooling systems requiring power sources.

**Probability of Future Occurrence of the Hazard**

The probability of California experiencing a power outage can be difficult to quantify but is a hazard that occurs annually during the same seasonal periods of temperature variance throughout the calendar year. The City of San Diego and San Diego County experience such outages. As such, the probability ranking for the San Diego area is **Likely**. Since the San Diego State University campus has also recorded power outage events, it is prudent to assign this same ranking for the campus.

Climate models suggest summer global temperatures are likely to increase while changes between temperature extremes would be more pronounced. As such, it is expected that power outages will occur more frequently in the future.
Vulnerability to the Hazard

Based on the data available, and in consideration of the increasing effects of climate change, the probability of future occurrences prompting intentional outages and creating unintentional power outages the hazard is high for the county in different areas but not specifically influencing the Cal State San Diego. Nonetheless, it would serve the campus to ensure to be able to mitigate and cope with an interruption to electrical power.

Although the campus has specific power outage protocols in place, an outage can impact the operations of the university depending on the severity of the outage. During daytime hours, the University may remain open and business and instructional operations will remain on-going to the maximum extent possible. It will be expected that the areas surrounding the campus, including streetlights, will have also experienced a blackout.

Estimate of Potential Losses

The data provided by Cal State San Diego State does not report any value for potential losses due to power outage.

Vulnerability Assessment Conclusions

Elevators, entry ways, air filtration systems and lighting provide the campus community with the necessary infrastructure and systems to function and navigate through the campus and to maintain a safe campus environment and visibility during nighttime hours. The primary concern for campus leadership is that a loss of power can lead to potential hazards to students, faculty, and staff. Vulnerable populations (especially students with physical disabilities) may be the most heavily affected by loss of power, as they rely on elevators, entry ways with automatic doors, and locks and lights; a power outage would impede a disabled student’s ability to travel and utilize the campus and its structures safely.

The use of communication devices, billing, records, and electrical tools may also become unusable due to a loss of electricity. Many records and billing items may have to revert to “by-hand” procedures and paper copies may have to be kept continuing operations. Additionally, classrooms may not be usable if lighting equipment is not functioning impacting a semester or quarter’s progress for the academic year.

Identified Data Limitations

Cal State San Diego did not report any monetary or life losses due to a power outage. Also, the campus did not report any incidents involving a power outage directly affecting the campus community and operations.
**Tsunami**

Description of the Hazard:

A tsunami is a wave triggered by any form of land displacement along the edge or bottom of an ocean or lake. Land displacement can be in the form of submarine landslides or submarine dip-slip faults. These types of faults cause ruptures that result in seafloor uplift or down-drop. This mass movement translates to a tsunami or gravity wave within the overlying water at the surface.

Tsunamis travel radially outward from the area of initiation. The size of a tsunami is proportional to the mass that moved to generate the tsunami. As a tsunami approaches the shore and the depth of the water column decreases, the energy in the wave pushes the wave crest above the water surface resulting in a larger wave height. Wave runup is the elevation above mean sea level on dry land that a tsunami reaches. Run-up is what causes inundation of coastal areas that are below the run-up height.

There are two types of source regions for tsunamis—resulting in local and distant source tsunamis as viewed from the affected shoreline. Local tsunamis are typically more threatening because they afford at-risk populations only a few minutes to find safety. California is vulnerable to, and must consider, both types. Identifying tsunami hazards requires 1) evaluating the potential for submarine mass movement both locally and at great ocean distances, and 2) identifying coastal regions within the direct or indirect path of a potential tsunami wave that are below the run-up height.

Tsunamis can travel at speeds of over 600 miles per hour in the open ocean and can grow to over 50 feet in height when they approach a shallow shoreline, potentially causing severe damage to coastal development. At the shoreline, tsunamis may take the form of a fast-rising tide, a cresting wave, or a bore (a large, turbulent wall-like wave). The bore phenomenon resembles a step-like change in the water level that advances rapidly (from 10 to 60 miles per hour). The first wave is usually followed by several larger and more destructive waves.

Location of the Hazard:

According to the 2018 CA State Hazard Mitigation Plan, tsunami locations span 94 incorporated communities and 83 unincorporated areas across 20 coastal counties.

As identified on the Tsunami Inundation Area map (below), San Diego County is at risk to the tsunami hazard, although the San Diego State University campus is located away from the tsunami inundation zone. However, due to its role in the community, the campus conducts tsunami warnings due to the potential impact of tsunami to transportation routes utilized by staff and students.
Extent of the Hazard

The factors shaping the extent or severity of the hazard are a combination of geophysical forces (the amount of vertical and horizontal motion of the sea floor, the area over which it occurs, and the efficiency with which energy is transferred from the earth’s crust to the ocean water) and the geographic range of coastal development to be impacted.

More specifically, as a tsunami approaches the shore, wave run-up is the elevation above mean sea level on dry land that a tsunami reaches. A tsunami’s potential severity can be forecasted as a function of the wave’s mass along with the difference between the wave’s run-up height and the ground elevation of the affected coastal location.

There are two types of source regions for tsunamis—resulting in local and distant source tsunamis as viewed from the affected shoreline. Local tsunamis are typically more threatening because they afford at-risk populations only a few minutes to find safety. California is vulnerable to, and must consider, both types. Identifying tsunami hazards requires 1) evaluating the potential for submarine mass movement both locally and at

great ocean distances, and 2) identifying coastal regions within the direct or indirect path of a potential tsunami wave that are below the run-up height.

According to the 2018 San Diego County Hazard Mitigation Plan, the planning committee ranked the extent of tsunami as Moderate. The greatest type of tsunami risk is material damage to small watercraft, harbors, and some waterfront structures with flooding along the coast. (See the Estimate of Potential Losses section for additional data).

History of the Hazard:

The California Seismic Safety Commission report, the Tsunami Threat to California Findings and Recommendations on Tsunami Hazards Risks, published in December 2005, indicates that over 80 tsunamis have been observed or recorded along the coast of California in the past 150 years. That said, no tsunamis have impacted CSU campus locations.

According to the National Centers for Environmental Information (NCEI), have been eight tsunamis have caused damage to ports and harbors or coastal inundation in California since 1946. The most significant events are as follows:

- In 1964, a tsunami caused by a Magnitude 9.2 earthquake offshore from Alaska resulted in 13 deaths in California and destroyed portions of downtown Crescent City.
- A 2006 tsunami (originating in the Kuril Islands region north of Japan) caused approximately $20 million in damage to Crescent City harbor.
- A 2010 tsunami (originating offshore from Chile) caused millions of dollars in damage to ports and harbors in the state.
- A tsunami in 2011 (caused by a Magnitude 9.0 earthquake offshore of Japan) killed one person at the mouth of the Klamath River and caused up to $100 million of damage to 27 ports, harbors, and marinas throughout the State. The most damage occurred in Crescent City, Santa Cruz and Moss Landing harbors and a federal disaster was declared in Del Norte, Santa Cruz, and Monterey Counties. Both Crescent City and Santa Cruz harbors sustained damage to all docks, and oil spills and water/sediment contamination that resulted from sunk or damaged boats. Because recovery efforts in these two harbors took several years to complete, both harbors incurred business/economic losses that have been difficult to recapture.
- Historical Tsunami Run-Ups in San Diego County

The largest tsunami effect recorded in San Diego since 1950 was May 22, 1960, which had a maximum wave height 2.1 feet (NOAA, 1993). In this event, 80 meters of dock were destroyed and a barge sunk in Quivera Basin.
Other tsunamis felt in San Diego County: 75

- November 5, 1952, with a wave height of 2.3 feet and caused by an earthquake in Kamchatka;
- March 9, 1957, with a wave height of 1.5 feet;
- March 27, 1964 with a wave height of 3.7 feet,
- September 29, 2009 with a wave height of 0.5 feet,
- February 2010 with a wave height of 0.6 meters;
- June, 2011 with wave height of 2 feet.

Potential Impacts of the Hazard:

Tsunamis can travel at speeds of over 600 miles per hour in the open ocean and can grow to over 50 feet in height when they approach a shallow shoreline, potentially causing total devastation to coastal development.

The configuration of the coastline, the shape of the ocean floor, and the characteristics of advancing waves play important roles in the destructiveness of the waves. Bays, sounds, inlets, rivers, streams, offshore canyons, islands, and flood control channels may cause various effects that alter the level of damage. Offshore canyons can focus tsunami wave energy, and islands can filter the energy. It has been estimated that a tsunami wave entering a flood control channel could reach a mile or more inland, especially if it enters at high tide. The orientation of the coastline determines whether the waves strike head-on or are refracted from other parts of the coastline.

SDSU is not at risk to physical impacts from tsunamis. In carrying out its role as an evacuation center, the key potential impact is a depletion or exceedance of campus resources for managing a refugee population during emergency response.

Potential impacts to buildings and infrastructure within the county’s inundation zone include destruction of the natural environment, destruction of boats, as well as other coastal development, and loss of life. Tsunamis that impact both harbors and communities also can produce free-floating debris hazards and environmental contamination from chemical spills.

Probability of Future Occurrence of the Hazard:

The California Seismic Safety Commission report, the Tsunami Threat to California Findings and Recommendations on Tsunami Hazards Risks, published in December 2005, indicates that over 80 tsunamis have been observed or recorded along the coast of

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California in the past 150 years. If we consider historical occurrence as one data set for estimating future events, the average rate of occurrence over the past 150 years is 1 tsunami every 1.9 years. Currently, no analysis is available which differentiates this statewide probability specifically for San Diego County, CA. Although 7 events have been recorded for the county between 1952 and 2021 (1 event every 9.8 years), it is prudent to utilize the 1.9-year statewide recurrence interval for planning purposes given extreme difficulties predicting tsunami points of origin.

The rate of future occurrence may change and may be able to make target estimates for specific locations in the future; the California State Tsunami Program is trying to refine the accuracy of the data. In doing so, the State Tsunami Program is completing a set of Probabilistic Tsunami Hazard Analysis (PTHA) maps representing risk levels from 100-year to 3000-year average return periods. Analysis using these probabilistically based products will allow for a more common platform for comparison to other seismic and flood probabilistic analyses.

Vulnerability to the Hazard:

With regard to CSU campus locations, direct vulnerability of assets and people to tsunami only applies to the CSU Chancellor’s Office in Long Beach, CA, as it is the only campus clearly located in a mapped tsunami zone.

With regard to SDSU, the campus planning committee indicates that no campus assets or people are vulnerable. However, campus staff and students may have reduced access to transportation routes during a tsunami evacuation.

Vulnerability of Populations

For SDSU, the campus population is not directly vulnerable to tsunami.

The populations most vulnerable to the tsunami hazard in San Diego County are the elderly, disabled and very young who reside near beaches, low-lying coastal areas, tidal flats and river deltas that empty into ocean going waters. In the event of a local tsunami generated near the San Diego coast, little warning time would exist, so more of the population would be vulnerable. According to the County’s 2018 Hazard Mitigation Plan, 10,360 residents live within the inundation zone.

Property Vulnerability

For San Diego County, the impact of tsunami waves and the scouring associated with debris that may be carried in the water could be damaging to all structures along beaches, low-lying coastal areas, tidal flats and river deltas. The most vulnerable structures are those in the front line of tsunami impact and those that are structurally unsound.

Critical Facilities and Infrastructure Vulnerabilities

No campus critical facilities or infrastructure are vulnerable to physical impacts from a tsunami wave. However, the following infrastructure is vulnerable to damage in San Diego County, CA:

- **Water Proximate Infrastructure**—Breakwaters and piers collapse, sometimes because of scouring actions that sweep away their foundation material and sometimes because of the sheer impact of the tsunami waves.
- **Flood Control Systems**—Floodwaters can back up drainage systems, causing localized flooding. Culverts can be blocked by debris from tsunami events, also causing localized urban flooding.
- **Utility Systems**—Floodwaters can get into drinking water supplies, causing contamination. Sewer systems can be backed up, causing waste to spill into homes, neighborhoods, rivers and streams. Tsunami waves can knock down power lines and radio/cellular communication towers. Power generation facilities can be severely impacted by wave action and by inundation from floodwater.
- **Fuels**—Destruction of fueling infrastructure and related environmental and potable water contamination can occur.

For more information on vulnerable building types and other property in San Diego County, please see the Estimate of Potential Losses section (below).

Estimate of Potential Losses:

Given that the campus is located outside of the inundation zone, an estimate of potential losses from a tsunami wave impact is not applicable.

For San Diego County, estimated dollar losses to vulnerable buildings and infrastructure lying within the inundation zone is provided (below):

**Summary of Potential Tsunami Exposure/Loss in San Diego:**

- Exposed Population (10,360)
- Number of Residential Buildings (5,357)
- Potential Loss Value of Residential Buildings ($1,507,996,000)
- Number of Commercial Buildings (1,736)
- Potential Loss Value of Commercial Buildings ($607,514,000)
- Number of Critical Facilities (37)
- Potential Loss Value of Critical Facilities ($51,550,000)

Vulnerability Assessment Conclusions:
According to the 2018 State of California Hazard Mitigation Plan, community exposure to tsunamis in California varies considerably—some communities may experience great losses that reflect only a small part of their community and others may experience relatively small losses that devastate them. Among the 94 incorporated communities and 83 unincorporated areas of the 20 coastal counties, the communities that are most vulnerable to injury and life safety issues exist within Del Norte and Humboldt counties while the cities of Alameda, Belvedere, Crescent City, Emeryville, Oakland, and Long Beach have the highest combinations of the number and percentage of people and businesses in tsunami-prone areas.

To improve tsunami vulnerability assessments, FEMA has developed a new tsunami loss estimation module for HAZUS using existing numerical model results for tsunami inundation, flow depth, velocity, and force. This HAZUS module allows new capability for estimation of economic losses, and site-specific analysis of content losses, casualties, infrastructure damage, and evacuation time. The module calibrates losses based on safe zones and community preparedness levels. Such technological improvements in assessment capability can be utilized for tsunami hazard analysis and planning purposes for SDSU.

Along with new probability-based tsunami maps, the HAZUS module will improve the ability to compare tsunami impacts to those of other hazards. Moreover, the probability mapping will be used for numerous applications including identifying potential tsunami hazard “zones of required investigation” under the Seismic Hazards Mapping Act and will assist state and local agencies in making land use planning decisions and will help regional and state planners understand the flood potential from tsunamis representing different risk levels. The improved analysis and data will be utilized by SDSU through its partnerships with key stakeholder organizations.77

Note: To download the Community Exposure to Tsunami Hazards in California report visit the USGS website: http://pubs.usgs.gov/sir/2012/5222/.

Identified Data Limitations:

As identified in the vulnerability conclusions (above), with regard to the current planning effort, the primary data limitations for assessing the tsunami hazard for CSU campuses mostly pertain to a complete set of valuations for the assets of the Chancellor’s Office campus lying within the tsunami inundation zone. In addition, the CSU system-wide effort would benefit from FEMA’s new probability mapping techniques and tsunami loss estimation module to the footprint of those campuses proximate to the inundation zone to ensure that the current “not at risk of direct impact” to staff, students and physical assets still holds true. That said, CSU leadership and planning teams intends to pursue such data in the future.

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**Volcano (Associated Air Quality)**

**Description of the Hazard**

The US Geological Service defines volcanoes as “openings or vents where lava, tephra (small rocks), and steam erupt on to the Earth’s surface. Through a series of cracks within and beneath the volcano, the vent connects to one or more linked storage areas of molten or partially molten rock (magma). This connection to fresh magma allows the volcano to erupt over and over again in the same location.”  

A volcanic eruption occurs when magma, lighter than surrounding rock, is driven upwards by its buoyancy and by pressure from the dissolved gases contained within it. Gases are released from magma as it reaches the surface and pressure decreases. Magma can be erupted in several ways and violent eruptions typically cause tiny pieces of tephra (ash) to be carried away by the wind. This ash is hard, does not dissolve in water, is extremely abrasive and mildly corrosive, and conducts electricity when wet. The gases released in an eruption include carbon dioxide, sulfur dioxide, hydrogen sulfide, and hydrogen halides. Depending on their concentration, these are potentially hazardous to people, animals, agriculture, and property.

**Location of the Hazard**

There are eight volcanic areas located throughout California. Seven of these - Medicine Lake Volcano, Mount Shasta, Lassen Volcanic Center, Clear Lake Volcanic Field, Long Valley Volcanic Region, Coso Volcanic Field, and Salton Buttes – are considered active volcanoes. No portion of San Diego State University (SDSU) or San Diego County is within a volcano hazard zone.

**Extent of the Hazard**

Volcanic hazards are most severe within a few miles of the volcano vent and the severity generally decreases with distance. Ash impact zones can range from tens to hundreds of miles from the vent source. The US Geological Survey has estimated zones surrounding active volcanoes wherein 2 inches or more of ashfall following an eruption is possible. While SDSU does not fall within an estimated ashfall zone, lighter dustings of ash outside of those areas may directly or indirectly impact the campus. As such, the planning committee ranks the extent of the hazard for the campus as **Low**.

**History of the Hazard**

No historical eruption events in California have affected the campus. Over the last 1,000 years, there have been at least 12 eruptions in California. The most recent volcanic

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eruption in California occurred at Lassen Peak about 100 years ago, when a major explosion delivered windborne ash over 275 miles away.

Potential Impacts of the Hazard

The specific impacts vary widely and depend on which type of volcano erupts, the style of explosion, the volume of lava, the eruption duration, and the local water conditions. As SDSU is not proximal to an active volcano, only the potential impacts of ashfall and gases have been detailed. While both these hazards can be widespread, their most severe impacts are generally seen closer to the volcanic source.

Although ashfall is typically a nonlethal volcanic hazard, it is the most widespread and disruptive. Falling ash can damage crops, electronics, and machinery. It can also impact human health by irritating the respiratory tract, eyes, and skin. The particles may enter drinking water and structures and may cause structure failure if it is thick and heavy enough. Even a fine layer of ash can disrupt utilities. A portion of California’s major electric transmission lines, aerial telecommunication lifelines, transportation corridors, and water storage and conveyance lie within the state’s volcano hazard zones. Impacts to any of these can impact operations at SDSU.

The potential impacts of gases released during volcanic eruptions are as follows:

- Carbon dioxide typically becomes diluted very quickly and is not life threatening. However, it can become trapped in higher concentrations in low-lying areas and has the potential to be fatal.
- Sulfur dioxide can cause acid rain and air pollution downwind of a volcano.
- Hydrogen sulfide can cause irritation of the upper respiratory tract. At high concentrations it can cause unconsciousness and death.
- Hydrogen halides can coat ash particles and, once deposited, poison drinking water, agricultural crops, and grazing land.

Probability of Future Occurrence of the Hazard

The US Geological Survey, based on the record of volcanic activity in California, estimates that the probability of another small- to moderate-sized eruption in the next thirty years is about 16 percent. As such, the annual probability of future occurrence for the campus is ranked by the committee as Unlikely.

Vulnerability to the Hazard

Populations living near volcanoes are the most vulnerable to eruptions and lava flows. However, volcanic ash can travel and affect populations miles away. The location and thickness of ash in any given area is a function of the severity of the eruption and wind speed and direction. For SDSU, there is low vulnerability to the immediate impacts of
volcanic eruptions due to the limited area affected and remote potential of an eruption. In the event of a widespread ashfall event, the elderly, infants, and populations with existing respiratory disease will be at higher risk.

**Estimate of Potential Losses**

Impacts to critical infrastructure, agriculture, and property from ashfall have the potential to cause widespread disruption, damage, and economic loss throughout the state. In the event of a widespread ashfall event, impacts will be immediate.

Current modeling is not precise enough to allow for an assessment of potential losses from ashfall to structures or infrastructure on or surrounding the campus.

**Vulnerability Assessment Conclusions**

SDSU is unlikely to experience the direct impacts of a volcanic event. While the campus may be indirectly impacted by ashfall elsewhere in the state, direct ashfall impacts are generally unlikely but possible in a widespread event. However, the likelihood of any volcanic eruption in the state impacting the campus is very low.

**Identified Data Limitations**

Not all active volcanoes in California have been zoned for hazards by the US Geological Survey. This, together with the infrequent occurrence of volcanic explosions and number of factors determining type and extent of impacts, make the quantification of potential loss difficult.

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**Wildfire**

**Description of the Hazard**

While wildfires are a natural part of California’s ecosystem, wildfires in California represent a hazard that presents one of the greatest probabilities of destruction along with a demonstrated history of catastrophic fire events in recent years. The destructive fire seasons of 2017 to 2020 illustrated the destructive forces fire presents to communities across the state. Wildfires may result in the structural loss, infrastructure loss, dangerous air quality, environmental damages, economic impacts, injuries, and loss of life. In many communities throughout California, wildfire presents greatest risk to human life and property.

Wildfires have been defined as any free burning vegetation fire that initiates from an unplanned ignition, whether natural or human caused demanding fire suppression
actions to contain. These fires are prone to become uncontrolled, spreading through vegetative fuels rapidly exposing people and structures to harm. Wildfires present a significant risk to communities across the state, as evidenced by increasing trends of structural losses from wildland fires. This risk is elevated in areas where development and community growth has intersected, also known as the wildland-urban interface (WUI). In the interface setting, development itself can provide additional fuel for large fires. Recent fires have also demonstrated the ability of fire to consume populated areas in extreme conditions.

California’s Mediterranean climate in combination with its geography and vast population create a combination of factors that promotes an optimal environment for large fire growth and consequences. As there is great diversity of geographic characteristics across the state, the risks and potential consequences of wildfire must be assessed locally. The physical location, weather patterns, local fuel types and volume, extent of the WUI, topography, and additional factors will factor differently from part of the state to another. The behavior of wildfires in California is significantly influenced by three distinct geographic factors. These factors will help shape the size, direction of spread, rate of combustion, fire intensity, and ability to pre-heat fuels. The physical factors contributing to wildfire behavior include:

- **Topography** – The rate in which wildfires spread increases with greater slopes in topography. The greater the slope will result in more pre-heating of fuel above the advancing fire. The direction that a slope faces will also influence fire behavior as south facing slopes receive greater solar radiation and thus drier vegetation that is more susceptible to combustion. Ridgetops often denote the end of fire spread as fire has greater difficulty spreading downhill.

- **Weather** – Weather factors substantially in influencing the behavior of wildfires. Wind, temperature, humidity, lightning, and lack of precipitation all contribute to a fire’s ability or inability to spread and intensify. California routinely experiences conditions in which these factors are in alignment to contribute to extreme fire behavior during the summer and fall seasons. High winds, low humidity, and high temperatures provide an environment promoting extreme fire activity.

- **Fuels** – Certain types of vegetation are increasingly prone to igniting and promote more intense burning. Areas with greater “fuel loading” (amount of fuel present in terms of weight of fuel per unit of area) increases the amount of fuel to fuel a fire. Greater volumes of dead or dry vegetation compared to live plants is a critical factor. Vegetation during drought conditions will experience decrease in moisture content increasing the conditions for combustion. Fuels close proximity to one another allows for rapid spread through contact or radiant exposures.

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80 *State of California Hazard Mitigation Plan, September 2018*
A risk assessment for wildfires should be implemented within a geospatial context focusing on the specific location features and incorporates the three components of the wildfire risk triangle – likelihood, intensity, and susceptibility.

Location of the Hazard

Substantial portions of the State of California are exceptionally vulnerable to wildfire activity or reside in a wildland-urban interface (WUI) area due to the vast open spaces, rangelands, forests, and other lands with high susceptibility to fire occurring throughout the state. San Diego State University (SDSU) is located on a set of bluffs overlooking Mission Valley, the San Diego River, and Alvarado Creek. Areas considered to be within Fire Hazard Severity Zones defined by the Fire and Resource Assessment Program (FRAP) within the California Department of Forestry and Fire Protection (CalFire) occur to the west and north of the campus. Additionally, these fire hazard zones exist in other areas throughout San Diego County. These areas of higher fire hazards occurring near the campus are primarily located in the numerous creek channels leading to the San Diego River channel. Each of these hazard zones include light to moderate vegetation and are bordered by dense residential development.

The San Diego State University campus is located in the central portion of the City of San Diego. The area immediately to the south and east of the campus is predominately commercial and residential. The areas to the west and north include open hillsides and valleys combined with residential land uses. Fire Hazard Severity Zones are found on the western portions of the campus and throughout the hillsides surrounding the campus to include Very High Fire Hazard Severity Zones (VHFHSZ).

Figure 20-16: Fire Hazard Severity Zones near San Diego State University81

San Diego County has multiple areas considered as fire hazard zones that present direct threats of burning potential in areas that are in proximity to those hazard areas. Additionally, these large areas of land that are considered to be hazardous for the potential for fire will also produce the threat of diminished or hazardous air quality due to the smoke and particulates produced in the burning process. The air quality for residents of the County and the San Diego State University campus community can be greatly affected by large fires burning in these areas.

Fire Hazards Zones surrounding San Diego County demonstrate the broader community threat that wildfires present to the population. Fire hazard severity zones are found surrounding the populated areas of the county. This presents the potential for fire related damages and smoke inundation to occur in many areas that members of the campus community reside at, are employed in, or where they recreate. Transportation routes are equally impacted causing potential added challenges for the campus community to get to areas if safety, get resources, or gain access to the campus.
Extent of the Hazard

While the threat to fire directly affecting the campus is considerable, the direct effect of fire generated smoke is also likely to occur. Fires are likely to occur in close proximity to the campus generating smoke that could envelop the campus in the right atmospheric conditions. Fires that are large enough to generate volumes of smoke to cover great distances have the potential to affect the air quality of San Diego County, including the campus. This will especially be the case in weather conditions creating strong offshore winds. The potential for this impact has been demonstrated during the summers of 2018, 2019, and 2020 as fires burned across the state and spread smoke over vast distances. Fires burning well outside of the San Diego County region have the potential to distribute smoke onto the SDSU campus.

Given that the area immediately surrounding the SDSU campus is in proximity to fire hazard zones designated as High Fire Hazard Severity Zones (HFHSZ), and that the

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County and surrounding hillsides are considered to be of high fire threat including Very High Fire Hazard Severity Zones (VHFHSZ), the planning committee ranks the extent of the wildfire hazard for the campus as High.

Moreover, as a large number of wildfires are ignited due to human caused factors, the ability to determine when or where a wildfire might occur is impossible. Only the conditions for a wildfire can be predicted with any accuracy.

The National Fire Danger Rating System (NFDRS) is the current system in use for rating and classifying the potential danger of fire. The NFDRS tracks the effects of previous weather events on both dead and live fuel loads and adjusts accordingly based on future or predicted weather conditions. These complex relationships and equations are computed, and the outputs are expressed in terms that users can quickly and easily understand. The current NFDRS is used by all federal and most state agencies to assess fire danger conditions.

The following table depicts the NFDRS, from the US Forest Service’s Wildland Fire Assessment System.

Table 20-26: National Fire Danger Rating System

<table>
<thead>
<tr>
<th>Rating</th>
<th>Basic Description</th>
<th>Detailed Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>CLASS 1: Low Danger (L) COLOR CODE: Green</td>
<td>Fires not easily started</td>
<td>Fuels do not ignite readily from small firebrands. Fires in open or cured grassland may burn freely a few hours after rain, but wood fires spread slowly by creeping or smoldering and burn in irregular fingers. There is little danger of spotting.</td>
</tr>
<tr>
<td>CLASS 2: Moderate Danger (M) COLOR CODE: Blue</td>
<td>Fires start easily and spread at a moderate rate</td>
<td>Fires can start from most accidental causes. Fires in open cured grassland will burn briskly and spread rapidly on windy days. Woods fires spread slowly to moderately fast. The average fire is of moderate intensity, although heavy concentrations of fuel – especially draped fuel – may burn hot. Short-distance spotting may occur but is not persistent. Fires are not likely to become serious and control is relatively easy.</td>
</tr>
</tbody>
</table>

### CLASS 3: High Danger (H)
**COLOR CODE:** Yellow

Fires start easily and spread at a rapid rate. All fine dead fuels ignite readily, and fires start easily from most causes. Unattended brush and campfires are likely to escape. Fires spread rapidly and short-distance spotting is common. High intensity burning may develop on slopes or in concentrations of fine fuel. Fires may become serious and their control difficult, unless they are hit hard and fast while small.

### CLASS 4: Very High Danger (VH)
**COLOR CODE:** Orange

Fires start very easily and spread at a very fast rate. Fires start easily from all causes and immediately after ignition, spread rapidly and increase quickly in intensity. Spot fires are a constant danger. Fires burning in light fuels may quickly develop high-intensity characteristics - such as long-distance spotting - and fire whirlwinds when they burn into heavier fuels. Direct attack at the head of such fires is rarely possible after they have been burning more than a few minutes.

### CLASS 5: Extreme (E)
**COLOR CODE:** Red

Fire situation is explosive and can result in extensive property damage. Fires under extreme conditions start quickly, spread furiously, and burn intensely. All fires are potentially serious. Development into high intensity burning will usually be faster and occur from smaller fires than in the Very High Danger class (4). Direct attack is rarely possible and may be dangerous, except immediately after ignition. Fires that develop headway in heavy slash or in conifer stands may be unmanageable while the extreme burning condition lasts. Under these conditions, the only effective and safe control action is on the flanks, until the weather changes or the fuel supply lessens.

Due to the impacts of wildfires on public health, agencies across the nation have adopted the use of the Air Quality Index (AQI) to communicate and provide a consistent approach to air quality measurements and categorization. The AQI primarily focuses on the health effects caused by pollutants in the air such as smoke. The goal of the AQI is to provide advisories to assist the public in determining when to reduce exposures to inhalation of air pollution as pollution levels rise.
Figure 20-17: Air Quality Index for Ozone and Particulate Pollution

<table>
<thead>
<tr>
<th>Daily AQI Color</th>
<th>Levels of Concern</th>
<th>Values of Index</th>
<th>Description of Air Quality</th>
</tr>
</thead>
<tbody>
<tr>
<td>Green</td>
<td>Good</td>
<td>0 to 50</td>
<td>Air quality is satisfactory, and air pollution poses little or no risk.</td>
</tr>
<tr>
<td>Yellow</td>
<td>Moderate</td>
<td>51 to 100</td>
<td>Air quality is acceptable. However, there may be a risk for some people, particularly those who are unusually sensitive to air pollution.</td>
</tr>
<tr>
<td>Orange</td>
<td>Unhealthy for Sensitive Groups</td>
<td>101 to 150</td>
<td>Members of sensitive groups may experience health effects. The general public is less likely to be affected.</td>
</tr>
<tr>
<td>Red</td>
<td>Unhealthy</td>
<td>151 to 200</td>
<td>Some members of the general public may experience health effects; members of sensitive groups may experience more serious health effects.</td>
</tr>
<tr>
<td>Purple</td>
<td>Very Unhealthy</td>
<td>201 to 300</td>
<td>Health alert: The risk of health effects is increased for everyone.</td>
</tr>
<tr>
<td>Maroon</td>
<td>Hazardous</td>
<td>301 and higher</td>
<td>Health warning of emergency conditions: everyone is more likely to be affected.</td>
</tr>
</tbody>
</table>

History of the Hazard

The State of California has a long history of chronic and destructive wildfires throughout the state. On average, 8,300 wildfires have caused burnt 928,245 acres across the state over the 20-year period between 2000 and 2020. San Diego County also has a long history of wildfire activity primarily in the foothills and mountains. Wildfires occurring in the San Diego County have resulted in hundreds of thousands of acres burned and hundreds of millions of dollars in damages.

The area immediately surrounding the San Diego State University campus is in proximity to fire hazard zones designated as a High Fire Hazard Severity Zones. The campus does not have a history of wildfire activity occurring within direct proximity to the campus. However, the County is surrounded by areas that are considered to be of high fire threat that would produce vast quantities of smoke and particulates into the air. The San Diego campus has experienced days of poor air quality due to fires burning in parts of the county, although infrequent.


85 California Department of Forestry and Fire Protection, Stats and Events, https://www.fire.ca.gov/stats-events/
Table 20-27: Historic Large-Scale Fires Near San Diego State University

<table>
<thead>
<tr>
<th>Date</th>
<th>Fire</th>
<th>Location</th>
<th>Declaration</th>
<th>Damages</th>
</tr>
</thead>
<tbody>
<tr>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
</tr>
</tbody>
</table>

Potential Impacts of the Hazard

The location of the San Diego State University campus on a hillside near areas designated as High Fire Hazard Severity Zones places a threat that flame, ember, and smoke exposure from wildfire to the campus. There is potential for fire to occur from the west or north of the campus. The surrounding hillsides and valleys are composed of light to moderate fuels. Although the campus itself does not have a history of wildfire activity, the fire threat to campus structures from these neighboring hillsides and valleys is significant.

Potential impacts to the campus community resulting from wildfires include:

- Injuries or loss of life
- Campus property destruction or damage
- Residential property destruction or damage
- Commercial property destruction or damage
- Loss of property contents
- Infrastructure damage
- Threat or damage to on campus child care facilities
- Threatened structures on the north side of campus including Chapultepec Residence Hall, Huaxyacac Residence Hall, Metepec Residence Hall, Zapotec Residence Hall, Toltec Residence Hall, Mixquic Residence Hall, Zacatepec Residence Hall, Huaxtepec Residence Hall, Tarastec Residence Hall, International Student Center, Central Receiving, and the Villa Alvarado Residence Halls.
- Substantial on-campus student resident population reside within fire hazard zone requiring evacuation in fire events
- Damaged or destroyed lifelines/supply routes
- Damaged or destroyed utilities, on campus power generation
- Damaged or destroyed critical facilities supporting campus emergency support needs

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86 San Diego County Multi-Jurisdictional Hazard Mitigation Plan, October 2017
- Loss of community economic base
- Employment losses
- Loss to ground supporting vegetation on hillsides resulting in erosion or landslides in future precipitation events
- Environmental damage
- Societal and community impacts
- Damage to organizations and facilities providing support services to vulnerable populations
- Greater evacuation challenges for those most vulnerable
- Psychological impacts of impacted populations
- Disruptions to education delivery to community

Potential impacts resulting from wildfire generated smoke include:
- Dangerous levels of air pollution
- Human Health Effects
  - Similar health impacts on pets
- Air conditioning systems overwhelmed
- Greater demands on air filtration systems
- Greater demands on healthcare systems
- Reduced outdoor work productivity
- Closures of academic sessions

Additionally, there remains a number of secondary impacts from wildfires that could affect the campus community. Utilities feeding areas of San Diego County including the campus may be damaged resulting in power outages. Fire related damage in the watersheds will likely cause future landslides, degradation to plants supporting hillsides, and impact the hydroelectric power capabilities. Fires may present threats to areas of recreation, scenic value, and wildlife that are a part of the culture of the campus community. Finally, the campus may experience effects of evacuated individuals arriving on campus from other areas as a location of refuge.

**Probability of Future Occurrence of the Hazard**

Based on the wildfire threat potential in the area surrounding the San Diego State University campus and canyons along the north side of the campus, including the immediate proximity to Local Fire Hazard Severity Zones listed as “Very High”, the
density of residential and commercial development, and the historic occurrences of fires, the probability of wildfire related damage is considered Possible.

Based on the wildfire threat potential in the area surrounding Southern California including the hills and mountains throughout the region, the volume of areas in elevated Fire Hazard Severity Zones throughout the southern portions of the state, and the historic occurrences of smoke, the probability of wildfire generated smoke impacts to air quality is considered Possible.

Vulnerability to the Hazard

The San Diego State University campus is subject to direct impact from wildfire due to the campus location within a wildland-urban interface zone. The campus is identified to reside near a designated local Very High Fire Hazard Severity Zone. The campus is adjacent to hillsides and open lands containing combustible vegetation combined with residential development. Additionally, vulnerabilities to the effects of wildfire would lie within the campus community who may reside or work in locations that are exposed to the Fire Hazard Severity Zones in other parts of the surrounding region. Wildfires occurring in other areas of the region may result in the displacement of large numbers of people. These effects may spill onto the campus in the form of evacuees or facility support to emergency resources.

Fire directly threatening the campus would likely take the form of vegetation fires along the hillsides to the north and west of campus and extending onto the campus or localized fires involving single structures or small areas. Smaller vegetation fires are possible surrounding the campus in the urban forest or fields surrounding the city. These incidents would likely have significant impact to the campus.

The primary basis of vulnerability is based on the population affected and the built environment exposed. In general, newer construction will be more fire resistant than older buildings as building and fire codes and construction technology have improved. Density of buildings and proximity of fuels to buildings or equipment at risk of combustion would additionally influence the fire’s ability to spread to structures. Structures with vegetation and other combustibles near the structure increases the ability of fire to spread to buildings.

Additional concerns regarding vulnerabilities to wildfire are related to the smoke that fires in the area would produce. The recent summer seasons have clearly demonstrated the reality of large wildfires producing enough smoke to fill urban areas even from substantial distances away. These recent fires have displayed how the effects of this smoke impact the general population and especially vulnerable populations. San Diego State University students, faculty, and staff both on campus and off campus face these same vulnerabilities related to smoke filled air.

Smoke generated from large wildfires pose a threat in terms of diminished air quality that would be exposed to the population within the area of smoke distribution. Individuals with existing health problems such as respiratory or cardiac illnesses are increasingly vulnerable to wildfire generated smoke. Staff who work in roles requiring outdoor activity
will be increasingly exposed during days where the air quality index is considered unhealthy or worse. Student athletes participating in outdoor sports and engaging in aerobic activities are increasingly vulnerable to the effects of wildfire.

The vulnerability to members of the campus community in which wildfire generated smoke on the San Diego State University campus will vary depending on when the air quality was to reach unhealthy levels. The risk to the campus population will be lessened during periods when classes are not in session or during periods of breaks. Conversely, during the days and hours that classes are in session and staff are at their workplaces, the human vulnerability increases. However, in region-wide events this vulnerability may be shared with the homes and workplaces of members of the campus community and their families.

Vulnerable populations will likely face disproportionate health safety issues from smoke filled air, experience increased stresses, may require the need to remain away from the campus enclosed at home, and may find difficulty in accessing equipment or supplies to aid in a specific need.

**Estimate of Potential Losses**

Estimates of potential losses will be influenced by a variety of factors. Costs would also be likely to include mitigation or repairs of HVAC systems, sealing of doors and windows, and other methods of keeping smoke from entering buildings. Secondary costs would include lost academic days during campus closures, lost staff on campus productivity, and health and medical interventions for affected members of the campus community.

Based on estimate replacement costs of facilities and structures on campus, the maximum total replacement costs due to wildfire are $726,584,983. However due to the lack of a complete inventory of building and facility costs, the total replacement estimate is likely much higher.

Table 20-28: Wildfire Hazard Potential (WHP) Zone Estimated Losses

<table>
<thead>
<tr>
<th>WHP Zone</th>
<th>No of Buildings</th>
<th>Maximum Replacement Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Extreme</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Very High</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>High</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Moderate</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Low</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Very Low</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Non-Burnable</td>
<td>147</td>
<td>$726,584,983</td>
</tr>
</tbody>
</table>

| No Building Value Data Provided* | 68 | Unknown |

*Buildings with no value defined are also included in the respective Zones they are found in.
The table above includes 14 facilities located at the Calexico based San Diego State University, Imperial Valley campus. The provided cost estimates for the Imperial Valley campus includes $18,144,214. However, 12 facilities do not have costs included.

Vulnerability Assessment Conclusions

The occurrence of wildfires has been a frequent event in San Diego County, including wildfire incidents that have threatened or caused secondary impacts to the San Diego State University campus. The location of the San Diego State University campus surrounded by densely developed residential, commercial, and industrial land uses mitigates any vulnerabilities of wildfire hazards to the campus community or facilities. The placement at the top of a bluff overlooking the San Diego River Valley exposes vulnerabilities to fire that may ignite along the hillside. The foothills and mountains surrounding San Diego County host environments that are ideal for the development of wildfire activity. The consequences of fires in these areas would present primary and secondary consequences to the San Diego State University campus and expose vulnerabilities on the campus and to the campus community.

The topography of the valleys surrounded by mountains allows for smoke filled air to linger in the valleys of the San Diego area with the potential for unhealthy air quality depending on wind conditions. Fires in the watersheds of the San Diego area mountains and tributaries may damage vegetation stabilizing hillsides and result in increased sediments to be discharged into the river system and reservoirs reducing their capacity and effectiveness. Communities located within or near the Wildland Urban Interface may be subject to damaging fires. These same communities may be home to members of the campus community. The potential for large-scale wildfires in the region further generates the added potential for a number of cascading effects such as disruptions to the local economy, utility failures, disruptions to providing for the needs of the community, and development of public health hazards. The potential for large-scale wildfires and resulting damage of homes and businesses has exponentially powerful impacts on particular populations among the campus community including those with access or functional needs, international students, the homeless, and students residing in the residence halls.

Identified Data Limitations

Data limitations include missing campus structural replacement costs, and lack of both a complete inventory of building construction types and mitigation efforts to lessen the impact due to fire activity. HAZUS generated analysis is focused on the broader community level versus fine-tuning the analysis to the micro-level for facilities such as a university campus.

**Severe Weather (Wind, Tornado, Hail, Lightning)**

Description of the Hazard
Severe weather can be described as a variety of weather or climate events that are beyond or near the ends of the range of observed weather patterns and behavior. These events can include high or extreme winds, storms, lightning, hail, tornadoes, heat waves, unusually cold temperatures, extreme rainfall, and flooding. According to the Intergovernmental Panel on Climate Change (IPCC), to be classified as severe (or extreme), the occurrence of each value of a climate or weather variable (e.g., wind, hail, lightning, tornado, etc.) must be “above (or below) a threshold value near the upper (or lower) ends of the range of observed values of the variable.”

Severe weather in California can be generated by local, regional, and/or global weather and climate influences. From the individual thunderstorm to the Santa Ana wind event to the strong El Niño, damaging weather elements that are produced by and accompany severe weather and climate phenomena (e.g., damaging winds, hail, lightning, and tornadoes) occur throughout California and the California State University (CSU) system.

**Global Scale Influences on Severe Weather in California: El Niño, La Niña, and ENSO**

The El Niño-Southern Oscillation (ENSO) is a recurring climate pattern involving changes in the temperature of waters in the central and eastern tropical Pacific Ocean. On periods ranging from about three (3) to seven (7) years, the surface waters across a large swath of the tropical Pacific Ocean warm or cool by anywhere from 1°C to 3°C, compared to normal. This oscillating warming and cooling pattern, referred to as the ENSO cycle, directly affects rainfall distribution in the tropics and can have a strong influence on weather across the United States and other parts of the world.

El Niño and La Niña are extreme phases of the ENSO cycle, with a third phase occurring between them called the Neutral phase. The El Niño phase is characterized by unusually warm ocean temperatures and weaker-than-normal east winds in the Equatorial Pacific, while the La Niña phase is characterized by unusually cold ocean temperatures and stronger-than-normal east winds in the Equatorial Pacific. Both extreme ENSO phases

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89 Retrieved on 07.18.2021 from https://www.weather.gov/mhx/ensowhat

lead to significant differences from the average ocean temperatures, winds, surface pressure, and rainfall across parts of the tropical Pacific. The Neutral phase indicates that conditions are near their long-term average.91

The extreme ENSO phases affect the frequency and intensity of weather events across the world, including in California.92 On average, areas across California experience exceptionally stormy winters with increased precipitation under El Niño conditions, but experience less stormy and drier winters under La Niña conditions.93 This variability in storminess and precipitation brought on by El Niño and La Niña events affects the both the frequency and intensity of severe weather conditions experienced by all CSU campuses, including San Diego State University.

Regional Climate Influences on Severe Weather across California

Most of the weather in California is influenced by the wet-winter/dry-summer Mediterranean climate pattern. In the summer months, Pacific storm tracks are deflected north due to the position of the Pacific High (i.e., a large-scale atmospheric circulation over the Northeast Pacific Ocean), preventing Pacific storms from reaching California. As a result, most summer storms are generated due to the incursion of moist air from the Gulf of Mexico or the Gulf of California, and occur as scattered, locally heavy showers in the desert and mountain regions of the state. In the winter months, the Pacific High decreases in intensity and moves south, permitting powerful Pacific storms to move into and across the state; these storms can produce extreme winds, heavy rains (including “atmospheric river” events), and widespread coastal and inland flooding. (Please see the Flood Hazard profile in this document for information on Floods.) As a result, storm events accompanied by precipitation in California are far more frequent in the winter months than they are in the summer months.94

While the Mediterranean climate pattern influences the seasonal frequency, intensity, geographic spread, and type of some severe weather events CSU campuses experience (including San Diego State), other severe weather phenomena may occur in California at any time of the year. For example, near the coast and over the Central Valley, there appears to be no defined seasonality to thunderstorms, and these storms are usually light and infrequent. Thunderstorms are more intense and more frequent in the intermediate

91 Retrieved on 07.17.2021 from https://www.climate.gov/news-features/understanding-climate/el-ni%C3%B1o-and-la-ni%C3%B1a-frequently-asked-questions
92 Retrieved on 07.16.2021 from https://www.pmel.noaa.gov/elnino/what-is-el-nino
94 Retrieved on 07.17.2021 from https://wrcc.dri.edu/Climate/narrative_ca.php
and higher elevations of the Sierra Nevada, and occur with greater frequency during the summer months.95

Types of Storms in California

The 2018 California State Hazard Mitigation Plan (SHMP) defines a storm as a violent atmospheric disturbance occurring over land and/or water that is distinguished by its strength, characteristics, and the scale of the resulting damage.96 The SHMP also lists the following types of storms that produce hazardous conditions and potential damage throughout the state of California.97 These storms affect (in varying degrees) all CSU campuses, including San Diego State.

- **Thunderstorm**: A rain-bearing cloud that also produces lightning. Thunderstorms can produce some of nature’s most destructive and deadly weather including tornadoes, hail, strong winds, lightning and flooding.98 Thunderstorms are caused by an atmospheric imbalance from warm unstable air rising rapidly into the atmosphere. Lightning, which occurs during all thunderstorms, can strike anywhere.99 Thunderstorms can produce some of nature’s most destructive and deadly weather including tornadoes, hail, strong winds, lightning and flooding.100 **Severe thunderstorms** are more intense, violent, and dangerous thunderstorms. The National Oceanic and Atmospheric Administration (NOAA) defines a severe thunderstorm as any storm that produces one or more of the following elements: Damaging winds or speeds of 58 mph (50 knots) or greater, hail 1 inch in diameter or larger, and/or a tornado.101 102

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95 Retrieved on 07.17.2021 from https://wrcc.dri.edu/Climate/narrative_ca.php


101 Retrieved on 07.15.2021 from https://www.noaa.gov/explainers/severe-storms

102 Retrieved on 07.15.2021 from https://www.weather.gov/safety/thunderstorm
- **Hailstorm**: a type of storm that precipitates round chunks of ice. Hailstorms usually occur during regular thunderstorms.\(^{103}\)

- **Wind storm**: marked by high wind with little or no precipitation.\(^{104}\)

- **Winter storm**: A storm that can produce a combination of freezing rain, sleet, heavy snow, and/or strong winds.\(^{105}\)

- **Coastal storm**: large wind-driven waves and/or storm surge that strike the coastal zone.\(^{106}\)

- **Ice storm**: Ice storms are one of the most dangerous forms of winter storms. When surface temperatures are below freezing, but a thick layer of above-freezing air remains aloft, rain can fall into the freezing layer and freeze upon impact into a glaze of ice. In general, 8 millimeters (0.31 inch) of accumulation is all that is required, especially in combination with breezy conditions, to start downing power lines as well as tree limbs. Ice storms also make unheated road surfaces too slick to drive on. Ice storms can vary in time range from hours to days and can cripple small towns and large urban centers alike.\(^{107}\)

- **Snowstorm**: A heavy fall of snow accumulating at a rate of more than 5 centimeters (2 inches) per hour that lasts several hours. Snowstorms, especially ones with a high liquid equivalent and breezy conditions, can down tree limbs, cut off power, and paralyze travel over a large region.\(^{108}\)

### Severe Weather Hazard Elements: Wind Hazards, Hail, and Lightning


This hazard profile concentrates on the following types of severe weather hazards: wind hazards (including tornadoes), hail, and lightning. These hazards are produced by a variety of weather phenomena, including thunderstorms, coastal storms, winter storms, and topographically-enhanced downslope winds. While storm and downslope wind hazards are responsible for severe weather events across the CSU system, only the wind, tornado, hail, and lightning elements generated by these hazards are covered in this profile. (Storm-related hazards such as flooding and extreme temperatures are covered in other sections of this document.)

**Wind Hazards**

**Wind** is the horizontal movement of air past any given point. Wind begins with differences in air pressures; pressure that is higher at one point than another sets up a force, pushing the high towards the low pressure.\(^{109}\) Wind gusts are defined as “rapid fluctuations in the wind speed with a variation of 10 knots or more between peaks and lulls.”\(^{110}\)

Wind hazards in California take several forms: High Wind, Strong Winds, Thunderstorm Winds, Mountain-Valley (Downslope) Winds, and Tornadoes. These hazards are encountered across California, and have the potential to cause harm to or loss of life and/or property throughout California and the CSU system (including San Diego State).

**High Winds, Strong Winds, and Thunderstorm Winds**

The National Weather Service reports three (3) types of wind events that occur areas over land: High Winds, Strong Winds, and Thunderstorm Winds. Collectively, these reports are used to determine the frequency with which wind hazard events have affected areas across the U.S., including California.

**High Winds**

High winds are defined as sustained non-convective winds of 35 knots (40 mph) or greater lasting for 1 hour or longer, or gusts of 50 knots (58 mph) or greater for any duration (or otherwise locally/regionally defined). In some mountainous areas, the above numerical values are 43 knots (50 mph) and 65 knots (75 mph), respectively.\(^{111}\)

**Strong Winds**

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Strong winds are defined as non-convective winds gusting less than 50 knots (58 mph), or sustained winds less than 35 knots (40 mph), resulting in a fatality, injury, or damage.\textsuperscript{112}

\textbf{Thunderstorm Winds}

Thunderstorm winds are winds that arise from thunderstorm convection (occurring within 30 minutes of lightning being observed or detected), with speeds of at least 50 knots (58 mph). They can also be winds of any speed (non-severe thunderstorm winds below 50 knots (58 mph)) producing a fatality, injury, or damage.\textsuperscript{113}

Please note: \textbf{Straight-line wind} is a term used to define any thunderstorm wind that is not associated with rotation. It is used mainly to differentiate from the rotational winds found in tornado-producing storms.\textsuperscript{114} However, it is not a term used in the NCEI Storm Events Database, and therefore cannot be used to determine severe weather history of or potential impacts to CSU campuses.

\textbf{Tornadoes}

A tornado is an extreme severe weather wind hazard. A tornado is a rapidly rotating column of air extending from a thunderstorm to the surface of the Earth.\textsuperscript{115} This column extends between cloud and the Earth’s surface. The damage from tornadoes comes from the strong winds they contain and the flying debris they create. It is generally believed that rotational wind speeds can be as high as 300 mph in the most violent tornadoes.\textsuperscript{116} On a local scale, tornadoes are the most violent and most destructive of all atmospheric phenomena.\textsuperscript{117}

\textbf{Mountain-Valley (Downslope) Wind Systems: Santa Ana, Diablo, and Sundowner Winds.}

\textbf{Santa Ana Winds.} A type of wind hazard that is peculiar to Southern California is called a \textit{Santa Ana Wind}. Santa Ana winds are strong, topographically-enhanced, extremely dry downslope winds that originate inland and affect coastal southern California and northern Baja California (Mexico).\textsuperscript{118} They occur when air from a region of high pressure over the dry, desert region of the southwestern U.S. flows westward towards low pressure located

\textsuperscript{112} Retrieved on 07.17.2021 from https://www.nws.noaa.gov/directives/sym/pd01016005curr.pdf


\textsuperscript{114} Retrieved on 07.15.2021 from https://www.nssl.noaa.gov/education/svrwx101/wind/types/

\textsuperscript{115} Retrieved on 07.15.2021 from https://www.earthnetworks.com/tornado/

\textsuperscript{116} Retrieved on 07.15.2021 from https://www.nssl.noaa.gov/education/svrwx101/tornadoes/faq/

\textsuperscript{117} Retrieved on 07.15.2021 from https://www.weather.gov/bgm/severedefinitions

off the California coast. This creates dry winds that flow east to west through the mountain passages in Southern California. These winds have a strong seasonal component; they are most common during the cooler months of the year, occurring from September through May. Santa Ana winds typically feel warm (or even hot) because as the cool desert air moves down the side of the mountain, it is compressed, which causes the temperature of the air to rise. If strong enough, Santa Ana winds can cause major property damage, and may present difficulties for airborne and seagoing transportation. They also may increase wildfire risk because of the dryness of the winds and the speed at which they can spread a flame across the landscape.\(^{119}\) (Note: The Wildfire hazard is profiled elsewhere in this document.)

Figure below illustrates the mechanisms involved in the generation of Santa Ana winds across Southern California.

Figure 20-18: What Drives a Santa Ana Wind?\(^{120}\)

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\(^{120}\) Retrieved on 07.14.2021 from https://twitter.com/nwslosangeles/status/933049473034579968
**Diablo Winds.** The Diablo wind is another type of topographically-enhanced downslope wind phenomenon that occurs in the North-Central areas of California. Diablo winds are offshore wind events that flow northeasterly over Northern California’s Coast Ranges, often creating high wind speeds downwind of major canyons and over ridges, and extreme fire danger for the San Francisco Bay Area. Diablo winds are driven by a surface pressure gradient that forms in response to an inverted pressure trough that develops over California.121

**Sundowner Winds.** Sundowner winds are significant and potentially damaging downslope wind and warming events that periodically occur along a short segment of the southern California coast in the vicinity of Santa Barbara, CA. The unique topography of this coastal region promotes the development of Sundowner wind events: over a length of about 100 km, the coastline is oriented approximately west–east, with the adjoining narrow coastal plain bounded by a steeply rising (to elevations greater than 1200 m) and coast-parallel mountain range. Called Sundowner winds because they often begin in the late afternoon or early evening, their onset is typically associated with a rapid rise in temperature and decrease in relative humidity, and the winds tend to blow from the north from the Santa Ynez Mountains to the coast of Santa Barbara County, California. During the more intense Sundowner wind events, wind speeds can be of gale force 39-54 miles per hour) or higher, and can even reach hurricane force (≥ 74 miles per hour) in the most extreme cases. Temperatures over the coastal plain, and even at the coast itself, can rise significantly above 37.8°C (100°F). Seasonally, Sundowner winds peak in March, April, and May, with a minimum during summer and a secondary peak in winter that often corresponds with Santa Ana winds. In addition to causing a dramatic change from the more typical marine-influenced local weather conditions, Sundowner wind episodes have produced significant wind-related property and agricultural damage, as well as conditions of extreme fire danger.122 123 124

**Hail**

Hail is a form of precipitation consisting of solid ice that forms inside thunderstorm updrafts.125 It is roughly round in shape and at least 0.2’ in diameter. Hail develops in the upper atmosphere as ice crystals that are bounced about by high velocity updraft winds;

the ice crystals accumulate frozen droplets and fall after developing enough weight. The size of hailstones varies and is a direct consequence of the severity and size of the storm that produces them – the higher the temperatures at the Earth’s surface, the greater the strength of the updrafts and the amount of time hailstones are suspended, and therefore the greater the size of the hailstone.\textsuperscript{126}

\textbf{Lightning}

Lightning is an electrical discharge produced by a thunderstorm. Lightning rapidly heats the air in its immediate vicinity to about 50,000°F - about five times the temperature of the surface of the sun. This compresses the surrounding air and creates a supersonic shock wave, which decays to an acoustic wave that is heard as thunder.\textsuperscript{127}

The discharge may occur within or between clouds, between the cloud and air, between a cloud and the ground, or between the ground and a cloud.\textsuperscript{128} Lightning that is produced from thunderstorms in which precipitation evaporates before reaching the ground is called “dry lightning.”

\textbf{Location of the Hazard}

Severe weather is a non-spatial hazard, and can occur anywhere in the CSU system, including either at the San Diego State University main campus or at satellite campus facilities owned by the school. No one area of the campus – or of the surrounding community – is subject to experiencing severe weather more than any other area.

There is geographic variability among the different types of mountain and valley wind events (as a sub-category of the severe weather hazard). Santa Ana winds occur in Southern California, Diablo winds occur in North-Central California, and Sundowner winds occur almost exclusively in Santa Barbara County, California.

\textbf{Extent of the Hazard}

Severe weather hazards are non-spatial hazards that potentially affect all San Diego State campus areas equally. However, the smallest geographic unit of measurement for almost all official severe weather event data is at the county level. Because the severe weather data used do not exist at the campus level, it is assumed that the same (or similar) severe weather risks to San Diego State campuses reflect those of the surrounding community and County. As a result, all assets and people at San Diego State campuses are at risk from the effects of severe weather and can expect to experience at least some (or the complete range of) endemic severe weather hazards. In consideration of the campus’ design, layout, and operations, the severe weather history and degree of severity in the San Diego (San Diego County), Brawley (Imperial County), and Calexico (Imperial County)

areas, as well as the history and degree of severity of each severe weather sub-type identified by the extent scales (below), the campus planning committee ranks the overall extent of the Severe Weather hazard as **MODERATE**. See each sub-hazard below for the planning committee’s sub-type extent ranking.

**Wind Hazard: Non-Rotational**

The Beaufort Scale is an empirical measure that relates wind speed to observed conditions at sea or on land. Its full name is the Beaufort wind force scale.\(^{129}\) First developed in 1805, it is still used today to estimate wind strengths.\(^{130}\)

Table 20-29: Beaufort Wind Force Scale\(^{131}\)

<table>
<thead>
<tr>
<th>Force</th>
<th>Speed (mph)</th>
<th>Speed (knots)</th>
<th>Description</th>
<th>Specifications for use at sea</th>
<th>Specifications for use on land</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0-1</td>
<td>0-1</td>
<td>Calm</td>
<td>Sea like a mirror.</td>
<td>Calm; smoke rises vertically.</td>
</tr>
<tr>
<td>1</td>
<td>1-3</td>
<td>1-3</td>
<td>Light Air</td>
<td>Ripples with the appearance of scales are formed, but without foam crests.</td>
<td>Direction of wind shown by smoke drift, but not by wind vanes.</td>
</tr>
<tr>
<td>2</td>
<td>4-7</td>
<td>4-6</td>
<td>Light Breeze</td>
<td>Small wavelets, still short, but more pronounced. Crests have a glassy appearance and do not break.</td>
<td>Wind felt on face; leaves rustle; ordinary vanes moved by wind.</td>
</tr>
<tr>
<td>3</td>
<td>8-12</td>
<td>7-10</td>
<td>Gentle Breeze</td>
<td>Large wavelets. Crests begin to break. Foam of glassy appearance. Perhaps scattered white horses.</td>
<td>Leaves and small twigs in constant motion; wind extends light flag.</td>
</tr>
<tr>
<td>4</td>
<td>13-18</td>
<td>11-16</td>
<td>Moderate Breeze</td>
<td>Small waves, becoming larger; fairly frequent white horses.</td>
<td></td>
</tr>
</tbody>
</table>

\(^{129}\) Retrieved on 07.15.2021 from https://www.rmets.org/resource/beaufort-scale

\(^{130}\) Retrieved on 07.15.2021 from https://www.weather.gov/mfl/beaufort

\(^{131}\) Retrieved on 07.15.2021 from https://www.weather.gov/mfl/beaufort
<table>
<thead>
<tr>
<th>Number</th>
<th>Wind Scale</th>
<th>Wind Speed</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>Fresh Breeze</td>
<td>19-24</td>
<td>Raises dust and loose paper; small branches are moved.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>17-21</td>
<td>Moderate waves, taking a more pronounced long form; many white horses are formed.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Small trees in leaf begin to sway; crested wavelets form on inland waters.</td>
</tr>
<tr>
<td>6</td>
<td>Strong Breeze</td>
<td>25-31</td>
<td>Large waves begin to form; the white foam crests are more extensive everywhere.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>22-27</td>
<td>Large branches in motion; whistling heard in telegraph wires; umbrellas used with difficulty.</td>
</tr>
<tr>
<td>7</td>
<td>Near Gale</td>
<td>32-38</td>
<td>Sea heaps up and white foam from breaking waves begins to be blown in streaks along the direction of the wind.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>28-33</td>
<td>Whole trees in motion; inconvenience felt when walking against the wind.</td>
</tr>
<tr>
<td>8</td>
<td>Gale</td>
<td>39-46</td>
<td>Moderately high waves of greater length; edges of crests begin to break into spindrift. The foam is blown in well-marked streaks along the direction of the wind.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>34-40</td>
<td>Breaks twigs off trees; generally impedes progress.</td>
</tr>
<tr>
<td>9</td>
<td>Severe Gale</td>
<td>47-54</td>
<td>High waves. Dense streaks of foam along the direction of the wind. Crests of waves begin to topple, tumble and roll over. Spray may affect visibility</td>
</tr>
<tr>
<td></td>
<td></td>
<td>41-47</td>
<td>Slight structural damage occurs (chimney-pots and slates removed)</td>
</tr>
<tr>
<td>10</td>
<td>Storm</td>
<td>55-63</td>
<td>Very high waves with long overhanging crests. The resulting foam, in great patches, is blown in dense white streaks along the direction of the wind. On the whole the surface of the sea takes on a white appearance. The tumbling of the sea becomes heavy and shock-like. Visibility affected.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>48-55</td>
<td>Seldom experienced inland; trees uprooted; considerable structural damage occurs.</td>
</tr>
<tr>
<td>11</td>
<td>Violent Storm</td>
<td>64-72</td>
<td>Exceptionally high waves (small and medium-size ships might be for a time lost to view behind the waves). The sea is completely</td>
</tr>
</tbody>
</table>
covered with long white patches of foam lying along the direction of the wind. Everywhere the edges of the wave crests are blown into froth. Visibility affected.

Very rarely experienced; accompanied by widespread damage.

| 12 | 73+ | 64+ | Hurricane | The air is filled with foam and spray. Sea completely white with driving spray; visibility very seriously affected.

Based on those extent ranking factors identified (above), the planning committee ranks the extent of non-rotational wind hazards as MODERATE.

**Extent: Tornado**

Tornadoes have their own severity/extent scale. Until 2007, tornadoes were measured and described according to the Fujita Scale.\(^{132}\)

In February 2007, use of the Fujita Scale was discontinued. In its place, the Enhanced Fujita (EF) Scale is used. The Enhanced Fujita scale considers how most structures are designed and is thought to be a much more accurate representation of the surface wind speeds in the most violent tornadoes. Like the original Fujita scale, the Enhanced Fujita scale is a set of wind estimates (not measurements) based on damage.

It is important to note the date that a tornado occurred. Tornadoes that occurred prior to February, 2007 are classified using the original Fujita scale and will not be converted to the Enhanced Fujita Scale.

Table below illustrates the Fujita Scale in use prior to February 2007.

**Table 20-30: Fujita Tornado Scale (Pre-February 2007)**\(^{133}\)

<table>
<thead>
<tr>
<th>F-Scale Number</th>
<th>Intensity Phrase</th>
<th>Wind Speed</th>
<th>Type of Damage</th>
</tr>
</thead>
<tbody>
<tr>
<td>F0</td>
<td>Gale tornado</td>
<td>40-72 mph</td>
<td>Some damage to chimneys; breaks branches off trees; pushes over shallow-rooted trees; damages sign boards.</td>
</tr>
<tr>
<td>F1</td>
<td>Moderate tornado</td>
<td>73-112 mph</td>
<td>The lower limit is the beginning of hurricane wind speed; peels</td>
</tr>
</tbody>
</table>

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\(^{132}\) Retrieved on 07.19.2021 from https://www.weather.gov/tae/ef_scale

<table>
<thead>
<tr>
<th>F2</th>
<th>Significant tornado</th>
<th>113-157 mph</th>
<th>surface off roofs; mobile homes pushed off foundations or overturned; moving autos pushed off the roads; attached garages may be destroyed.</th>
</tr>
</thead>
<tbody>
<tr>
<td>F3</td>
<td>Severe tornado</td>
<td>158-206 mph</td>
<td>Considerable damage. Roofs torn off frame houses; mobile homes demolished; boxcars pushed over; large trees snapped or uprooted; light object missiles generated.</td>
</tr>
<tr>
<td>F4</td>
<td>Devastating tornado</td>
<td>207-260 mph</td>
<td>Roof and some walls torn off well-constructed houses; trains overturned; most trees in forest uprooted.</td>
</tr>
<tr>
<td>F5</td>
<td>Incredible tornado</td>
<td>261-318 mph</td>
<td>Well-constructed houses leveled; structures with weak foundations blown off some distance; cars thrown and large missiles generated.</td>
</tr>
<tr>
<td>F6</td>
<td>Inconceivable tornado</td>
<td>319-379 mph</td>
<td>Strong frame houses lifted off foundations and carried considerable distances to disintegrate; automobile sized missiles fly through the air in excess of 100 meters; trees debarked; steel reinforced concrete structures badly damaged.</td>
</tr>
</tbody>
</table>
|     |                     |             | These winds are very unlikely. The small area of damage they might produce would probably not be recognizable along with the mess produced by F4 and F5 wind that would surround the F6 winds. Missiles, such as cars and refrigerators would do serious secondary damage that could not be directly identified as F6 damage. If this level is ever achieved, evidence for it might only be found in some manner of ground swirl pattern, for it may never be
Table below illustrates the Enhanced Fujita (EF) Scale, currently in use. Tornadoes that have occurred since February, 2007 are classified using the Enhanced Fujita Scale.

Table 20-31: Enhanced Fujita Scale (February 2007 and Later) 134

<table>
<thead>
<tr>
<th>Enhanced Fujita Category</th>
<th>Wind Speed</th>
<th>Potential Damage</th>
</tr>
</thead>
<tbody>
<tr>
<td>EF0</td>
<td>65-85 mph</td>
<td>Light damage. Peels surface off some roofs; some damage to gutters or siding; branches broken off trees; shallow-rooted trees pushed over.</td>
</tr>
<tr>
<td>EF1</td>
<td>86-110 mph</td>
<td>Moderate damage. Roofs severely stripped; mobile homes overturned or badly damaged; loss of exterior doors; windows and other glass broken.</td>
</tr>
<tr>
<td>EF2</td>
<td>111-135 mph</td>
<td>Considerable damage. Roofs torn off well-constructed houses; foundations of frame homes shifted; mobile homes completely destroyed; large trees snapped or uprooted; light-object missiles generated; cars lifted off ground.</td>
</tr>
<tr>
<td>EF3</td>
<td>136-165 mph</td>
<td>Severe damage. Entire stories of well-constructed houses destroyed; severe damage to large buildings such as shopping malls; trains overturned; trees debarked; heavy cars lifted off the ground and thrown; structures with weak foundations blown away some distance.</td>
</tr>
<tr>
<td>EF4</td>
<td>166-200 mph</td>
<td>Devastating damage. Well-constructed houses and whole frame houses completely leveled; cars thrown and small missiles generated.</td>
</tr>
</tbody>
</table>

Incredible damage. Strong frame houses leveled off foundations and swept away; automobile-sized missiles fly through the air in excess of 100 m (107 yd); high-rise buildings have significant structural deformation; incredible phenomena will occur.

Based on the extent ranking factors identified (above), the planning committee ranks the extent of tornados as **LOW**.

**Extent: Hail**

The National Oceanic and Atmospheric Administration and the Tornado and Storm Research Organization (TORRO) have combined efforts to create the Hailstorm Intensity Scale. Table below provides details of this scale.

Table 20-32: Combined NOAA/TORRO Hailstorm Intensity Scale

<table>
<thead>
<tr>
<th>Size Code</th>
<th>Intensity Category</th>
<th>Typical Hail Diameter</th>
<th>Approximate Size</th>
<th>Typical Damage Impacts</th>
</tr>
</thead>
<tbody>
<tr>
<td>H0</td>
<td>Hard Hail</td>
<td>Up to 0.33”</td>
<td>Pea</td>
<td>No damage</td>
</tr>
<tr>
<td>H1</td>
<td>Potentially Damaging</td>
<td>0.33” – 0.60”</td>
<td>Marble or Mothball</td>
<td>Slight damage to plants and crops</td>
</tr>
</tbody>
</table>

<p>| | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>H2</td>
<td>Potentially Damaging</td>
<td>0.60” – 0.80”</td>
<td>Dime or grape</td>
</tr>
<tr>
<td>H3</td>
<td>Severe</td>
<td>0.80” – 1.20”</td>
<td>Nickel to Quarter</td>
</tr>
<tr>
<td>H4</td>
<td>Severe</td>
<td>1.20” – 1.60”</td>
<td>Half Dollar to Ping Pong Ball</td>
</tr>
<tr>
<td>H5</td>
<td>Destructive</td>
<td>1.60” – 2.0”</td>
<td>Silver Dollar to Golf Ball</td>
</tr>
<tr>
<td>H6</td>
<td>Destructive</td>
<td>2.0” – 2.4”</td>
<td>Lime or Egg</td>
</tr>
<tr>
<td>H7</td>
<td>Very Destructive</td>
<td>2.4” – 3.0”</td>
<td>Tennis Ball</td>
</tr>
</tbody>
</table>
Based on those extent ranking factors identified (above), the planning committee ranks the extent of the hail hazard as **LOW**.

**Extent: Lightning**

The National Weather Service (NWS) uses a Lightning Activity Level (LAL) scale to indicate the frequency and character of cloud-to-ground (C/G) lightning. The scale uses a range of 1 – 6, with 6 being the high end of the scale. Table below provides details of the LAL scale.
<table>
<thead>
<tr>
<th>Rank</th>
<th>Cloud and Storm Development</th>
<th>Areal Coverage</th>
<th>Counts C/G per 5 Minutes</th>
<th>Counts C/G per 15 Minutes</th>
<th>Average C/G per Minute</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>No Thunderstorms</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>2</td>
<td>Cumulus clouds are common but only a few reaches the towering stage. A single thunderstorm must be confirmed in the rating area. The clouds mostly produce virga, but light rain will occasionally reach ground. Lightning is very infrequent.</td>
<td>&lt;15%</td>
<td>1-5</td>
<td>1-8</td>
<td>&lt;1</td>
</tr>
<tr>
<td>3</td>
<td>Cumulus clouds are common. Swelling and towering cumulus cover less than 2/10 of the sky. Thunderstorms are few, but 2 to 3 occur within the observation area. Light to moderate rain will reach the ground, and lightning is infrequent.</td>
<td>15% to 24%</td>
<td>6-10</td>
<td>9-15</td>
<td>1-2</td>
</tr>
<tr>
<td>4</td>
<td>Swelling cumulus and towering cumulus cover 2-3/10 of the sky. Thunderstorms are scattered but more than three must occur within the observation area. Moderate rain is commonly produced, and lightning is frequent.</td>
<td>25% to 50%</td>
<td>11-15</td>
<td>16-25</td>
<td>2-3</td>
</tr>
</tbody>
</table>

Lightning Activity Level Scale

<table>
<thead>
<tr>
<th>Rank</th>
<th>Cloud and Storm Development</th>
<th>Areal Coverage</th>
<th>Counts C/G per 5 Minutes</th>
<th>Counts C/G per 15 Minutes</th>
<th>Average C/G per Minute</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>Towering cumulus and thunderstorms are numerous. They cover more than 3/10 and occasionally obscure the sky. Rain is moderate to heavy, and lightning is frequent and intense.</td>
<td>&gt;50%</td>
<td>&gt;15</td>
<td>&gt;25</td>
<td>&gt;3</td>
</tr>
<tr>
<td>6</td>
<td>Dry lightning outbreak. (LAL of 3 or greater with majority of storms producing little or no rainfall.)</td>
<td>&gt;15%</td>
<td>None</td>
<td>None</td>
<td>None</td>
</tr>
</tbody>
</table>

Based on those extent ranking factors identified (above), the planning committee ranks the extent of the lightning hazard as **LOW**.

**Extent: Thunderstorms that Generate Wind, Tornado, Hail, and Lightning Hazard Events**

Thunderstorms are not explicitly identified as a severe weather category for this hazard profile. However, they are responsible for most tornado, lightning, and hail hazard events – as well as a significant number of wind hazard events – across California and the CSU system. While individual thunderstorms affect relatively small areas, there are many instances in which thunderstorms can cluster together and/or travel in a line over long distances, producing significant damage over large geographic areas.

A thunderstorm is classified as “severe” when certain meteorological parameters within the thunderstorm are reached (i.e., damaging winds or speeds of 58 mph (50 knots) or greater, hail 1 inch in diameter or larger, and/or a tornado). However, there is currently no established, objective severity scale for thunderstorms.\(^{137}\)\(^{138}\) That said, according to the *Glossary of Meteorology* published by the American Meteorological Society (AMS), a thunderstorm is reported as **light, medium, or heavy** according to following five (5) characteristics:

- the nature of the lightning and thunder;

\(^{137}\) Retrieved on 07.15.2021 from https://www.noaa.gov/explainers/severe-storms

\(^{138}\) Retrieved on 07.15.2021 from https://www.weather.gov/safety/thunderstorm
the type and intensity of the precipitation, if any;

• the speed and gustiness of the wind;

• the appearance of the clouds; and

• the effect upon surface temperature.\(^{139}\)

A thunderstorm may also be classified by the nature of the overall weather situation in which the thunderstorm is produced, including:

• **Airmass Thunderstorm**: A thunderstorm produced by local convection within an unstable air mass;\(^{140}\)

• **Frontal Thunderstorm**: An individual thunderstorm the initiation of which results from rising motion associated with a front, or a thunderstorm within a convective system generated and organized by frontal rising motion;\(^{141}\) or

• **Squall-line Thunderstorm**: An individual thunderstorm included within a squall line (i.e., a continuous or broken line of active deep moist convection frequently associated with thunder).\(^{142}\)\(^{143}\)

Based on the extent ranking factors identified (above) in relation to campus layout and operations, and past event low degree of severity, the planning committee ranks the extent of the thunderstorm hazard as **LOW**.

**History of the Hazard**

Severe weather hazards have been an annual occurrence in San Diego County and on the San Diego State main campus. Severe weather hazards have also been an annual occurrence in Imperial County and on the San Diego State – Imperial Valley campuses in Brawley, CA and Calexico, CA. Historical data for these hazards are presented below.

**Historical Storm Data Collection: NCEI Storm Events Database**


Historical information regarding severe weather hazards can be found using The National Centers for Environmental Information (NCEI) Storm Events Database. The Storm Events Database contains searchable, archived National Weather Service (NWS) storm data from January 1950 to April 2021, as entered by NOAA’s National Weather Service (NWS). Due to changes in the data collection and processing procedures over time, there are unique periods of record available depending on the event type. For example, from 1950 through 1954, only tornado events were recorded; from 1955 through 1995, only tornado, thunderstorm wind, and hail events were introduced into the database; from 1996 to present, 45 additional event types are recorded, including high wind, strong wind, and lightning events. To obtain the most accurate portrayal of severe weather event frequency, searches of the Storm Events Database are conducted using data collected since 01/01/1996. As a reminder, all official severe weather event data is at the county level. Severe weather data do not exist at the campus level. That said, it may be the case that the campus to some degree experiences the severe weather events reported for the surrounding community and County.

**San Diego County**

**Wind Hazards (excluding Tornadoes)**

Information obtained from the NCEI Storm Event Database website shows the number of events (or occurrences) of wind hazard events in San Diego County since 1996. Here, wind hazard events include all “High Wind,” “Strong Wind,” and “Thunderstorm Wind” storm reports.

- **High Wind**: at least 434 events, or approximately 17.13 events per year
- **Strong Wind**: at least 61 events, or 2.41 events per year

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148 National Climatic Data Center. Storm Events Database. Retrieved 07.30.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28Z%29+High+Wind&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=SAN%2BDIEGO%3A73&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitButton=Search&statefips=6%2CCALIFORNIA
149 National Climatic Data Center. Storm Events Database. Retrieved 07.30.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28Z%29+Strong+Wind&beginDate_mm=
- **Thunderstorm Wind**: at least 88 events, or approximately 3.47 events per year\(^{150}\)

- **All Wind Hazard events** (excluding Tornadoes): at least 577 events, or approximately 22.78 events per year.\(^{151}\)\(^{152}\) (Note: This was determined by conducting a simultaneous search of the component wind hazards of high wind, strong wind and thunderstorm wind.)

Overall, in San Diego County, there have been at least 577 wind hazard events since 1996, excluding tornadoes.\(^{153}\)\(^{154}\) That translates to an approximate average historical frequency of occurrence of **22.78** wind hazard events per year.

Please note: Differences between the sums of individual component severe weather hazard event Database searches (i.e., 583 events) and simultaneous Database searches of all severe weather hazard events (i.e., 577 events) may be due to the following factors: (1)
multiple event types are in the same record (e.g., “Thunderstorm Wind/Hail” or “Hail/Tornado,” and/or (2) severe weather hazard events such as “Thunderstorm Wind” or “Hail” that are reported for San Diego County have actually taken place hundreds of miles away, but are erroneously recorded as events that have occurred in the County. When such a discrepancy arises, the more conservative aggregate hazard wind event value (i.e., 577 events) is used to determine the historical frequency of occurrence for the severe weather hazard. The origin of this discrepancy is unknown at this time.

**Historical Wind Hazard Losses for San Diego County since 1996**

According to the NCEI Storm Events Database, the wind hazard events that San Diego County has experienced since 1996 have been costly. There have been 7 deaths and 29 injuries, and property and crop damage estimates have totaled approximately $44,415,000 and $36,745,000, respectively.

**Tornado Wind Hazards**

Information from the NCEI Storm Events Database indicates that since 1996, there have been 13 reported events of tornadoes in San Diego County, which translates to approximately 0.51 tornado events per year.

The vast majority of tornado reports in San Diego County since 1996 have been of tornadoes with a severity rating of F0/EF0. Only two (2) of the tornadoes reported have...
been rated F1/EF1 or higher; both have been F1/EF1 tornadoes.\textsuperscript{159} That means that approximately 0.08 F1/EF1 tornado hazard events have occurred per year in San Diego County.

**Historical Tornado Hazard Losses for San Diego County since 1996**

According to the NCEI Storm Events Database, the tornado hazard events that San Diego County has experienced since 1996 have been costly. While there have been no reported deaths, injuries, or crop damage, property damage estimates have totaled approximately $219,600.\textsuperscript{160}

**Hail**

Information from the NCEI Storm Events Database indicates that since 1996, there have been 39 reported events of hail in San Diego County, which translates to approximately 1.54 hail events per year.\textsuperscript{161}

**Historical Hail Hazard Losses for San Diego County since 1996**

According to the NCEI Storm Events Database, the hail hazard events that San Diego County has experienced since 1996 have been costly. While there have been no deaths, there have been five (5) injuries, and property and crop damage estimates have totaled approximately $40,000 and $310,000, respectively.\textsuperscript{162}

**Lightning**

\textsuperscript{159} National Climatic Data Center. Storm Events Database. Retrieved 07.30.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Tornado&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=SAN%2BDIEGO%3A73&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA

\textsuperscript{160} National Climatic Data Center. Storm Events Database. Retrieved 07.30.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Tornado&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=SAN%2BDIEGO%3A73&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA

\textsuperscript{161} National Climatic Data Center. Storm Events Database. Retrieved 07.30.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Hail&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=SAN%2BDIEGO%3A73&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA

\textsuperscript{162} National Climatic Data Center. Storm Events Database. Retrieved 07.30.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Hail&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=SAN%2BDIEGO%3A73&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA
Information from the NCEI Storm Events Database indicates that since 1996, there have been 33 reported event(s) of lightning in San Diego County, which translates to approximately 1.30 lightning events per year.163

**Historical Lightning Hazard Losses for San Diego County since 1996**

According to the NCEI Storm Events Database, the lightning hazard events that San Diego County has experienced since 1996 have been costly. There have been 1 death and 7 injuries, and property and crop damage estimates have totaled approximately $102,400 and $5,000, respectively164

**All Severe Weather Hazard Events Recorded by the NCEI Storm Events Database**

Information obtained from the NCEI Storm Events Database indicates that there have been 662 occurrences of the severe weather hazard in San Diego County. This translates to 26.13 severe weather hazard occurrences per year.165 166

Please note: Differences between the sums of individual component severe weather hazard event Database searches (i.e., 668 events) and simultaneous Database searches of all severe weather hazard events (i.e., 662 events) may be due to the following factors: (1) multiple event types are in the same record (e.g., "Thunderstorm Wind/Hail" or "Hail/Tornado;" and/or (2) severe weather hazard events such as “Thunderstorm Wind” or “Hail” that are reported for San Diego County have actually taken place hundreds of

163 National Climatic Data Center. Storm Events Database. Retrieved 07.30.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Lightning&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=S AN%2BDIEGO%3A73&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA

164 National Climatic Data Center. Storm Events Database. Retrieved 07.30.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Lightning&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=S AN%2BDIEGO%3A73&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA

165 National Climatic Data Center. Storm Events Database. Retrieved 07.30.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Hail&eventType=%28Z%29+Hig h+Wind&eventType=%28C%29+Lightning&eventType=%28Z%29+Strong+Wind&eventType=%28C%29+Thunderstorm+Wind&eventType=%28C%29+Tornado&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=S AN%2BDIEGO%3A73&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA

166 National Climatic Data Center. Storm Events Database. Retrieved 07.30.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Hail&eventType=%28Z%29+Hig h+Wind&eventType=%28C%29+Lightning&eventType=%28Z%29+Strong+Wind&eventType=%28C%29+Thunderstorm+Wind&eventType=%28C%29+Tornado&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=S AN%2BDIEGO%3A73&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA
miles away, but are erroneously recorded as events that have occurred in the County.¹⁶⁷ When such a discrepancy arises, the more conservative aggregate hazard wind event value (i.e., 662 events) is used to determine the historical frequency of occurrence for the severe weather hazard. The origin of this discrepancy is unknown at this time.

**Historical, Aggregated Severe Hazard Losses for San Diego County since 1996**

According to the NCEI Storm Events Database, the severe weather events that San Diego County has experienced since 1996 have been costly. There have been 8 deaths and 41 injuries, and property and crop damage estimates have totaled approximately $32,874,000 and $36,955,000, respectively.¹⁶⁸ ¹⁶⁹ However, it is important to note that for all San Diego County severe weather hazard events recorded on the Storm Events Database, almost all (i.e., 87.5%) deaths, the majority (i.e., 70.7%) of all injuries, and almost all (i.e., 99.2%) reported property and crop damage estimates have been attributed to wind hazard events alone.

**Imperial County**

**Wind Hazards (excluding Tornadoes)**

Information obtained from the NCEI Storm Event Database website shows the number of events (or occurrences) of wind hazard events in Imperial County since 1996.¹⁷⁰ Here, wind hazard events include all “High Wind,” “Strong Wind,” and “Thunderstorm Wind” storm reports.¹⁷¹

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¹⁶⁸ National Climatic Data Center. Storm Events Database. Retrieved 07.30.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Hail&eventType=%28Z%29+HighWind&eventType=%28C%29+Lightning&eventType=%28Z%29+StrongWind&eventType=%28C%29+ThunderstormWind&eventType=%28C%29+Tornado&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=SAN%2BDIEGO%3A73&hailfilter=0.00&tornadofilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA

¹⁶⁹ National Climatic Data Center. Storm Events Database. Retrieved 07.30.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Hail&eventType=%28Z%29+HighWind&eventType=%28C%29+Lightning&eventType=%28Z%29+StrongWind&eventType=%28C%29+ThunderstormWind&eventType=%28C%29+Tornado&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=SAN%2BDIEGO%3A73&hailfilter=0.00&tornadofilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA


- **High Wind**: at least 7 events, or approximately 0.28 events per year\(^{172}\)
- **Strong Wind**: at least 3 events, or 0.12 events per year\(^{173}\)
- **Thunderstorm Wind**: at least 55 events, or approximately 2.17 events per year\(^{174}\)
- **All Wind Hazard events** (excluding Tornadoes): at least 59 events, or approximately 2.33 events per year.\(^{175}\) (Note: This was determined by conducting a simultaneous search of the component wind hazards of high wind, strong wind and thunderstorm wind.)

Overall, in Imperial County, there have been at least 59 wind hazard events since 1996, excluding tornadoes\(^{176}\). That translates to an approximate average historical frequency of occurrence of 2.33 wind hazard events per year.

Please note: Differences between the sums of individual component severe weather hazard event Database searches (i.e., 65 events) and simultaneous Database searches of all severe weather hazard events (i.e., 59 events) may be due to the following factors: (1) multiple event types are in the same record (e.g., "Thunderstorm Wind/Hail" or "Hail/Tornado;" and/or (2) severe weather hazard events such as “Thunderstorm Wind” or “Hail” that are reported for Imperial County have actually taken place hundreds of

\(^{172}\) National Climatic Data Center. Storm Events Database. Retrieved on 08.04.2021 from [https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28Z%29+High+Wind&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=IMPERIAL%3A25&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA](https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28Z%29+High+Wind&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=IMPERIAL%3A25&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA)

\(^{173}\) National Climatic Data Center. Storm Events Database. Retrieved on 08.04.2021 from [https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28Z%29+Strong+Wind&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=IMPERIAL%3A25&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA](https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28Z%29+Strong+Wind&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=IMPERIAL%3A25&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA)

\(^{174}\) National Climatic Data Center. Storm Events Database. Retrieved on 08.04.2021 from [https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Thunderstorm+Wind&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=IMPERIAL%3A25&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA](https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Thunderstorm+Wind&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=IMPERIAL%3A25&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA)

\(^{175}\) National Climatic Data Center. Storm Events Database. Retrieved on 08.04.2021 from [https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28Z%29+High+Wind&eventType=%28Z%29+Strong+Wind&eventType=%28C%29+Thunderstorm+Wind&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=IMPERIAL%3A25&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA](https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28Z%29+High+Wind&eventType=%28Z%29+Strong+Wind&eventType=%28C%29+Thunderstorm+Wind&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=IMPERIAL%3A25&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA)

\(^{176}\) National Climatic Data Center. Storm Events Database. Retrieved on 08.04.2021 from [https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28Z%29+High+Wind&eventType=%28Z%29+Strong+Wind&eventType=%28C%29+Thunderstorm+Wind&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=IMPERIAL%3A25&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA](https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28Z%29+High+Wind&eventType=%28Z%29+Strong+Wind&eventType=%28C%29+Thunderstorm+Wind&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=IMPERIAL%3A25&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA)
miles away, but are erroneously recorded as events that have occurred in the County. When such a discrepancy arises, the more conservative aggregate hazard wind event value (i.e., 59 events) is used to determine the historical frequency of occurrence for the severe weather hazard. The origin of this discrepancy is unknown at this time.

**Historical Wind Hazard Losses for Imperial County since 1996**

According to the NCEI Storm Events Database, the wind hazard events that Imperial County has experienced since 1996 have been costly. While there have been no deaths or crop damages reported, there has been one (1) injury, and property damage estimates have totaled approximately $5,891,000.178

**Tornado Wind Hazards**

Information from the NCEI Storm Events Database indicates that since 1996, there have been two (2) reported events of tornadoes in Imperial County, which translates to approximately 0.08 tornado events per year; both tornadoes have been rated F0/EF0.179

**Historical Tornado Hazard Losses for Imperial County since 1996**

According to the NCEI Storm Events Database, there have been no tornado-related deaths, injuries, property damage, or crop damage.180

**Hail**

Information from the NCEI Storm Events Database indicates that since 1996, there have been eight (8) reported events of hail in Imperial County, which translates to...
approximately 0.32 hail events per year.\textsuperscript{181} (Note: The NCEI Storm Event Database search results for hail indicate that there has been a total of nine (9) reports of hail since 1996. However, one (1) entry is for a hail event in San Diego County coastal areas that are not proximal to Imperial County. The origin of this error is unknown at this time.)

**Historical Hail Hazard Losses for Imperial County since 1996**

There have been no hail-related deaths, injuries, property damage, or crop damage in Imperial County since 1996.\textsuperscript{182} (Note: The San Diego County hail event that was included erroneously in the search results for hail hazard events in Imperial County accounted for all injuries (i.e., 5) and crop damage estimates (i.e., $300,000) presented in the search results.)

**Lightning**

Information from the NCEI Storm Events Database indicates that since 1996, there has been one (1) reported event of lightning in Imperial County, which translates to approximately 0.04 lightning events per year.\textsuperscript{183}

**Historical Lightning Hazard Losses for Imperial County since 1996**

There have been no lightning-related deaths, injuries, property damage, or crop damage in Imperial County since 1996.\textsuperscript{184}

**All Severe Weather Hazard Events Recorded by the NCEI Storm Events Database**

(Imperial County)

\textsuperscript{181} National Climatic Data Center. Storm Events Database. Retrieved on 08.04.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Hail&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=IMPERIAL%3A25&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA

\textsuperscript{182} National Climatic Data Center. Storm Events Database. Retrieved on 08.04.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Hail&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=IMPERIAL%3A25&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA

\textsuperscript{183} National Climatic Data Center. Storm Events Database. Retrieved on 08.04.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Lightning&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=IMPERIAL%3A25&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA

\textsuperscript{184} National Climatic Data Center. Storm Events Database. Retrieved on 08.04.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Lightning&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=IMPERIAL%3A25&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA
Information obtained from the NCEI Storm Events Database indicates that there have been 70 occurrences of the severe weather hazard in Imperial County. This translates to 2.76 severe weather hazard occurrences per year.\textsuperscript{185}

Please note: Differences between the sums of individual component severe weather hazard event Database searches (i.e., 76 events) and simultaneous Database searches of all severe weather hazard events (i.e., 70 events) may be due to the following factors: (1) multiple event types are in the same record (e.g., "Thunderstorm Wind/Hail" or "Hail/Tornado;" and/or (2) severe weather hazard events such as “Thunderstorm Wind” or “Hail” that are reported for Imperial County have actually taken place hundreds of miles away, but are erroneously recorded as events that have occurred in the County.\textsuperscript{186} When such a discrepancy arises, the more conservative aggregate hazard wind event value (i.e., 70 events) is used to determine the historical frequency of occurrence for the severe weather hazard. The origin of this discrepancy is unknown at this time.

**Historical, Aggregated Severe Hazard Losses for Imperial County since 1996**

According to the NCEI Storm Events Database, the severe weather events that Imperial County has experienced since 1996 have been costly. While there have been no deaths or crop damage, there has been one (1) injury, and property damage estimates have totaled approximately $5,891,000.\textsuperscript{187} It is important to note that for all Imperial County severe weather hazard events recorded on the Storm Events Database, all injuries and all estimated property damage have been attributed to wind hazard events alone.

**Wind Hazards Not Included in the NCEI Storm Events Database**

*Santa Ana Winds*

\textsuperscript{185} Re National Climatic Data Center. Storm Events Database. Retrieved on 08.04.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Hail&eventType=%28Z%29+High+Wind&eventType=%28C%29+Lightning&eventType=%28Z%29+Strong+Wind&eventType=%28C%29+Thunderstorm+Wind&eventType=%28C%29+Tornado&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=IMPERIAL%3A25&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA


\textsuperscript{187} National Climatic Data Center. Storm Events Database. Retrieved on 08.04.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Hail&eventType=%28Z%29+High+Wind&eventType=%28C%29+Lightning&eventType=%28Z%29+Strong+Wind&eventType=%28C%29+Thunderstorm+Wind&eventType=%28C%29+Tornado&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=IMPERIAL%3A25&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA
Santa Ana wind events occur at least twice per month from October through April.\textsuperscript{188} From 1948 to 2012, total of 2056 events on the 65-year record were recorded in the Southern California region, yielding an average of \textbf{32 occurrences per year}. Typical Santa Ana wind events last 1–2 days and represent 27\% of the occurrences, with events lasting up to 6 days accounting for 90\% of all occurrences. The remaining 10\% are made up almost entirely of events lasting between 7 and 12 days.\textsuperscript{189, 190}

Figure below shows the mean monthly frequency per season of Santa Ana Wind events detected from 1948 to 2012. Extreme Santa Ana wind events are shown in dark red, and are defined as those events that are above the 90th percentile of all events on record.

**Diablo Winds**

Diablo wind events occur approximately *2.5 events per year*. These events are most frequent during the fall and early winter seasons, with the highest frequency of events occurring in October. As a result, the highest risk of Diablo-wind-related damage is in the fall and early winter.\(^{193}\)


Figure below shows the monthly frequency of Diablo winds (along with average live fuel moisture content). The Diablo Wind data are derived from a 17-year climatology of San Francisco Bay Area regional surface weather stations.\(^\text{194}\)

Figure 20-20: Monthly Frequency of Diablo Winds and Average Live Fuel Moisture Content (Dashed Line)\(^\text{195}\)

\[\text{Sundowner Winds}\]

Strong sundowner wind events occur approximately \textbf{2-3 times per year}. These events can create sharp temperature rises, local gale force winds, and significant weather-related problems. Rare, “explosive” types of sundowner wind events occur about 6 times per century that present dangerous weather situations, generating extremely strong and hot winds that can reach gale force or higher speeds.\(^\text{196}\)

\textbf{Historical Frequency of All Severe Weather Hazards}

Table below shows the average historical frequency of severe weather hazard events for San Diego County since 1996.

\(^\text{194}\) Retrieved on 07.15.2021 from https://www.fireweather.org/diablo-winds

\(^\text{195}\) Retrieved on 07.13.2021 from https://www.fireweather.org/diablo-winds

Table 20-34: Severe Weather Hazard Event

Frequencies for San Diego County since 1996.

<table>
<thead>
<tr>
<th>Severe Weather Hazard Category</th>
<th>Average Number of Hazard Events Per Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wind (Includes High, Strong and Thunderstorm Winds ONLY)</td>
<td>22.78</td>
</tr>
<tr>
<td>Tornado</td>
<td>0.51</td>
</tr>
<tr>
<td>Hail</td>
<td>1.54</td>
</tr>
<tr>
<td>Lightning</td>
<td>1.30</td>
</tr>
<tr>
<td>Diablo Wind*</td>
<td>2.5</td>
</tr>
<tr>
<td>Santa Ana Wind</td>
<td>32</td>
</tr>
<tr>
<td>Sundowner Wind*</td>
<td>2 to 3</td>
</tr>
</tbody>
</table>

* Note: The Diablo and Sundowner wind hazards are not present in San Diego County. They are included here for information purposes only.

Table below shows the average historical frequency of severe weather hazard events for Imperial County since 1996.)
Table 20-35: Severe Weather Hazard Event

Frequencies for Imperial County since 1996.

<table>
<thead>
<tr>
<th>Severe Weather Hazard Category</th>
<th>Average Number of Hazard Events Per Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wind (Includes High, Strong and Thunderstorm Winds ONLY)</td>
<td>2.33</td>
</tr>
<tr>
<td>Tornado</td>
<td>0.08</td>
</tr>
<tr>
<td>Hail</td>
<td>0.32</td>
</tr>
<tr>
<td>Lightning</td>
<td>0.04</td>
</tr>
<tr>
<td>Diablo Wind*</td>
<td>2.5</td>
</tr>
<tr>
<td>Santa Ana Wind</td>
<td>32</td>
</tr>
<tr>
<td>Sundowner Wind*</td>
<td>2 to 3</td>
</tr>
</tbody>
</table>

* Note: The Diablo and Sundowner wind hazards are not present in Imperial County. They are included here for information purposes only.

Potential Impacts of the Hazard

The significance (or priority) of a hazard’s potential impacts is based primarily on the frequency and resulting damage caused by the hazard, including deaths/injuries and property, crop, and economic damage. All assets and people within San Diego State main campus and satellite campus areas are at risk from the effects of severe weather hazards.

**Wind Hazards (Including Tornadoes)**

Wind hazard events have the potential to impact people, property, and operations on campuses across the CSU system. People caught in the open during an extreme wind event are exposed to high winds and debris, and could be injured or killed.

The habitability of buildings can be compromised (by damaging roofs, windows, or other weak points in the building envelope), leading to long-term operational issues for the campus. As with most university campuses, space is always at a premium at the San Diego State campus, and the loss of any currently utilized space due to building or structural damage would likely disrupt operations and the University’s mission.
Extreme wind events can result in power failure, which would impact the operation of the campus. Fallen tree limbs and other potential transportation hazards may also cause disruption to the surrounding community and limit ingress/egress to the campus.

**San Diego State Main Campus, San Diego (San Diego County)**

The 2017 San Diego County Multi-Jurisdictional Hazard Mitigation Plan profiles only one severe weather-related hazard – coastal storm/coastal erosion/tsunami hazard. High winds are a component of this hazard. Damage from high wind speeds by themselves is considered to be minor, although they contribute to storm surge and erosion. As a result, wind hazards (including tornadoes) are considered to be of low to moderate significance, and therefore to have a minimal to moderate potential impact on the County and on the San Diego State main campus. Tornadoes are not profiled at all by the Plan. As a result, tornado hazards are considered to be of low significance, and therefore to have minimal potential impact on the County and on the San Diego State main campus.197

**San Diego State – Imperial Valley Campuses, Brawley and Calexico (Imperial County)**

According to the 2021 Imperial County Multi-Jurisdictional Hazard Mitigation Plan (MHMP), “Extreme Weather” sub-hazards like windstorms and tornadoes are considered to be significant for Imperial County, and therefore to have a moderate to high potential impact on the County and on the San Diego State – Imperial Valley campuses.198

**Hail**

Hail typically impacts property by damaging structures, cars, and utilities as it falls. Dents in cars, broken glass, and holes in roofs are common impacts of hail. Injuries to people from hail are less common, though they can happen, as hail is a hard object falling in an unpredictable manner at a fairly high rate of speed.

**San Diego State Main Campus, San Diego (San Diego County)**

The 2017 San Diego County Multi-Jurisdictional Hazard Mitigation Plan profiles only one severe weather-related hazard – coastal storm/coastal erosion/tsunami hazard. Hail hazards are not profiled in the Plan. As a result, hail hazards are considered to be of low significance, and therefore to have a minimal potential impact on the County and on the San Diego State main campus.199

**References**


San Diego State – Imperial Valley Campuses, Brawley and Calexico (Imperial County)

According to the 2021 Imperial County Multi-Jurisdictional Hazard Mitigation Plan (MHMP), an “Extreme Weather” sub-hazard like hail is considered to be significant for Imperial County, and therefore to have a moderate to high potential impact on the County and on the San Diego State – Imperial Valley campuses.200

Lightning

Lightning strikes the United States about 20-25 million times a year.201 Although most lightning occurs in the summer months, people can be struck at any time of year. Since 1990, lightning has killed an average of 39 people each year in the United States, and hundreds more have been injured.202 Property losses due to lightning have been very costly across the U.S. For example, from 2005 through 2020, U.S. homeowner’s insurance claim payouts for lightning losses totaled approximately $15,334,600,000, or $958,412,500 worth of payouts per year.203 (Commercial claim payouts for lightning losses for the U.S. were not available.)

San Diego State Main Campus, San Diego (San Diego County)

The 2017 San Diego County Multi-Jurisdictional Hazard Mitigation Plan profiles only one severe weather-related hazard – coastal storm/coastal erosion/tsunami hazard. Lightning hazards are not profiled in the Plan. As a result, lightning hazards are considered to be of low significance, and therefore to have a minimal potential impact on the County and on the San Diego State main campus.204

San Diego State – Imperial Valley Campuses, Brawley and Calexico (Imperial County)

According to the 2021 Imperial County Multi-Jurisdictional Hazard Mitigation Plan (MHMP), an “Extreme Weather” a sub-hazard like a thunderstorm is considered to be significant for Imperial County, and therefore to have a moderate to high potential impact on the County. By definition, lightning is a hazard that is always present in a thunderstorm. As a result, lightning is also considered to have a “medium” or moderate


to high potential impact on the County and (by extension) on the San Diego State – Imperial Valley campuses.205

Probability of Future Occurrence of the Hazard

Areas throughout California, including all California State University (CSU) campuses, experience severe weather events every year. Future occurrences of such events are projected to increase in both their frequency and intensity.

**San Diego State Main Campus, San Diego (San Diego County)**

The 2017 San Diego County Multi-Jurisdictional Hazard Mitigation Plan states that damage from high wind speeds by themselves is considered to be minor, although they do contribute to storm surge and erosion.206 However, according to the NCEI Storm Events Database, wind, hail, and lightning events occur on average far more than once per year, with wind hazard events occurring on average 22.78 per year since 1996. Furthermore, while the severe weather hazard is a non-spatial hazard that affects all areas of the San Diego State main campus equally, the smallest geographic unit of measurement for almost all official severe weather event data is at the county level. Because the severe weather data used in this assessment do not exist at the campus level, it is assumed that the severe weather probabilities for the San Diego State main campus reflect those of the surrounding community and County identified in the Table below.

Based on the data available from both the 2017 San Diego County Multi-Jurisdictional Hazard Mitigation Plan and the NCEI Storm Events Database, the severe weather hazard is expected to occur on (or otherwise impact) the San Diego State main campus at least once on an annual basis. Therefore, the probability of future occurrence of the severe weather hazard for San Diego State is **HIGHLY LIKELY**.

**San Diego State – Imperial Valley Campuses, Brawley and Calexico (Imperial County)**

The 2021 Imperial County Multi-Jurisdictional Hazard Mitigation Plan (MHMP) states that there is an 80% chance (i.e., “high” probability) that each of the severe weather hazards profiled above (i.e., wind, tornado, hail and lightning) will occur in the future.207 Also, according to the NCEI Storm Events Database, wind hazard events have occurred in Imperial County significantly more than once per year. Furthermore, while the severe weather hazard is a non-spatial hazard that affects all areas of the San Diego State...
University – Imperial Valley campuses equally, the smallest geographic unit of measurement for almost all official severe weather event data is at the county level. Because the severe weather data used in this assessment do not exist at the campus level, it is assumed that the severe weather probabilities for the San Diego State – Imperial Valley campuses reflect those of the surrounding community and County.

Based on the data available from both the 2021 Imperial County Multi-Jurisdictional Hazard Mitigation Plan (MHMP) and the NCEI Storm Events Database, the severe weather hazard is expected to occur on (or otherwise impact) the San Diego State – Imperial Valley campuses at least once on an annual basis. Therefore, the probability of future occurrence of the severe weather hazard for San Diego State – Imperial Valley is **HIGHLY LIKELY**.

**San Diego State University – All Campus Areas**

The probability of future occurrence of the severe weather hazard for all San Diego State University campus areas is **HIGHLY LIKELY**.

The following tables show the probabilities of future occurrence for component severe weather hazards for San Diego State campuses in San Diego County and Imperial County.

**Table 20-36: Severe Weather Hazard Probabilities of Future Occurrence for San Diego County and San Diego State University.**

<table>
<thead>
<tr>
<th>Severe Weather Hazard Category</th>
<th>Average Number of Hazard Events Per Year</th>
<th>Probability of Future Occurrence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wind (Includes High, Strong and Thunderstorm Winds ONLY)</td>
<td>22.78</td>
<td>Highly Likely</td>
</tr>
<tr>
<td>Tornado</td>
<td>0.51</td>
<td>Likely</td>
</tr>
<tr>
<td>Hail</td>
<td>1.54</td>
<td>Highly Likely</td>
</tr>
<tr>
<td>Lightning</td>
<td>1.30</td>
<td>Highly Likely</td>
</tr>
<tr>
<td>Diablo Wind**</td>
<td>2.5</td>
<td>Not Rated</td>
</tr>
<tr>
<td>Santa Ana Wind</td>
<td>32</td>
<td>Highly Likely</td>
</tr>
<tr>
<td>Sundowner Wind**</td>
<td>2 to 3</td>
<td>Not Rated</td>
</tr>
</tbody>
</table>

**Severe Weather Hazard** | **Highly Likely**

**Note:** The Diablo and Sundowner wind hazards are not present in San Diego County, and therefore are not rated for probability of future occurrence. They are included here for information purposes only.
Table 20-37: Severe Weather Hazard Probabilities of Future Occurrence for Imperial County and San Diego State University – Imperial Valley (Brawley, CA and Calexico, CA campuses).

<table>
<thead>
<tr>
<th>Severe Weather Hazard Category</th>
<th>Average Number of Hazard Events Per Year</th>
<th>Probability of Future Occurrence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wind (Includes High, Strong and Thunderstorm Winds ONLY)</td>
<td>2.33</td>
<td>Highly Likely</td>
</tr>
<tr>
<td>Tornado</td>
<td>0.08</td>
<td>Unlikely</td>
</tr>
<tr>
<td>Hail</td>
<td>0.32</td>
<td>Possible</td>
</tr>
<tr>
<td>Lightning</td>
<td>0.04</td>
<td>Unlikely</td>
</tr>
<tr>
<td>Diablo Wind**</td>
<td>2.5</td>
<td>Not Rated</td>
</tr>
<tr>
<td>Santa Ana Wind</td>
<td>32</td>
<td>Highly Likely</td>
</tr>
<tr>
<td>Sundowner Wind**</td>
<td>2 to 3</td>
<td>Not Rated</td>
</tr>
</tbody>
</table>

** Note: The Diablo and Sundowner wind hazards are not present in Imperial County, and therefore are not rated for probability of future occurrence. They are included here for information purposes only.

Vulnerability to the Hazard

People, structures, and assets on all San Diego State campuses are all vulnerable to the impacts associated with severe weather. Infrastructure can be damaged or destroyed by hail, wind, tornadoes, thunderstorms, and lightning, which can result in service interruptions and outages. Structures can be damaged or destroyed by hail, wind, tornadoes, thunderstorms, and lightning. People can be injured or killed by lightning, flying debris, hail, or extreme wind events. San Diego State also has vehicles that are all vulnerable to a severe weather event.

Estimate of Potential Losses

Severe weather is a non-spatial hazard that affects the all San Diego State campuses. Each of the hazards associated with severe weather can result in losses throughout the planning areas.
All structures at all San Diego State campuses are at risk from severe weather. There are approximately 215 buildings that could be damaged by wind, hail, and/or lightning. If even a fraction of these assets were to be damaged, the resulting estimated losses would still be in the millions of dollars. The total replacement costs due to severe weather hazard are $726,584,983 for 147 buildings, and unknown for the remaining 68 buildings. An analysis of projected dollar losses to campus buildings from severe weather as a percentage of building replacement costs is also not currently available, though CSU leadership may pursue such data in the future.

The population at the San Diego State campus varies throughout the day. As of Fall, 2019, San Diego State had 35,081 students and 3,702 faculty and staff. All are at risk from severe weather events, with 38,783 being directly vulnerable in this scenario.

Vulnerability Assessment Conclusions

Severe weather presents a variety of hazards to all San Diego State campuses. People, assets, infrastructure, and vehicles can all be damaged by this hazard, and losses can quickly begin to rise. In the aggregate, severe weather is a frequently occurring hazard (mostly in the form of wind hazard events) that presents a variety of risks to San Diego State.

It is evident that San Diego State has vulnerabilities to and risks from severe weather hazard incidents, and that pre-event planning, communication, and mitigation efforts should be implemented. Public education and outreach regarding areas of shelter that could be used by campus populations during severe weather events is considered by campus leadership to be one viable mitigation option. The campus planning committee will continue to look for feasible and cost-effective options for the mitigation of severe weather risks going forward.

Identified Data Limitations

Numerous federal agencies maintain a variety of records regarding losses associated with hazards. Unfortunately, no single source is considered to offer a definitive accounting of all losses. The Federal Emergency Management Agency (FEMA) maintains records on federal expenditures associated with declared major disasters. The US Army Corps of Engineers (USACE) and the Natural Resources Conservation Service (NRCS) collect data on losses during the course of some of their ongoing projects and studies. Additionally, the National Oceanic and Atmospheric Administration’s (NOAA) National Centers for Environmental Information (NCEI) collects and maintains data about natural hazards in summary format, as well as occurrences, dates, injuries, deaths, and estimated

208 Retrieved on 07.19.2021 from https://www2.calstate.edu/csu-system/about-the-csu/facts-about-the-csu/enrollment/Pages/default.aspx

costs for individual storm events. Many of these databases and other data collection services, including the NCEI, have inherent data limitations when searching for information at a scale as small as a single campus.

The best available data and records have been used throughout this section. Where no data or records exist or could be located, that deficiency is noted.
20.4 Social Resilience Assessment

Overview

While every person is vulnerable to risk, individuals from diverse populations such as those with access and functional needs are disproportionately more vulnerable and may be at a higher risk to harm in a disaster event. In addition to physical vulnerabilities, the intersectionality between physical hazard risks and population social vulnerabilities must be considered to holistically address overall campus risk.

As inclusivity is a high priority for CSU, addressing campus risk and resilience must be done through the lens of inclusion and equity. Addressing social vulnerability is an increasingly critical requirement of state and national doctrines and described in Section 4.4 of the HVRA Base Plan. Every individual of the campus’s richly diverse population group needs to have the capacity, skills, and knowledge in order to understand, access, and participate in risk reduction and disaster response in ways that are meaningful to their own unique situation. In a campus community, having strong social support networks and active involvement in community disaster responses may negatively or positively impact these opportunities and reduce the resilience-building process. This section offers a glimpse into the CSU San Diego campus’s unique social construct, population demographics, strengths and concerns and presents a high-level assessment of the resilience, coping capacities and potential social vulnerabilities of students, staff and faculty. The research variables that were asked are often considered sensitive subjects, and few are traditionally included in emergency management/hazard mitigation planning.

This social resilience assessment of college campuses is the first of its kind in the nation. The research methodology unfolded as the interviews with campuses progressed. The assessment data presented are not definitive or authoritative. The answers, analysis, and suggested trends are strictly indicators for potential social risk. They do not represent an accurate data capture as limitations on the data gathering process influenced an ability to provide accuracy. This assessment provides indications of increased risk, not accuracy of response or a true reflection of the situation of the campus. The information presented is to be considered in the context of the more detailed system-wide CSU social vulnerability assessment that is included in the baseline HVRA.

Campus-Identified Populations of Concern

During the campus interview, the following responses were provided when asked, “In considering the diverse population group(s) amongst student body, faculty and staff, which are of the most concern in your emergency management planning?”

Table x: High level summary of campus populations of concern
Table 20-38: High level summary of campus populations of concern

<table>
<thead>
<tr>
<th>Question</th>
<th>Campus Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>Which population groups amongst the student body, faculty, and staff, are of the most concern for physical and social vulnerabilities in emergency management planning?</td>
<td>Populations with access and functional needs</td>
</tr>
<tr>
<td>Which population groups are most difficult to reach in an event?</td>
<td>International students</td>
</tr>
<tr>
<td>Which population groups have little/limited support networks if impacted by an event?</td>
<td>Students with economic challenges</td>
</tr>
</tbody>
</table>

**Resilience Variables Related to Campus Emergency Management**

The interviewees were asked to reflect on a set of 12 variables for the campus populations of student, faculty and staff: homelessness (*housing insecurity*), food security, health and wellness, disability/access and functional needs (AFN), racial equity, digital equity, communications, international students, immigrants/immigration status issues (*undocumented, DACA, etc.*), LGBTQI (Lesbian Gay Bisexual Transgender Questioning (or queer) Intersex), and transportation dependency. They were also offered an opportunity to add any other factor they wanted to include. The following two questions were asked:

- Is this factor a particular issue of concern for emergency management on your campus? Responses were summarized as *Very High, High, Medium, Low*
- Is this factor reflected in the emergency plans and processes for your campus? Responses were summarized as *Yes, No, In Progress, NA*
In order to provide a high-level qualitative response for the answers, the approach of averaging response was taken. If conflicting answers were expressed by the interviewees, the answer (code) was averaged out. A detailed explanation of the response averaging approach is included in the base HVRA.

Table 20-39: Graph of campus-specific emergency management issues of concern and inclusion in emergency management plans and processes.

<table>
<thead>
<tr>
<th>Issue of Concern</th>
<th>Plans &amp; Processes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Homelessness (Housing Insecurity)</td>
<td>Low</td>
</tr>
<tr>
<td>Food Security</td>
<td>Low</td>
</tr>
<tr>
<td>AFN</td>
<td>Low</td>
</tr>
<tr>
<td>Digital Equity</td>
<td>Low</td>
</tr>
<tr>
<td>International Students</td>
<td>Low</td>
</tr>
<tr>
<td>Immigrants / Immigration Status</td>
<td>Low</td>
</tr>
<tr>
<td>LGBTQI</td>
<td>Low</td>
</tr>
<tr>
<td>Transportation Dependency</td>
<td>Low</td>
</tr>
</tbody>
</table>

Qualitative Narrative: Campus Overview of Potential Resilience Vulnerabilities

The following are interview notes of interest:

- There are plans for plans for civil unrest though not for racial conflict/racial equity.
- The EOP references the use of calling an Uber or Lyft and other alternative forms of transportation during an evacuation process.
- There is likely to be commuter students from across the border for the Imperial Valley facility.
Campus High Hazards and Potentially Vulnerable Populations

This section provides a brief introduction to the link between socially vulnerable populations and a particular hazard type. While extensive research has been conducted on the impacts of hazards, not all linkages have been documented or published, and detail for finding them are beyond the scope of this assessment. It’s important to note, the intersectional nature of what makes an individual’s personal experience and resilience to an event is played out by unique factors for that individual or population. The nuanced social vulnerabilities often come from the social and physical environment in which a person is embedded.

In order to aid in further assessing campus resilience, below is a general description of the known impacts. From some hazards, the descriptions are robust, while others are only brief introductions.

Table 20-40: CSU San Diego *Highly Likely* and *Likely* Hazards

<table>
<thead>
<tr>
<th>Hazard</th>
<th>Future Occurrence Probability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Communicable Disease</td>
<td>Highly Likely</td>
</tr>
<tr>
<td>Drought</td>
<td>Highly Likely</td>
</tr>
<tr>
<td>Earthquake</td>
<td>Possible</td>
</tr>
<tr>
<td>Erosion</td>
<td>Likely</td>
</tr>
<tr>
<td>Extreme Temperature</td>
<td>Highly Likely (Heat only)</td>
</tr>
<tr>
<td>Landslide</td>
<td>Highly Likely</td>
</tr>
<tr>
<td>Power Outage</td>
<td>Likely</td>
</tr>
<tr>
<td>Wildfire</td>
<td>Possible (Fire); Possible (Smoke)</td>
</tr>
</tbody>
</table>
**Drought**

The 2012-2016 drought had severe effects on two vulnerable sectors of our population: those in low-income brackets, and those, especially Native Americans, who rely on subsistence fishing for their livelihoods.\(^{210}\) Water bills increased throughout the state. Due to rising water prices, for the working poor, many have paid four to five percent of their income for water. Since many CSU students are commuters, and many living with families, future drought impacts may potentially affect a percentage of non-resident students. NASA’s modeling shows that future droughts are likely to last longer and be more intense, even leading to “megadroughts” in the western states.\(^{211}\) Fresh water supplies are predicted to be full of extremes, with both droughts and extreme precipitation events being more severe. The interrelationship between drought and other hazard conditions may lead to a set of secondary impacts. Drought conditions lead to water quality issues due to loss of drinking water, increased fire danger that leads to drought-induced fires and elevated AQI levels, as well as extreme heat or prolonged heat events.

**Earthquake**

Impacts on populations from earthquakes are complex, with long-term implications on social stability for all populations. In addition to the physical impact exposure during a no-notice earthquake event and the social and logistical challenges of a recovering community, an earthquake can have lasting impacts long afterwards due to post traumatic stress disorder (PTSD).

Socioeconomic vulnerabilities of populations at risk were analyzed in the hypothetical yet scientifically realistic earthquake sequence that is being used to better understand hazards for the San Francisco Bay region during and after a magnitude-7 earthquake (mainshock) on the Hayward Fault and its aftershocks. In this study, the at-risk populations located in areas of concentrated damage are anticipated to experience longer recovery trajectories, increased long term housing displacement, and transportation impacts due to dependencies on transit dependencies. When neighborhood schools close, families with school age children may move to other areas to keep their children in schools. Persons with access and functions needs are likely to be more dependent on access to functioning medical, social and personal health care services that would be overwhelmed by the event and therefore increasing their vulnerabilities. For the homeless populations, the loss of social community services and damages to shelters could add to protracted relocations. For the young and mobile populations who rent, the


major disruption to housing, jobs and transit will also drive relocation. Widespread housing damage and preexisting housing market constraints will make it “extremely challenging” for the socially and economically vulnerable populations to find alternative housing near their home communities. Those who utilize interim and irregular housing for months and years after a disaster are more vulnerable to physical, social, and mental disorders, including suicide, substance abuse, and physical and verbal abuse. Aftershocks and post disaster conditions delay population return and increase outmigration.212

**Erosion**

Risk from erosion relates to earthen and infrastructural losses. The degree of vulnerability to these events and their impacts depends on human behavior and the traditional social factors such as situational awareness, prior knowledge of hazards, social capital and decision-making capabilities, as well as increased vulnerability due to social factors, such as racial and economic disparities.

**Extreme Temps**

People susceptible to respiratory ailments (asthma, lower and upper respiratory disease) disproportionately suffer from the effects of fire, smoke, air pollutions, allergens, heat and PSPS. Those with limited income or without resources are affected disproportionately due to the inability to provide safe shelter, air conditioning, cooling, air purification, medical care, and quality foods, and are also least able to obtain information related to climate risks and adaptation strategies.

**Heat**

Heatstroke, cardiovascular disease, respiratory disease and cerebrovascular disease are related to extreme heat events. Increased number of heat waves creates heat-related physical stress on populations and is exacerbated in the metropolitan areas where greater amounts of heat-absorbing surfaces (e.g., asphalt and concrete) trap heat and emit higher temperatures throughout the night.

The heat also extends the geographic range and the distribution of disease-carrying insects and pests. Health professionals are concerned that California’s warming climate will allow species to acclimate. Such vectors include such pests as ticks that carry Lyme disease, and mosquitoes that transmit Zika, dengue fever, West Nile, plague and tularemia. Some others, such as chikungunya, Chagas disease, and Rift Valley fever virus, are threats as well.

Some communities of color and some low-income, homeless, and immigrant populations are more exposed to heat waves, as these groups often reside in urban areas affected by heat island effects. In addition, these populations are likely to have limited adaptive capacity due to a lack of adequately insulated housing, inability to afford or to use air conditioning, inadequate access to public shelters such as cooling centers, and inadequate access to both routine and emergency health care. These social, economic, and health risk factors give rise to the observed increase in deaths and disease from extreme heat in some immigrant and impoverished communities.

Heat stroke, the most serious heat-related illness, occurs when the body is unable to control its temperature. Body temperature rises rapidly, the sweating mechanism fails, and the body cannot cool down. In extreme cases, heat stroke can cause confusion and unconsciousness, so the victim is unable to seek treatment without assistance.

There are several groups of people who are uniquely vulnerable to the effects of extreme heat, such as infants and children, older adults aged 65 and up, athletes and outdoor workers, low-income households, and individuals with certain chronic medical conditions.

When dealing with an extreme heat event, the most common impacts are those generally felt by the people living in the targeted area. For people in particular, heat can kill when the body is pushed beyond its limits. Most heat disorders occur because the victim has been overexposed to heat. As discussed, the major human risks associated with extreme heat include dehydration, sunburn, fatigue, heat exhaustion, heat stroke, and in severe cases, death.

Some portions of the population are more at risk to the effects of extreme heat. The very young, the elderly, and certain groups with chronic medical conditions (such as asthma or other pulmonary illnesses, heart disease, poor blood circulation, neurological illnesses, and obesity) are generally more vulnerable to the effects of extreme heat, and are more likely to suffer illness or death as a result.

This is especially true if exposure is extended for a period of time and preventative measures are not taken immediately. Distributional implications of impacts, and even less on distributional implications of adaptation actions.”

**Landslides**

Although infrastructural losses are of secondary importance to the risk to humans themselves, research investigating the vulnerability of people to landslides is rare. The many reasons for this lack of data are related to the fact that the collapse of occupied buildings which makes it a function of structural vulnerability and therefore, indirect. The degree of vulnerability to landslides by an individual considered at high risk, or even the

general populations, also depends on human behavior, including many of the traditional social factors that are difficult to measure such as situational awareness, prior knowledge of hazards, and decision-making capabilities.\(^{214}\)

Landslides can result in primary lifeline failures through the loss of roads or power and communication lines. Transportation routes are often expensive to clean up, and prolonged obstruction can disrupt the movement of people and goods. Risk from landslide relates to earthen and infrastructural losses. The degree of vulnerability to these events and their impacts depends on human behavior and the traditional social factors such as situational awareness, prior knowledge of hazards, social capital and decision-making capabilities, as well as increased vulnerability due to social factors, such as racial and economic disparities.

**Power Outage/Public Safety Power Shutdowns (PSPS)**

Loss of power creates economic hardship to a region experiencing regular PSPS events, such as those experienced throughout the state over the recent years. Many businesses close, including gas stations, grocery stores, and local retail establishments. These impacts may deeply impact students dependent on support jobs, as well impacting family members of campus staff and faculty. PSPS increases risks to the public due to inability to use medical devices, spoilage of food and medicines, and disruption to infrastructure, such as supply of clean water and electricity used to run home medical equipment, such as lift chairs and ventilators.

**Wildfire**

Increased wildfire threat occurs especially in the end of fall, when conditions are driest, but before the winter rains have come; an east-to-west wind gusts exacerbate fire risk. Wildfire threats have the concomitant threat of Public Safety Power Shutoffs (PSPS). And, in the case of an actual wildfire, danger exists both from fire and from the smoke. Recent wildfires have demonstrated that some demographics are disproportionately affected. Native Americans are six times more likely to be affected than white people. Blacks and Hispanic people are 50 percent more vulnerable. These values take into account the likelihood of a community being affected and the greater difficulty of that community to recover. These statistics reflect the lack of access to resources to pay for insurance, to rebuild and recover, to implement fire safety measures, and to access other resources. Price gouging after a fire (such as documented in Sonoma County after the 2017 Tubbs Fire) further exacerbates the disparity.\(^{215}\) Furthermore, the disabled and the elderly are at


particular risk from extreme wildfire conditions, as they are often not as able to effectively evacuate. Of the 85 people who died in the Camp Fire in Butte in 2018, 62 of them were at least 65 years old.\textsuperscript{216}

Smoke from wildfires creates a significant public health threat. Especially vulnerable are individuals who have heart or lung issues, such heart disease, lung disease or asthma. Those most vulnerable include the medically fragile, elderly and children. Air Quality Indexes track the level of the following:\textsuperscript{217} particulate matter, surface levels of ozone, carbon monoxide, sulfur dioxide, and nitrogen dioxide. All of these can cause respiratory distress and harm lungs.\textsuperscript{218}

The California Department of Public Health reports the increased public health risks, and risk indicators that include: heat-related ED visits, populations living in wildfire areas, adults with multiple chronic conditions, populations living in poverty, race/ethnicity, outdoor workers, public transit access, air conditioner ownership and tree canopy.\textsuperscript{219}

Hazard Mitigation and Emergency Management Planning

The goal of this high-level assessment is to provide a starting point to encourage further exploring campus social risks and vulnerabilities, as well as to inform and to enhance holistic emergency management and hazard mitigation decision making, planning processes and future adaptive risk management strategies. By including the social resilience factors, mitigation investments may move beyond standardized planning and regulations, structure and infrastructure projects, and natural systems protections to embrace a more expanded, customized emergency operations plan and an education and outreach program unique to the campus.

A more robust social resilience inquiry is strongly encouraged to develop an accurate picture, based on methodical and scientific research-based data. Such an effort would be envisioned through both nuanced discussions with a variety of campus stakeholders and the invitation of nontraditional stakeholders to join in a collaborative resilience partnership. Such a forward-leaning effort would be directly in keeping with CSU’s commitment to inclusion and equity in risk reduction.


Section 21
San Francisco State University

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21.1 University Profile

University History

Founded in 1899 as a normal school, San Francisco State University became a four-year school in 1930 and received university status as a part of the California State University system in 1972. During the next fifty years, the University played a large role in increasing the size and offerings of the California State University system. It was also the site of several protests during the 1960s and 1970s, including the longest student strike in U.S. history. Today, San Francisco State University includes seven colleges and is classified as a Master’s College by the Carnegie Institute. It is also designated as both a Hispanic-Serving Institution (HSI) and an Asian American and Native American Pacific Islander-Serving Institution (AANAPISI).

University Governance

The campus president is the chief executive officer who oversees the administration of the entire university. The president manages campus operations and fundraising, oversees strategic planning processes, sets campus priorities, and oversees the hiring and support of staff and faculty. The president also maintains a close working relationship with the CSU’s systemwide office, reporting to the chancellor and participating in the systemwide Executive Council.

The provost is the chief academic officer of the university, overseeing all academic affairs and programs of the university. The provost reports directly to the president.

The San Francisco State Academic Senate, made up of university community members, develops policies and procedures regarding the hiring and support of staff and faculty, business and fiscal matters, University goals and academic standards, and campus development. The Executive Committee of the Academic Senate constitutes its leadership and is made up of three officers, two at-large members, three ASCSU representatives, and the five chairs of the Senate standing committees; all committee members are elected annually. The Standing Committees include: Academic Policies, Curriculum Review and Approval, Faculty Affairs, Strategic Issues, and Student Affairs.

University Mission

“From the heart of a diverse community, San Francisco State University honors roots, stimulates intellectual and personal development, promotes equity, and inspires the courage to lead, create, and innovate.”

The University expresses a commitment to broad access to quality education, diversity, and issues of social justice.

University Location
The San Francisco State University campus encompasses 142 acres two miles from the Pacific Ocean. It is located in the southwestern portion of San Francisco, a major urban area on the northern California coast with a dense population of about 881,000. The three principal cities of the Bay Area - Oakland, San Jose, and San Francisco – represent different employment clusters, including the financial and business industry, heavy industry, and technology industry. The North Bay contributes to California’s agriculture and wine industry. The Bay area’s proximity to the San Andreas and Hayward Faults results in recurrent earthquake activity.

University Population

San Francisco State University typically enrolls approximately 30,000 each semester. In fall 2019, the 28,880-student population was overwhelmingly made up of undergraduate degree seekers, among whom the average age is 22. Asian students make up 30% of the undergraduate students, with Chicano/Mexican American students making up the second most populous group at 27%. About a third of students are first generation to attend college; about half are first generation to earn a bachelor’s degree.

In addition to the student population, the University is home to 3,567 employees, 55% of whom are faculty.

21.2 Interim Final Rule for Hazard Vulnerability and Risk Assessment

Requirement §201.6(c)(2): The plan shall include a risk assessment that provides the factual basis for activities proposed in the strategy to reduce losses from identified hazards. Local risk assessments must provide sufficient information to enable the jurisdiction to identify and prioritize appropriate mitigation actions to reduce losses from identified hazards.

Requirement §201.6(c)(2)(i): [The risk assessment shall include a] description of the type...location and extent of all natural hazards that can affect the jurisdiction. The plan shall include information on previous occurrences of hazard events and on the probability of future hazard events.

Requirement §201.6(c)(2)(ii): [The risk assessment shall include a] description of the jurisdiction’s vulnerability to the hazards described in paragraph (c)(2)(i) of this section. This description shall include an overall summary of each hazard and its impact on the community.

Requirement §201.6(c)(2)(ii)(A): [The risk assessment] must also address National Flood Insurance Program (NFIP) insured structures that have been repetitively damaged floods.

Requirement §201.6(c)(2)(ii)(A): The plan should describe vulnerability in terms of the
types and numbers of existing and future buildings, infrastructure, and critical facilities located in the identified hazard area.

**Requirement §201.6(c)(2)(ii)(B):** [The plan should describe vulnerability in terms of an] estimate of the potential dollar losses to vulnerable structures identified in paragraph (c)(2)(ii)(A) of this section and a description of the methodology used to prepare the estimate.

**Requirement §201.6(c)(2)(ii)(C):** [The plan should describe vulnerability in terms of] providing a general description of land uses and development trends within the community so that mitigation options can be considered in future land use decisions.

**Requirement §201.6(c)(2)(iii):** For multi-jurisdictional plans, the risk assessment must assess each jurisdiction’s risks where they vary from the risks facing the entire planning area.

### 21.3 Hazard Identification and Risk Assessment

**Overview of San Francisco State University History of Hazards**

Numerous federal agencies maintain a variety of records regarding losses associated with hazards. Unfortunately, no single source is considered to offer a definitive accounting of all losses. The Federal Emergency Management Agency (FEMA) maintains records on federal expenditures associated with declared major disasters. The US Army Corps of Engineers (USACE) and the Natural Resources Conservation Service (NRCS) collect data on losses during the course of some of their ongoing projects and studies. Additionally, the National Oceanic and Atmospheric Administration’s (NOAA) National Centers for Environmental Information (NCEI) database collects and maintains data about natural hazards in summary format. The data includes occurrences, dates, injuries, deaths, and estimated costs. Many of these databases and other data collection services, including the NCEI, have inherent data limitations when searching for information at a university scale.

The best available data and records were used throughout this assessment.

**Hazard Identification**

As part of the initial hazard identification process, the Campus Assessment Team considered potential hazards with the most chance to significantly affect the planning area. The hazards include those that have occurred in the past and may occur in the future. A variety of sources were used to develop the list of hazards considered including national, regional, and local sources such as emergency operations plans, FEMA’s *How-To Series*, websites, published documents, databases, and maps, as well as discussion among the Campus Assessment Team members.

In the initial phase of the planning process, the Campus Assessment Team considered 14 hazards and the risks they create for the University and its material assets, population,
and operations. The hazards initially considered, and the determinations as to the treatment of those hazards, are shown in Table 21-1 (following).

Table 21-1: Hazard Identification Determinations

<table>
<thead>
<tr>
<th>Hazard</th>
<th>Determination (Yes/No)</th>
<th>Reason for Determination</th>
<th>Future Occurrence Probability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Communicable Disease</td>
<td>Yes</td>
<td>Hazard of concern to campus</td>
<td>Highly Likely</td>
</tr>
<tr>
<td>Dam and Levee Failure</td>
<td>No</td>
<td>Not a hazard of concern to campus</td>
<td>N/A</td>
</tr>
<tr>
<td>Drought</td>
<td>Yes</td>
<td>Hazard of concern to campus</td>
<td>Highly Likely</td>
</tr>
<tr>
<td>Earthquake</td>
<td>Yes</td>
<td>Hazard of concern to campus</td>
<td>Possible</td>
</tr>
<tr>
<td>Erosion</td>
<td>Yes</td>
<td>Hazard of concern to campus</td>
<td>Unlikely</td>
</tr>
<tr>
<td>Extreme Temperature</td>
<td>Yes</td>
<td>Hazard of concern to campus</td>
<td>Likely; Unlikely (Cold)</td>
</tr>
<tr>
<td>Flood</td>
<td>Yes</td>
<td>Hazard of concern to campus</td>
<td>Unlikely</td>
</tr>
<tr>
<td>Hazardous Materials</td>
<td>Yes</td>
<td>Hazard of concern to campus</td>
<td>Possible</td>
</tr>
<tr>
<td>Landslide</td>
<td>Yes</td>
<td>Hazard of concern to campus</td>
<td>Unlikely</td>
</tr>
<tr>
<td>Power Outage</td>
<td>Yes</td>
<td>Hazard of concern to campus</td>
<td>Likely</td>
</tr>
<tr>
<td>Sea Level Rise</td>
<td>No</td>
<td>Not a hazard of concern to campus</td>
<td>N/A</td>
</tr>
<tr>
<td>Tsunami</td>
<td>No</td>
<td>Not a hazard of concern to campus</td>
<td>N/A</td>
</tr>
<tr>
<td>Volcano</td>
<td>Yes</td>
<td>Hazard of concern to campus</td>
<td>Unlikely</td>
</tr>
<tr>
<td>Wildfire</td>
<td>Yes</td>
<td>Hazard of concern to campus</td>
<td>Unlikely; Possible (Smoke)</td>
</tr>
</tbody>
</table>

**Future Occurrence Probability**

In order to determine the probability of future occurrences of each hazard profiled, the following scale was developed:

- Highly Likely- 76%-100% that the hazard would occur annually.
- Likely- 50%-75% that the hazard would occur annually.
- Possible- 11%-49% that the hazard would occur each annually.
- Unlikely- 0%-10% that the hazard would occur each annually.
Communicable Disease

Description of the Hazard

Communicable diseases are illnesses that occur due to infectious agents or their toxic products and are infectious due to their potential of transmission from one person or species to another by a replicating agent. They may be transmitted from a reservoir to a susceptible host either directly as from an infected person or animal or indirectly through the agency of an intermediate plant or animal host, vector, or the inanimate environment. Communicable diseases are clinically evident illness resulting from the presence of pathogenic microbial agents, including pathogenic viruses, pathogenic bacteria, fungi, protozoa, multi-cellular parasites, and aberrant proteins known as prions. The degree of spread of a communicable disease depends on both the ability of an organism to enter, survive and multiply in the host and the comparative ease with which the disease is transmitted to other hosts.

Some ways in which communicable diseases spread are by:

- Travel through the air, such as tuberculosis, measles, or COVID-19;
- Physical contact with an infected person, such as through touch (staphylococcus), sexual intercourse (gonorrhea, HIV), fecal/oral transmission (hepatitis A), or droplets (influenza, TB, COVID-19);
- Contact with a contaminated surface or object (Norwalk virus), food (salmonella, E. coli), blood (HIV, hepatitis B), or water (cholera); and
- Bites from insects or animals capable of transmitting the disease (mosquito: malaria and yellow fever; flea: plague)

Collectively, the twenty-three (23) campuses and Chancellor’s Office of the California State University (CSU) system have identified nine (9) communicable disease hazards that have had significant impacts on their respective student, faculty, and staff populations. Of these communicable diseases, COVID-19 is considered to be the most prominent and widespread agent across all CSU campuses. (See Table 21-2 below.)

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1 California Legislative Information. Health and Safety Code – HSC. Print. Retrieved 03.22.2021 from: https://leginfo.legislature.ca.gov/faces/codes_displaySection.xhtml?lawCode=HSC&sectionNum=120290.&text=(2)%20%E2%80%9CInfectious%20or%20communicable%20disease%20has%20significant%20public%20health%20implications
Table 21-2: Communicable Diseases Identified CSU Campuses

<table>
<thead>
<tr>
<th>Collective List of Communicable Diseases Identified by All CSU Campuses</th>
<th>Number of CSU Campuses (Including Chancellor’s Office) Identifying Communicable Disease Having Significant Impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>COVID-19 (SARS-CoV-2)</td>
<td>24</td>
</tr>
<tr>
<td>Meningitis</td>
<td>7</td>
</tr>
<tr>
<td>Measles</td>
<td>6</td>
</tr>
<tr>
<td>Influenza (Including H1N1/Swine Flu)</td>
<td>6</td>
</tr>
<tr>
<td>Tuberculosis</td>
<td>5</td>
</tr>
<tr>
<td>Norovirus</td>
<td>4</td>
</tr>
<tr>
<td>Mumps</td>
<td>2</td>
</tr>
<tr>
<td>E. Coli</td>
<td>2</td>
</tr>
<tr>
<td>Sexually Transmitted Diseases (STDs)</td>
<td>2</td>
</tr>
</tbody>
</table>

(Source: Interviews with CSU campus staff at CSU campuses and at CSU Chancellor’s Office.)

With the exception of COVID-19, there is variability among CSU campuses regarding which communicable diseases have had the greatest impact on individual campus communities. Table 21-3 shows the communicable disease hazards that have had the greatest impact on each CSU campus.
Table 21-3: Communicable Disease Hazards at CSU Campuses with Greatest Impact

<table>
<thead>
<tr>
<th>CSU Campus</th>
<th>Identified Communicable Disease Hazards with the Greatest Impact on CSU Campus</th>
</tr>
</thead>
<tbody>
<tr>
<td>CSU Bakersfield</td>
<td>COVID-19, Meningitis</td>
</tr>
<tr>
<td>CSU Channel Islands</td>
<td>COVID-19, Measles</td>
</tr>
<tr>
<td>Chico State</td>
<td>COVID-19, Tuberculosis</td>
</tr>
<tr>
<td>CSU Dominguez Hills</td>
<td>COVID-19</td>
</tr>
<tr>
<td>Cal State East Bay</td>
<td>COVID-19, Meningitis</td>
</tr>
<tr>
<td>Fresno State</td>
<td>COVID-19, Meningitis, Tuberculosis</td>
</tr>
<tr>
<td>Cal State Fullerton</td>
<td>COVID-19, Influenza</td>
</tr>
<tr>
<td>Humboldt State</td>
<td>COVID-19, Measles, Norovirus, Influenza, STDs</td>
</tr>
<tr>
<td>Cal State Long Beach</td>
<td>COVID-19</td>
</tr>
<tr>
<td>Cal State LA</td>
<td>COVID-19, E. coli, Measles</td>
</tr>
<tr>
<td>Cal Maritime</td>
<td>COVID-19</td>
</tr>
<tr>
<td>CSU Monterey Bay</td>
<td>COVID-19</td>
</tr>
<tr>
<td>CSUN (Northridge)</td>
<td>COVID-19, Measles</td>
</tr>
<tr>
<td>Cal Poly Pomona</td>
<td>COVID-19, Influenza (Swine Flu - H1N1)</td>
</tr>
<tr>
<td>Sacramento State</td>
<td>COVID-19</td>
</tr>
<tr>
<td>Cal State San Bernardino</td>
<td>COVID-19, Tuberculosis</td>
</tr>
<tr>
<td>San Diego State</td>
<td>COVID-19, Meningitis, Mumps</td>
</tr>
<tr>
<td>San Francisco State</td>
<td>COVID-19</td>
</tr>
<tr>
<td>San José State</td>
<td>COVID-19, H1N1</td>
</tr>
<tr>
<td>Cal Poly San Luis Obispo</td>
<td>COVID-19, Meningitis, Norovirus</td>
</tr>
<tr>
<td>CSU San Marcos</td>
<td>COVID-19</td>
</tr>
<tr>
<td>Sonoma State</td>
<td>COVID-19, H1N1, Norovirus</td>
</tr>
<tr>
<td>Stanislaus State</td>
<td>COVID-19, Tuberculosis</td>
</tr>
<tr>
<td>Office of the Chancellor</td>
<td>COVID-19</td>
</tr>
<tr>
<td>CSU System-Wide</td>
<td>COVID-19, Meningitis, Measles, Tuberculosis, Influenza-Swine Flu-H1N1, Mumps, Norovirus, E. coli, STDs</td>
</tr>
</tbody>
</table>

(Source: Interviews with CSU campus staff at CSU campuses and at CSU Chancellor’s Office.)
Descriptions of Identified Communicable Disease Hazards at San Francisco State University

San Francisco State University (SFSU) has identified one (1) communicable disease hazard that has had the greatest impact on campus – COVID-19. The following is a brief description of the communicable disease hazard at SFSU.

COVID-19 (SARS-CoV-2)

Coronaviruses are a family of viruses that can cause illnesses such as the common cold, severe acute respiratory syndrome (SARS) and Middle East respiratory syndrome (MERS). In 2019, a new coronavirus was identified as the cause of a disease outbreak that originated in China. This virus is now known as the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2). The disease it causes is called Coronavirus Disease 2019 (COVID-19). In March 2020, the World Health Organization (WHO) declared the COVID-19 outbreak a pandemic.

Signs and symptoms of coronavirus disease 2019 (i.e., COVID-19) may appear two to 14 days after exposure. Common signs and symptoms can include fever, cough, and tiredness. Early symptoms of COVID-19 may also include a loss of taste or smell.

The virus that causes COVID-19 spreads easily among people, and more continues to be discovered over time about how it spreads. Data has shown that the COVID-19 virus spreads mainly from person to person among those in close contact (within about 6 feet, or 2 meters). The virus is transmitted by respiratory droplets being released when someone with the virus coughs, sneezes, breathes, sings or talks. These droplets can be inhaled or land in the mouth, nose or eyes of a person nearby. In some situations, the COVID-19 virus can spread by a person being exposed to small droplets or aerosols that stay in the air for several minutes or hours (i.e., airborne transmission). It's not yet known how common it is for the virus to spread this way. The COVID-19 virus can also spread if a person touches a surface or object with the virus on it and then touches his or her mouth, nose or eyes; however, this is not considered to be a main way it spreads.

The severity of COVID-19 symptoms can range from very mild to severe. Some people may have only a few symptoms, and some people may have no symptoms at all. However, some people may experience worsened symptoms, such as worsened shortness of breath and pneumonia. People who are older have a higher risk of serious illness from COVID-19, and the risk increases with age. People who have existing medical conditions also may have a higher risk of serious illness from COVID-19. In some cases, the disease can cause severe medical complications and may even lead to death.  

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Location of the Hazard

Communicable diseases have the potential to affect the entire San Francisco State University (SFSU) planning area equally. As a result, the communicable disease hazard can be found at both the SFSU main campus and Downtown San Francisco campus; both campuses are located in San Francisco, CA (San Francisco County). The communicable disease hazard can also be found (June through August only) at the SFSU Sierra Nevada Field Campus in Calpine, CA (Sierra County). Because of the ubiquitous nature of many communicable diseases, students, faculty, staff at (and visitors to) all three (3) SFSU locations are at risk of exposure to the communicable disease hazard.

CSU Student Housing Locations and Populations

Although CSU-campus-owned student housing opportunities have been severely limited due to the COVID-19 pandemic, this situation is temporary. Eventually, students will be allowed back on campus at full capacity, and many of these students will be living in campus-owned housing. When this occurs, over 53,000 students (i.e., just over 11% of the CSU total enrollment) will be at increased risk of exposure to communicable disease hazards, owing to the “close-quarters” living arrangements in student housing. For SFSU, approximately 13% of its 28,880 enrolled students (or 3,754 students) reside in student housing.

Extent of the Hazard

Various communicable diseases are categorized by the Center for Disease Control and Prevention (CDC) by levels of containment called Biosafety Levels (or BSLs). The higher the BSL, the greater the level of containment and level of effort necessary to prevent transmission of the disease, and therefore the greater the hazard. Biosafety Levels prescribe procedures and levels of containment for a particular microorganism or material (including research involving recombinant or synthetic nucleic acid molecules) and procedures associated with that containment. BSLs also consider primary barriers (e.g., biosafety cabinets), secondary barriers, facility design, air handling, laboratory security, etc. BSLs are graded from 1 to 4; as the BSL increases so does the relative risk of the agent/procedures as well the stringency of procedures and facility design.

Figure 21-1 describes the different BSLs, and provides examples of communicable diseases that would typically fall in to these classifications, as well as the typical protections that would be necessary to prevent transmission of each of the diseases.

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6 San Francisco State University. About. Retrieved 4.29.2021 from: https://cel.sfsu.edu/about
8 California State University. CSU Campus Match. Retrieved 04.30.2021 from: https://www2.calstate.edu/attend/campuses/campus-match/Pages/campus-match.aspx
The Extent of San Francisco State University Communicable Disease Hazards except COVID-19:

Besides COVID-19, there was no information provided on other communicable disease hazards on campus.

The Extent of San Francisco State University COVID-19 Communicable Disease Hazard:

As a microorganism, the SARS-CoV-2 (COVID-19) virus requires a high level of containment. It is therefore classified at BSL-3.  

History of the Hazard

Over an approximately one-year period, from mid-March, 2020 to March 23, 2021, there were a reported 32 cases of COVID-19 at San Francisco State University (SFSU). Most communicable disease data are maintained by at the state and at the county levels, and are not generally available at the municipal or campus levels, unless (a) the CSU campus falls under the jurisdiction of a city-level health department, or (b) a geographically

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specific outbreak occurs on campus or in the local community. The exception to this is the current COVID-19 pandemic, where both campus and County-level case data have been collected. As a result, it is important to provide COVID-19 case statistics for both CSU campuses and the counties where CSU campus assets are located.

Tables 21-5, 21-6, and 21-7 show campus-level and County-level COVID-19 case data for San Francisco State University (SFSU). These case data are updated on at least a weekly basis. (Please note that the COVID-19 case numbers here may not reflect the most recent updates.)

Table 21-4: Campus-level case data for SFSU (as of 03/20/2021)\textsuperscript{11}

<table>
<thead>
<tr>
<th>Case Type</th>
<th>Number of Cases</th>
</tr>
</thead>
<tbody>
<tr>
<td>Student cases reported (including students living in student housing)</td>
<td>14</td>
</tr>
<tr>
<td>Faculty and staff cases reported</td>
<td>16</td>
</tr>
<tr>
<td>Vendor and visitor cases reported</td>
<td>2</td>
</tr>
<tr>
<td>Total cases reported</td>
<td>32</td>
</tr>
</tbody>
</table>

Table 21-5: Confirmed COVID-19 Statistics for San Francisco County (as of 03/19/2020)\textsuperscript{12}

<table>
<thead>
<tr>
<th>COVID-19 Statistic</th>
<th>Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cases</td>
<td>34,781</td>
</tr>
<tr>
<td>Deaths</td>
<td>451</td>
</tr>
</tbody>
</table>


Table 21-6: Confirmed COVID-19 Statistics for Sierra County (as of 03/19/2020)13

<table>
<thead>
<tr>
<th>COVID-19 Statistic</th>
<th>Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cases</td>
<td>103</td>
</tr>
<tr>
<td>Deaths</td>
<td>0</td>
</tr>
</tbody>
</table>

Potential Impacts of the Hazard

Communicable disease outbreaks and pandemics potentially have (and will continue to have) direct impact on life, health, and safety across the CSU system, including the SFSU campus. The extent of this impact is contingent on the type of infection or contagion, the severity of the outbreak, and the speed at which it is transmitted. Property and infrastructure integrity may be affected if large portions of the campus population contract communicable diseases at the same time and are therefore unable to perform maintenance, operations, and educational tasks. This would be particularly disruptive if those impacted are first responders or other essential personnel. Long-term outbreaks affecting large numbers of SFSU students could result in cancelled classes, delayed matriculation, or other disruptions to the CSU System’s mission. This has already occurred with the current COVID-19 pandemic and could occur again with more virulent strains of communicable diseases, including COVID-19.

Communicable disease hazards found across the CSU system (including SFSU) vary both by level of containment (BSL) (described previously) and by level of individual/public health risk, or Risk Group (RG) level. While BSLs describe the procedures and required levels of containment in a laboratory setting, Risk Groups (RGs) reflect the potential effects of disease exposure on humans or animals. Like BSLs, RGs range from Level 1 (RG1) to Level 4 (RG4), with Level 1 (RG1) posing minimal risk to healthy individuals and public health and Level 4 (RG4) posing a very serious or extreme risks to individuals and public. BSLs generally correlate with Risk Group (RG) Levels (e.g., a RG2 agent is worked with at BSL-2), but there are exceptions (e.g., production volumes, high-risk procedures, etc.). 14

The World Health Organization’s (WHO) Laboratory Biosafety Manual, 3rd ed., NIH Guidelines, categorizes Risk Groups (RGs) in the following way:


Table 21-7: WHO Risk Group Categorization

<table>
<thead>
<tr>
<th>Risk Group (RG)</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>RG1</td>
<td>Rarely associated with disease in healthy adult humans or animals and pose no-to-little public health risk (e.g., Saccharomyces cerevisiae, E. coli K-12 strain derivatives often used for recombinant/molecular biology, many environmental organisms)</td>
</tr>
<tr>
<td>RG2</td>
<td>Associated with mild to moderate disease for which preventative measures or post exposure treatments are often available; public health impact is limited (e.g., Streptococcus pyogenes, Salmonella, hepatitis B virus)</td>
</tr>
<tr>
<td>RG3</td>
<td>Associated with serious to lethal human disease for which preventative vaccines or post-exposure therapies may be scarce. Public health impact is limited-to-moderate (e.g., Mycobacterium tuberculosis, hantaviruses, West Nile virus, SARS)</td>
</tr>
<tr>
<td>RG4</td>
<td>Associated with serious to lethal human disease for which preventative vaccines or post exposure therapies are not usually available. Public health impact is high (e.g., Ebola virus, Marburg virus, smallpox virus, etc.)</td>
</tr>
</tbody>
</table>

Table 21-9 describes the four (4) Risk Group Levels (RGs), and provides examples of communicable diseases that would typically fall in to these classifications, and the typical protections that would be necessary to prevent transmission of the disease. It is important to note that all but two (2) communicable disease hazards identified by CSU campuses fall under either the lower-risk RG1 or RG2 categories. COVID-19 and tuberculosis are the two (2) communicable diseases fall under the higher-risk RG3 category. However, with the advent of the recently-developed COVID-19 vaccine, and with the expectation of an increasingly robust vaccine supply, it is possible that the RG level for COVID-19 could be lowered in the future, thereby reducing both the extent and the potential impact of COVID-19.

---

Table 21-8: Risk Group Levels (RGs) with Example Diseases and Recommended Precautions

<table>
<thead>
<tr>
<th>Level</th>
<th>Examples</th>
<th>Typical Protection to Prevent Transmission</th>
</tr>
</thead>
<tbody>
<tr>
<td>Risk Group Level I</td>
<td>E. Coli</td>
<td>Precautions are minimal, most likely involving gloves and some sort of facial protection. Usually, contaminated materials are left in open (but separately indicated) waste receptacles. Decontamination procedures for this level are similar in most respects to modern precautions against everyday viruses (i.e.: washing one’s hands with anti-bacterial soap, washing all exposed surfaces of the lab with disinfectants, etc.).</td>
</tr>
<tr>
<td>Risk Group Level II</td>
<td>Chicken Pox</td>
<td>These bacteria and viruses cause mild disease in humans or are difficult to contract via aerosol. Routine diagnostic work with clinical specimens can be done safely at BSL-2, using BSL-2 practices and procedures.</td>
</tr>
<tr>
<td></td>
<td>Hepatitis A, B, C</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Lyme disease</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Salmonella</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Mumps</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Measles</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Malaria</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Scrapie</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Dengue Fever</td>
<td></td>
</tr>
<tr>
<td></td>
<td>HIV</td>
<td></td>
</tr>
</tbody>
</table>

---

| Risk Group Level III | Anthrax  
| West Nile Virus  
| SARS Virus (Including COVID-19)  
| Tuberculosis  
| Typhus  
| Yellow Fever  
| Hantaviruses  
| Avian Flu | These bacteria and viruses cause severe to fatal disease in human, but vaccines or other treatments do exist to combat them. Laboratory personnel have specific training in handling pathogenic and potentially lethal agents and are supervised by competent scientists who are experienced in working with these agents. This is considered a neutral or warm zone. |

| Risk Group Level IV | H5N1 (Bird Flu)  
| Dengue Hemorrhagic Fever  
| Marburg Virus  
| Ebola Virus  
| Smallpox  
| Lassa Fever  
| Crimean-Congo Hemorrhagic Fever  
| Other Hemorrhagic Diseases | These viruses and bacteria cause severe to fatal disease in humans, for which vaccines or other treatments are not available. When dealing with biological hazards at this level the use of a Hazmat suit and a self-contained oxygen supply is mandatory. The entrance and exit of a BSL-4 lab will contain multiple showers, a vacuum room, an ultraviolet light room, autonomous detection system, and other safety precautions designed to destroy all traces of the biohazard. Multiple airlocks are employed and are electronically secured to prevent both doors opening at the same time. All air and water service going to and coming from a BSL-4 lab will undergo similar decontamination procedures to eliminate the possibility of an accidental release. |

**Probability of Future Occurrence of the Hazard**

There are significant data limitations regarding non-COVID-19 communicable disease cases, as the information thereof is outdated, anecdotal, and/or inadequate. As a result, it is not feasible to provide quantitative probabilities of future occurrence for non-COVID-19 communicable disease hazards. However, based on the limited data, it is feasible to present qualitative probabilities of future occurrence based on ranges of communicable disease frequency. Table 21-10 shows a probability scale of future occurrence for the nine (9) communicable disease hazards profiled in this assessment. This scale is divided into four (4) levels of probability:
Table 21-9: Likelihood of Future Hazard Occurrence

<table>
<thead>
<tr>
<th>Likelihood</th>
<th>Parameters for Determining Likelihood</th>
</tr>
</thead>
<tbody>
<tr>
<td>Highly Likely</td>
<td>76 – 100% probability that hazard will occur annually (high to very high frequency)</td>
</tr>
<tr>
<td>Likely</td>
<td>50 – 75% probability that hazard will occur annually (moderate to high frequency)</td>
</tr>
<tr>
<td>Possible</td>
<td>11 – 49% probability that hazard will occur annually (low to moderate frequency)</td>
</tr>
<tr>
<td>Unlikely</td>
<td>0 – 10% probability that hazard will occur annually (very low to low frequency)</td>
</tr>
</tbody>
</table>

Due to significant data limitations surrounding non-COVID communicable diseases, the probability of future occurrence of CSU-system-wide communicable disease is measured by the proportion of campuses that have identified a particular communicable disease as having an impact on the campus community. In this measure, the more frequent a communicable disease is seen as impactful CSU-wide, the greater the probability of future occurrence.

Note: Each communicable disease’s probability of future occurrence ranking CSU-system-wide reflects the ranking at the individual CSU campus level unless noted otherwise.

Table 21-10: Probability of Future Occurrence of Communicable Disease Hazard for CSU System.

<table>
<thead>
<tr>
<th>Collective List of Communicable Diseases Identified by All CSU Campuses</th>
<th>Number of CSU Campuses (Including Chancellor’s Office) Identifying Communicable Disease Having Significant Impact</th>
<th>Proportion of CSU Campuses Identifying Communicable Disease as Having Significant Impact System-Wide</th>
<th>CSU System-Wide Probability Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>COVID-19 (SARS-CoV-2)</td>
<td>24</td>
<td>1.00</td>
<td>Highly Likely</td>
</tr>
<tr>
<td>Meningitis</td>
<td>7</td>
<td>0.29</td>
<td>Possible</td>
</tr>
<tr>
<td>Measles</td>
<td>6</td>
<td>0.25</td>
<td>Possible</td>
</tr>
<tr>
<td>Influenza (Including H1N1/Swine Flu)</td>
<td>6</td>
<td>0.25</td>
<td>Possible</td>
</tr>
<tr>
<td>Tuberculosis</td>
<td>5</td>
<td>0.21</td>
<td>Possible</td>
</tr>
<tr>
<td>Norovirus</td>
<td>4</td>
<td>0.17</td>
<td>Possible</td>
</tr>
<tr>
<td>Mumps</td>
<td>2</td>
<td>0.08</td>
<td>Unlikely</td>
</tr>
</tbody>
</table>
Vulnerability to the Hazard

Vulnerability to a communicable diseases hazard resides in the population of a given area – both human and animal – not in the infrastructure or physical assets. While CSU assets and infrastructure could be impacted indirectly by the communicable disease hazard, these impacts would be secondary to the impact that the communicable disease hazard would have on students, faculty, staff, and visitors at the SFSU campus.

CSU campus settings are geographically diverse, with locations ranging from small towns to medium-sized cities to densely populated urban areas. Hundreds of thousands of people work, study, and/or pass through CSU campuses on any given day. (As of Fall 2019, San Francisco State University had 28,880 students and additional faculty and staff.) Each of these persons is vulnerable to communicable disease, particularly if it is a pathogen that individual has not been immunized against, or for which no immunization exists. Prolonged outbreaks could result in a loss of services, failure of infrastructure (from lack of operators or maintenance), and closure of facilities. This exact scenario has played out in the current COVID-19 pandemic on the SFSU campus.

Estimate of Potential Losses

COVID-19 Pandemic Health Impact on CSU Campuses and Surrounding Communities

The most prescient metric for estimating losses from COVID-19 is loss of life. The nationwide campus-related COVID-19 death rate of 0.02% remains well below the average COVID-19 death rate in the U.S. However, due to data limitations, there is no information on CSU-campus-specific deaths by COVID-19 or by any other communicable diseases. In fact, COVID-19 is the only communicable disease for which case reports have been readily available for CSU campuses.

At some point in the future, CSU campuses will return to full capacity. Without adequate surveillance regarding campus access and student and employee interaction, CSU campuses are at risk of developing an extreme incidence of COVID-19 and may become

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17 The California State University. Enrollment. Retrieved 05.03.2021 from: https://www2.calstate.edu/csu-system/about-the-csu/facts-about-the-csu/enrollment/Pages/default.aspx

18 The California State University. Employee Head Count by Campus. Retrieved 05.03.2021 from: https://www2.calstate.edu/csu-system/faculty-staff/employee-profile/csu-workforce/Pages/employee-headcount-by-campus.aspx
“super-spreaders” for adjacent communities. The emergence of more virulent COVID-19 variants would only add to the potential for high negative impacts on life safety, operations, and service delivery across the CSU system. (Other communicable diseases would also re-emerge, but with low to moderate negative impacts on life safety, operations, and service delivery.)

**Economic Impact of COVID-19 Pandemic on CSU Financial Health**

During the first few months of the COVID-19 pandemic in 2020, the CSU system suffered tremendous negative fiscal impacts. From March through July of 2020 alone, over $146 million worth of revenue losses were sustained across the CSU system due to refunds to students for parking, housing and dining service fees during Spring Semester, 2020. Several CSU campuses saw refund losses surpass $10 million. (See Figure 21-2.)

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Mitigative Relief from Federal Assistance

The $1.5 billion in total federal assistance sent to the CSU system will help relieve the losses of revenues from services like dorms, parking and dining services during a year of mainly empty campuses. (See Table 21-12) However, because of staggering COVID-related revenue losses, the CSU system is planning for three (3) years of fiscal duress.

Table 23-11: Total Federal Assistance to CSU for COVID-19 Related Losses, 2020 – 2021

<table>
<thead>
<tr>
<th>Institution</th>
<th>December 2020 Stimulus</th>
<th>CARES Act</th>
<th>APLU Projection of HEERF Total ARP Act Funding Allocation</th>
<th>Total Estimated Federal COVID Relief Funding</th>
</tr>
</thead>
<tbody>
<tr>
<td>California Polytechnic State University</td>
<td>$20,752,799</td>
<td>$14,725,000</td>
<td>$37,000,928</td>
<td>$72,478,727</td>
</tr>
<tr>
<td>California State Polytechnic University, Pomona</td>
<td>$48,614,353</td>
<td>$31,102,000</td>
<td>$86,044,649</td>
<td>$165,761,002</td>
</tr>
<tr>
<td>California State University Channel Islands</td>
<td>$14,288,099</td>
<td>$8,512,000</td>
<td>$24,915,170</td>
<td>$47,715,269</td>
</tr>
<tr>
<td>California State University Maritime Academy</td>
<td>$1,381,700</td>
<td>$1,204,000</td>
<td>$2,472,622</td>
<td>$5,058,322</td>
</tr>
<tr>
<td>California State University - Sacramento</td>
<td>$59,891,260</td>
<td>$35,643,000</td>
<td>$104,900,133</td>
<td>$200,434,393</td>
</tr>
<tr>
<td>California State University, Bakersfield</td>
<td>$22,855,632</td>
<td>$12,483,000</td>
<td>$40,285,565</td>
<td>$75,624,197</td>
</tr>
<tr>
<td>California State University, Chico</td>
<td>$31,603,856</td>
<td>$20,019,000</td>
<td>$55,754,538</td>
<td>$107,377,394</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>University</th>
<th>Bond 1</th>
<th>Bond 2</th>
<th>Bond 3</th>
<th>Bond 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>California State University, Dominguez Hills</td>
<td>$31,843,563</td>
<td>$18,312,000</td>
<td>$55,915,410</td>
<td>$106,070,973</td>
</tr>
<tr>
<td>California State University, East Bay</td>
<td>$24,243,652</td>
<td>$14,394,000</td>
<td>$42,929,208</td>
<td>$81,566,860</td>
</tr>
<tr>
<td>California State University, Fresno</td>
<td>$52,725,317</td>
<td>$32,557,000</td>
<td>$92,926,594</td>
<td>$178,208,911</td>
</tr>
<tr>
<td>California State University, Fullerton</td>
<td>$67,736,949</td>
<td>$41,088,000</td>
<td>$120,859,884</td>
<td>$229,684,833</td>
</tr>
<tr>
<td>California State University, Long Beach</td>
<td>$67,421,424</td>
<td>$41,202,000</td>
<td>$119,508,329</td>
<td>$228,131,753</td>
</tr>
<tr>
<td>California State University, Los Angeles</td>
<td>$61,905,561</td>
<td>$40,067,000</td>
<td>$108,543,672</td>
<td>$210,516,233</td>
</tr>
<tr>
<td>California State University, Monterey Bay</td>
<td>$13,455,716</td>
<td>$8,705,000</td>
<td>$23,922,768</td>
<td>$46,083,484</td>
</tr>
<tr>
<td>California State University, Northridge</td>
<td>$74,004,088</td>
<td>$47,458,000</td>
<td>$131,021,450</td>
<td>$252,483,538</td>
</tr>
<tr>
<td>California State University, San Bernardino</td>
<td>$42,438,131</td>
<td>$27,924,000</td>
<td>$74,982,459</td>
<td>$145,344,590</td>
</tr>
<tr>
<td>California State University, San Marcos</td>
<td>$26,602,684</td>
<td>$15,542,000</td>
<td>$46,496,808</td>
<td>$88,641,492</td>
</tr>
<tr>
<td>California State University, Stanislaus</td>
<td>$22,007,207</td>
<td>$12,928,000</td>
<td>$38,636,391</td>
<td>$73,571,598</td>
</tr>
<tr>
<td>Humboldt State University</td>
<td>$16,130,016</td>
<td>$11,146,000</td>
<td>$28,831,619</td>
<td>$56,107,635</td>
</tr>
<tr>
<td>San Diego State University</td>
<td>$45,914,127</td>
<td>$30,394,000</td>
<td>$80,592,385</td>
<td>$156,900,512</td>
</tr>
<tr>
<td>San Francisco State University</td>
<td>$47,404,409</td>
<td>$30,000,000</td>
<td>$83,075,470</td>
<td>$160,479,879</td>
</tr>
<tr>
<td>San Jose State University</td>
<td>$46,631,939</td>
<td>$30,977,000</td>
<td>$82,976,130</td>
<td>$160,585,069</td>
</tr>
</tbody>
</table>
Vulnerability Assessment Conclusions

Before the COVID-19 pandemic, populations at all CSU campuses and CSU-affiliated facilities were substantial. Collectively, as of Fall 2019, CSU campuses had 480,541 students and 53,763 faculty and staff. All were at risk from the communicable disease events, with 534,304 people being directly vulnerable. The COVID-19 pandemic has caused campus population numbers to plummet to a small fraction of full capacity. At some point in the future, campus population numbers will return to their pre-pandemic levels, and students, faculty, and staff will again be vulnerable to the communicable disease hazard. If just 10% of the total CSU population were to become ill with a highly infective communicable disease like influenza or another strain of SARS, this would mean that approximately 53,430 people would be sick at the same time. This scenario would likely overwhelm available on-campus medical services could even overwhelm portions of the larger community’s medical resources – especially if there were large numbers of infected people with immune system compromises or other underlying health problems.

See Table 21-12 below for the “10% outbreak scenario” projections both for each CSU campus and for the entire CSU system.
<table>
<thead>
<tr>
<th>CSU Campus</th>
<th>Approximate Enrollment Population (Fall 2019)²⁴</th>
<th>Approximate Total FT/PT Faculty/Staff Population (Fall 2019)²⁵</th>
<th>Total Combined Approximate Student and Faculty/Staff Population</th>
<th>10% Outbreak Scenario (Students and Faculty/Staff Combined)</th>
</tr>
</thead>
<tbody>
<tr>
<td>CSU Bakersfield</td>
<td>11,199</td>
<td>1,277</td>
<td>12,476</td>
<td>1,248</td>
</tr>
<tr>
<td>CSU Channel Islands</td>
<td>7,093</td>
<td>994</td>
<td>8,087</td>
<td>809</td>
</tr>
<tr>
<td>Chico State</td>
<td>17,019</td>
<td>1,969</td>
<td>18,988</td>
<td>1,899</td>
</tr>
<tr>
<td>CSU Dominguez Hills</td>
<td>17,027</td>
<td>1,761</td>
<td>18,788</td>
<td>1,879</td>
</tr>
<tr>
<td>Cal State East Bay</td>
<td>14,705</td>
<td>1,764</td>
<td>16,469</td>
<td>1,647</td>
</tr>
<tr>
<td>Fresno State</td>
<td>24,139</td>
<td>2,534</td>
<td>26,673</td>
<td>2,667</td>
</tr>
<tr>
<td>Cal State Fullerton</td>
<td>39,868</td>
<td>3,736</td>
<td>43,604</td>
<td>4,360</td>
</tr>
<tr>
<td>Humboldt State</td>
<td>6,983</td>
<td>1,171</td>
<td>8,154</td>
<td>815</td>
</tr>
<tr>
<td>Cal State Long Beach</td>
<td>38,074</td>
<td>4,004</td>
<td>42,078</td>
<td>4,208</td>
</tr>
<tr>
<td>Cal State LA</td>
<td>26,361</td>
<td>2,821</td>
<td>29,182</td>
<td>2,918</td>
</tr>
<tr>
<td>Cal Maritime</td>
<td>911</td>
<td>329</td>
<td>1,240</td>
<td>124</td>
</tr>
<tr>
<td>CSU Monterey Bay</td>
<td>7,123</td>
<td>1,059</td>
<td>8,182</td>
<td>818</td>
</tr>
<tr>
<td>CSUN (Northridge)</td>
<td>38,391</td>
<td>3,832</td>
<td>42,223</td>
<td>4,222</td>
</tr>
<tr>
<td>Cal Poly Pomona</td>
<td>27,914</td>
<td>2,650</td>
<td>30,564</td>
<td>3,056</td>
</tr>
<tr>
<td>Sacramento State</td>
<td>31,156</td>
<td>3,228</td>
<td>34,384</td>
<td>3,438</td>
</tr>
<tr>
<td>Cal State San Bernardino</td>
<td>20,311</td>
<td>2,118</td>
<td>22,429</td>
<td>2,243</td>
</tr>
<tr>
<td>San Diego State</td>
<td>35,081</td>
<td>3,702</td>
<td>38,783</td>
<td>3,878</td>
</tr>
<tr>
<td><strong>San Francisco State</strong></td>
<td><strong>28,880</strong></td>
<td><strong>3,401</strong></td>
<td><strong>32,281</strong></td>
<td><strong>3,228</strong></td>
</tr>
<tr>
<td>San José State</td>
<td>33,282</td>
<td>3,568</td>
<td>36,850</td>
<td>3,685</td>
</tr>
</tbody>
</table>


While the case numbers of COVID-19 have been significantly lower (about 1% of the total CSU population) than those in the 10% scenario, the degree of virulence and resultant morbidity and mortality caused by COVID-19 have led to widespread campus shutdowns, educational disruption, and economic harm to the CSU system (including SFSU). In short, the real-time COVID-19 communicable disease outbreak scenario has proven far more devastating than the 10% simulated scenario.

Identified Data Limitations

There is a wealth of technical information available for communicable disease. However, there is also limited non-COVID-19 communicable disease data available regarding risk or vulnerability of specific populations throughout the CSU. Much of the data that does exist is protected by privacy policies, and therefore cannot be obtained for more specific populations. As a result, performing a detailed quantitative assessment for this hazard is difficult.

Data that could be collected prior to the next update in order to improve this methodology includes:

- Data regarding infection rates at the campus level and for specific populations;
- Data regarding communicable disease case numbers and outcomes, by CSU campus;
- Data regarding projected population changes;
- Data regarding absenteeism; and
- Data regarding increased operating costs as a result of absenteeism (i.e., temporary shifting of duties resulting in business interruption).
**Drought**

Description of the Hazard

Drought is defined as a condition where moisture levels fall significantly below normal for an extended period of time over a large area that adversely affects plants, animal life, and humans. Drought is a gradual phenomenon. Although droughts are sometimes characterized as emergencies, they differ from typical emergency events. Most natural disasters, such as floods or forest fires, occur relatively rapidly and afford little time for preparing for disaster response. Droughts occur slowly, over a multi-year period, and it is often not obvious or easy to quantify when a drought begins and ends.

Throughout California, one dry year does not normally constitute a drought. California’s extensive system of water supply infrastructure (reservoirs, groundwater basins, and conveyance assets) mitigates the effect of short-term dry periods for most water users. Defining when a drought begins is a function of drought impacts to water users. Drought in one location may not constitute a drought for all water users, as some users in relative proximity may have a different water supply. For example, individual water suppliers may use a combination of sources such as rainfall/runoff, water in storage, or expected supply from a water wholesaler to define their water supply conditions.

Drought can be characterized as one or more of the four following types:

- **Meteorological drought** is defined on the basis of the degree of dryness (in comparison to some “normal” or average amount) and the duration of the dry period. A meteorological drought must be considered as region-specific since the atmospheric conditions that result in deficiencies of precipitation are highly variable from region to region.

- **Hydrological drought** is associated with the effects of periods of precipitation (including snowfall) shortfalls on surface or subsurface water supply (e.g., streamflow, reservoir and lake levels, ground water). The frequency and severity of hydrological drought is often defined on a watershed or river basin scale. Although all droughts originate with a deficiency of precipitation, hydrologists are more concerned with how this deficiency plays out through the hydrologic system. Hydrological droughts are usually out of phase with or lag the occurrence of meteorological and agricultural droughts. It takes longer for precipitation deficiencies to show up in components of the hydrological system such as soil moisture, streamflow, and ground water and reservoir levels. As a result, these impacts are out of phase with impacts in other economic sectors.

- **Agricultural drought** focus is on soil moisture deficiencies, differences between actual and potential evaporation, reduced ground water or reservoir levels, and so forth. Plant water demand depends on prevailing weather conditions, biological characteristics of the specific plant, its stage of growth, and the physical and biological properties of the soil.
- **Socioeconomic drought** refers to when physical water shortage begins to affect health, well-being, and quality of life of people, or when the drought starts to affect the supply and demand of an economic product that relies on water.

The drought issue in California is further compounded by water rights. The central challenge is how to prioritize water usage among a broad variety of contexts. It is for this reason that water is a commodity possessed and utilized under a variety of legal doctrines. As such, many competing sets of interests create a dynamic prioritization process between, for example, farming and federally protected fish habitats and water supply for municipal/public use (including usage for San Francisco State University (SFSU) versus water usage for wildfire abatement or natural resource protection.

**Location of the Hazard**

Drought conditions have been identified throughout San Francisco County and the City of San Francisco which encompass the SFSU campus footprint. Drought is not a location-specific hazard and affects the entire planning area equally. Drought location is not isolated to the campus footprint but occurs on-campus as a geographic sub-set of drought conditions occurring at larger scales. From 2000-2020, drought conditions existed continuously in the state, with 80-100% of the state impacted for 12 of the last 20 years.  

**Extent of the Hazard**

Given the historical occurrence of drought impacts throughout the county and city surrounding the planning area, and the potential future impact exacerbated by climate change, the CSU Planning Committee recognizes that drought will continue to pose a high degree of risk statewide, potentially impacting crops, livestock, water resources, the natural environment at large, buildings and infrastructure (from land subsidence), and local economies. In addition, although drought affects the entire CSU system-wide planning area equally, the extent of the hazard is variable and specific to each campus/jurisdiction, depending on contextual factors such as the degree of assets and activities, historically impacted by drought within each jurisdiction. That said, the extent of the hazard on campus is reported to be Low.

In addition, drought related land subsidence has occurred statewide and will continue in areas where the groundwater basin has been subject to overdraft and long-term recharge is inadequate to maintain the water table elevation, leaving underground voids. Subsidence levels have been measured up to 30-feet in California with subsidence bowls covering hundreds of square miles. As such, drought-related subsidence may result in serious structural damage to buildings, roads, irrigation ditches, underground utilities, and pipelines. Though these effects have not been reported on campus, they remain issues of concern for the campus over the long term.

Although the campus planning team identifies the extent of the hazard as Low (qualitatively) which corresponds to D0 – D1 on the Extent scale (below), San Francisco County has experienced more severe drought conditions, including D4 levels during the statewide event from 2012-2017. As such, the campus planning team recognizes that while historic impacts shaping the extent of drought on campus have been minimal, the potential impacts are tied to trends across larger geographic areas, and, therefore, the committee recognizes that the extent of drought on campus has the potential to increase in the future.

The U.S. Drought Monitor developed tables of impacts reported during past droughts in California in order to depict the extent of drought risk for each level of drought on the U.S. These possible extent conditions for California complement the general impacts column of the U.S. Drought Monitor Classification Scheme.

Table 21-12: Impacts of Drought Levels as Determined by US Drought Monitor

<table>
<thead>
<tr>
<th>Category</th>
<th>Impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>D0</td>
<td>Soil is dry; irrigation delivery begins early</td>
</tr>
<tr>
<td></td>
<td>Dryland crop germination is stunted</td>
</tr>
<tr>
<td></td>
<td>Active fire season begins</td>
</tr>
<tr>
<td></td>
<td>Winter resort visitation is low; snowpack is minimal</td>
</tr>
<tr>
<td>D1</td>
<td>Dryland pasture growth is stunted; producers give supplemental feed to cattle</td>
</tr>
<tr>
<td></td>
<td>Landscaping and gardens need irrigation earlier; wildlife patterns begin to change</td>
</tr>
<tr>
<td></td>
<td>Stock ponds and creeks are lower than usual</td>
</tr>
<tr>
<td>D2</td>
<td>Grazing land is inadequate</td>
</tr>
<tr>
<td></td>
<td>Producers increase water efficiency methods and drought-resistant crops</td>
</tr>
<tr>
<td></td>
<td>Fire season is longer, with high burn intensity, dry fuels, and large fire spatial extent; more fire crews are on staff</td>
</tr>
<tr>
<td></td>
<td>Wine country tourism increases; lake- and river-based tourism declines; boat ramps close</td>
</tr>
<tr>
<td></td>
<td>Trees are stressed; plants increase reproductive mechanisms; wildlife diseases increase</td>
</tr>
<tr>
<td></td>
<td>Water temperature increases; programs to divert water to protect fish begin</td>
</tr>
<tr>
<td></td>
<td>River flows decrease; reservoir levels are low and banks are exposed</td>
</tr>
</tbody>
</table>

27 United States Drought Monitor. *Drought Classification*. Retrieved 05.04.2021 from: [https://droughtmonitor.unl.edu/About/AbouttheData/DroughtClassification.aspx](https://droughtmonitor.unl.edu/About/AbouttheData/DroughtClassification.aspx)
<table>
<thead>
<tr>
<th>Event</th>
<th>Cause</th>
</tr>
</thead>
<tbody>
<tr>
<td>Livestock need expensive supplemental feed, cattle and horses are</td>
<td>little pasture remains, producers find it difficult to maintain organic</td>
</tr>
<tr>
<td>sold; little pasture remains, producers find it difficult to maintain</td>
<td>meat requirements</td>
</tr>
<tr>
<td>organic meat requirements</td>
<td></td>
</tr>
<tr>
<td>Fruit trees bud early; producers begin irrigating in the winter</td>
<td></td>
</tr>
<tr>
<td>Federal water is not adequate to meet irrigation contracts;</td>
<td>extracting supplemental groundwater is expensive</td>
</tr>
<tr>
<td>Dairy operations close</td>
<td></td>
</tr>
<tr>
<td>Marijuana growers illegally tap water out of rivers</td>
<td></td>
</tr>
<tr>
<td>Fire season lasts year-round; fires occur in typically wet parts of</td>
<td>burn bans are implemented</td>
</tr>
<tr>
<td>state; burn bans are implemented</td>
<td></td>
</tr>
<tr>
<td>Ski and rafting business is low, mountain communities suffer</td>
<td></td>
</tr>
<tr>
<td>Orchard removal and well drilling company business increase; panning</td>
<td>gold increases</td>
</tr>
<tr>
<td>Low river levels impede fish migration and cause lower survival rates</td>
<td></td>
</tr>
<tr>
<td>Wildlife encroach on developed areas; little native food and water</td>
<td>available for bears, which hibernate less</td>
</tr>
<tr>
<td>Water sanitation is a concern, reservoir levels drop significantly,</td>
<td>surface water is nearly dry, flows are very low; water theft occurs</td>
</tr>
<tr>
<td>Wells and aquifer levels decrease; homeowners drill new wells</td>
<td></td>
</tr>
<tr>
<td>Water conservation rebate programs increase; water use restrictions</td>
<td></td>
</tr>
<tr>
<td>Fields are left fallow; orchards are removed; vegetable yields are</td>
<td></td>
</tr>
<tr>
<td>Fish season is very costly; number of fires and area burned are</td>
<td></td>
</tr>
<tr>
<td>Many recreational activities are affected</td>
<td></td>
</tr>
<tr>
<td>Fish rescue and relocation begins; pine beetle infestation occurs;</td>
<td>forest mortality is high; wetlands dry up; survival of native plants</td>
</tr>
<tr>
<td>Poor air quality affects health; greenhouse gas emissions increase as</td>
<td>and animals is low; fewer wildflowers bloom; wildlife death is</td>
</tr>
<tr>
<td>Policy change; agriculture unemployment is high, food aid is needed</td>
<td>widespread; algae blooms appear</td>
</tr>
<tr>
<td>Water shortages are widespread; surface water is depleted;</td>
<td></td>
</tr>
<tr>
<td>Water is inadequate for agriculture, wildlife, and urban needs;</td>
<td></td>
</tr>
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</tr>
</tbody>
</table>
History of the Hazard

Although drought has not been reported specifically for the campus, drought has been so prevalent in California that its presence is almost continuous. San Francisco County (which encompasses the campus footprint) has experienced several drought periods from 2000-2021, including severe drought from 2012-2017.

Figure 21-3: Periods of Drought in San Francisco County, CA, 2001 – 2021

According to the National Drought Mitigation Center, over 3,500 reports and publications covering 370 drought-related events took place across the state (many of which were statewide events) between 2000-2020. In addition, the National Center for Environmental Information (NCEI) reports more than 500 events statewide during this same time period. These events produced a comprehensive range of impacts to water supply, regulations and allocations to businesses and municipalities, budgets and resources for firefighting, water law and policy, and physical impacts to built and natural environments. As such, data records of previous occurrences can be viewed as separate time and event demarcations for a hazard almost continuously in effect across the state with cascading impact potential.

Source: https://droughtreporter.unl.edu/advancedsearch.aspx

According to the Department of Water Resources, droughts exceeding three years are relatively common in Southern California, but relatively rare in Northern California - the region is the geographic source of much of the state’s developed water supply. The 1929-34 drought established the criteria commonly used in designing storage capacity and yield of large Northern California reservoirs. 29

According to the US Drought Monitor’s time series data, from 2000-2021 (with the exception of a 2–3-month period in 2000 and 2011), some degree of drought conditions have been continuously in effect somewhere in California. In fact, 80% - 100% of the state has been subjected to drought conditions for 12 of the last 20 years, with the most severe drought being the 100% state-wide event from 2012-2017.

Figure 21-4: Periods of Drought in State of California, 2001 – 2021 30

![Drought Periods](image)

Given the extent of the drought risk in California, the following drought event was selected as an exemplar due to its broad and significant impacts on San Francisco County which surrounds the campus planning area:

2012 – 2017 – Drought produced severe impacts to water wells throughout the state of California, with a high number of wells running dry. Land subsidence due to increased groundwater pumping also occurred in numerous areas of the state such as the San Joaquin and Central Valleys. Crop damage was widespread as well. Water allotments were drastically reduced in many towns and water agencies, with extremely high costs for procuring water. In addition, job loss occurred with many families requiring food supply assistance, and water supply assistance provided to home-owners with dry wells. According to a report released by UC Davis Center for Watershed Sciences, the 2014-2017 period of the California drought cost the state’s agriculture industry about $1 billion in lost revenue, with a total statewide economic cost of the drought calculated to be $2.2 billion. The report says, “it is responsible for the greatest water loss ever seen in California agriculture - about one third less than normal”. The report calls the groundwater situation in California "a slow-moving train wreck." Spring snowpack at


Donner Summit reached record low levels in 2014, exceeded in 2015 by a remarkable April 1 snow-water-equivalent value of only 5% of average. Decreased precipitation since contributed to near-record low levels in the Shasta Reservoir. The ongoing drought has contributed to declines in crop values across the state. For example, crops including cotton, corn silage and barley (the field crop category) fell by 42 percent.  

Potential Impacts of the Hazard

Drought impacts are wide-reaching and may be economic, environmental, and/or societal. This assessment of its impact recognizes that historic occurrences of drought throughout the county surrounding the planning area are often a sub-set of larger and inter-connected regional droughts, and that the (related) historic local impacts provide a sound basis for understanding potential (future) impacts on campus.

The most significant potential impact associated with drought across the SFSU campus planning area is a potential reduction in water availability for the municipal area tied to each campus. Other impacts include crop loss and damage to trees and other natural resources (See Tree Mortality below). The footprint of SFSU to some extent includes these vulnerable resources based on the campus landscape (trees) and the presence (and footprint size) of any agricultural research crops and/or field stations.

As a secondary impact of drought, wildfire is directly attributable to dry atmospheric conditions. Wildfires almost always coincide with drought in California, though not limited to such. However, the wildfire hazard is analyzed separately in this plan.

In reviewing the occurrences of drought for San Francisco County, the US Drought Monitor and the National Drought Mitigation Center report that tens of millions of trees died during the (2012-2017) state-wide drought disaster. Though data sources do not provide data for tree mortality specific to SFSU, the broad geographic extent of the impact makes it likely that tree mortality occurred to some degree on the campus. Due to the lasting and ongoing effects of drought on the landscape, trees will continue to be impacted within the municipalities, counties and regions wherein lies the CSU campus system as long as drought conditions continue.

Given the absence of data, in order for the CSU Committee to assess the impact of tree mortality, it is useful to view it as a risk sub-set to the probability, location, extent, severity and duration of the drought hazard within each campus-located municipality, county and region. Regarding potential impacts, standing dead trees could fall, posing a risk to people, buildings, power lines, roads and other infrastructure. In addition, drought-impacted trees become susceptible to diseases and insect infestations (bark beetle) further adding to the risk of tree mortality and related potential impacts. No data is

currently available for tree mortality on campus, however, the CSU Planning Team will pursue data on this issue in the future.

As a potential tertiary impact, prolonged and repeated drought conditions over time can produce land subsidence and the risk of damage to building foundations and infrastructure on campus resulting from ground instability and collapse. Land subsidence is defined as the vertical sinking of the land over manmade or natural underground voids. Subsidence is often the direct result of groundwater over-extraction in response to drought conditions, as well as oil and gas extraction. Weight can accelerate the process of subsidence resulting from surface development and infrastructure such as roads and buildings, vibrations from construction blasting and heavy truck or train traffic. For example, the State Water Project’s 444-mile-long California Aqueduct has required repairs such as the raising of canal linings, bridges, and water control structures on the Aqueduct – in the Central Valley a five-mile reach of the Eastside Bypass was impacted by subsidence, and the Department of Water Resources estimated that it may cost in the range of $250 million to acquire flowage easements and levee improvements to restore the design capacity of the subsided area. 33

At present, drought related damage to campus buildings and infrastructure at SFSU has not been reported, but the potential for such impacts is possible. With regard to overall potential impact, water supply/availability for SFSU is ultimately tied to broader inter-dependent, and more intensive modes of water use at local and regional scales such as agriculture and ranching, wildfire protection, larger metropolitan/municipal usage, manufacturing and commerce, tourism, recreation, and wildlife preservation. During drought periods, the State of California’s regulated water allocations are modified and often reduced, which can result in reduced water availability for all usage contexts, including SFSU. A reduction of electric power generation and water quality deterioration are also potential impact factors.

Table 21-13: Summary of Drought Impacts on Water Resources34

<table>
<thead>
<tr>
<th>Resource</th>
<th>Type of Impact</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sea Level</td>
<td>Direct</td>
<td>Sea level is rising and will likely impact coastal areas</td>
</tr>
<tr>
<td>Soil Moisture</td>
<td>Direct</td>
<td>Prolonged dry seasons can lead to decreases in soil moisture; drier vegetation</td>
</tr>
</tbody>
</table>

Vegetation  | Indirect  | Longer and more intense fire season with increased extent of area burned
---|---|---
Stream Conditions  | Direct  | Increases in water temperature; potential effects on fish
Snowpack  | Indirect  | Increases in temperature will lead to decreases in snowpack
Runoff  | Direct  | Warmer temperatures are likely to lead to a shift in peak runoff from spring to winter and a likely decrease in summer base flow
Hydropower  | Indirect  | Decreased summer flows resulting from earlier snowmelt and a shift in peak runoff could affect hydropower generation during summer months
Precipitation  | Direct  | Warmer winter temperatures will result in a greater percentage of precipitation falling as rain rather than as snow
Groundwater  | Indirect  | Reduction in snowpack and extended periods of drought are likely to increase dependency on groundwater

**Probability of Future Occurrence of the Hazard**

**Highly Likely** — The US Drought Monitor’s time series data (2000-2020) indicates that some degree of drought has nearly a 100% probability of occurrence somewhere in the state in any given year. Given that SFSU lies within a drought impacted region, it is prudent to extend the **Highly Likely** probability of occurrence to the planning area even though past occurrences and impacts on campus have been minimal.

**Vulnerability to the Hazard**

In California, rising temperatures are projected to increase the average lowest elevation at which snow falls, reducing water storage in the snowpack, particularly at those lower mountain elevations which are now on the margins of reliable snowpack accumulation. Higher spring temperatures will also result in earlier melting of the snowpack. The shift in snow melt to earlier in the season is critical for California’s water supply because flood control rules require that water be allowed to flow downstream and that water cannot be stored in reservoirs for use in the dry season. As such, state-level drought risk factors that have led to drought’s state-wide severity and extent, and potential impacts also create drought vulnerabilities at the level of the SFSU campus.
Moreover, climate change will likely adversely impact the vulnerability of watersheds and ecosystems in their ability to deliver important ecosystem services. These changes may limit the natural capacity of healthy forests to capture water and regulate stream flows. Sierra Nevada mountain winters and springs are warming, and on average, precipitation as snowfall relative to rain is decreasing. A warming climate with reduced snowpack will result in earlier snowmelt and will subsequently reduce downstream water availability during summer and early fall.

As such, the state and the SFSU planning area stakeholders potentially have less capacity to address future drought risks due to projected temperature increases and shortages in water; ground-water withdrawals have been occurring at a deficit rate of 1 – 2-million-acre feet per year, where the impacts of drought include decreased availability of water for agriculture and environmental uses. In forested and other vegetated areas, prolonged drought decreases the moisture content of forest fuels and increases the risk of high severity wildfires. 35

It should be pointed out that California is the single most productive agricultural state and its agricultural industry relies heavily on reservoir water supplied by snowmelt and rainfall runoff. Yearly variations in snowpack depths have implications for water availability as snowmelt from the winter snowpack feeds a network of reservoirs. Spring snowpack at Donner Summit reached record low levels in 2014, exceeded in 2015 by a remarkable April 1 snow-water-equivalent value of only 5% of average. Decreased precipitation since 2011 has contributed to near-record low levels in the Shasta Reservoir. 36

Vulnerability of Populations

Drought vulnerabilities for California’s population include agricultural sector job loss, secondary economic losses to local businesses and public recreational resources, increased cost to local and state government for large-scale water acquisition and delivery, and water rationing and water wells running dry for individuals and families. As drought is often accompanied by prolonged periods of extreme heat, negative health impacts such as dehydration can also occur, where children and elderly are most susceptible. Air quality often declines in times of drought which can affect those with respiratory ailments. These same vulnerability measures apply to the students, faculty and staff of the campus.

Property Vulnerability

Drought vulnerabilities for property include crop loss, injury and death of livestock and pets, and damage to infrastructure, homes and other buildings resulting from the secondary drought impact of land subsidence. The related drought impacts of tree

mortality and land subsidence pose risks to vulnerable critical infrastructure and property. These same vulnerability measures apply to the properties of the SFSU campus.

**Natural Environment Vulnerability**

Drought vulnerabilities for the campus’ natural environment are primarily drought impacted flora and landscaping. That said, vulnerabilities are widespread throughout public and private lands within the state, including tree mortality, impacts to all flora and fauna, and destabilization (subsidence) of land along streams and rivers, and within watersheds.

The core issue shaping drought vulnerability on campus and throughout California is water supply and demand. Several factors play into the issue including groundwater basins, surface water run-off, public and agricultural demand, and surface water storage water sheds. A USGS led analysis was first conducted in 2010 through the Forest and Rangeland Assessment and ongoing through the USGS Forest and Rangeland Ecosystem Science Center to identify threats and assets where water supply would benefit from environmental management designed to protect or enhance water resources, the key effort which, in part, both defines and mitigates the severity of drought risk and vulnerabilities.

With regard to overall threat and asset findings shaping the potential severity of drought, the watersheds in the Sierra region contribute most greatly to the state’s water supply, but are under threat from climate change, wildfire and development. In addition, groundwater basins in the San Joaquin Valley and Sacramento Valley bioregions are an abundant resource that is heavily threatened by over pumping.

**Critical Facilities Vulnerabilities**

Drought vulnerabilities for SFSU’s critical facilities include water shortfalls for facility operations and critical functions, and potential structural destabilization and damage resulting from land subsidence.

**Estimate of Potential Losses**

An estimate of potential losses from drought has not been calculated for the campus or the CSU system as a whole. However, drought related losses to the City of San Francisco and the surrounding region such as crop loss and cost increases for water resources have re-occurred over time. Please consult city and county level government, and/or state agricultural agencies for data on the financial impacts from drought.

**Vulnerability Assessment Conclusions**

The CSU Planning Committee understands that the high degree of vulnerability posed by drought will be exacerbated by greater climate variation in the future and therefore greater variation and uncertainty regarding the availability of water supplies which are already under tremendous stress. In response to such vulnerability, state legislation passed in 2014 requires local governments to regulate pumping and recharge to better
manage groundwater supplies, and groundwater-dependent regions are required to halt overdraft and bring basins into sustainable levels of pumping and recharge by the early 2040s. That said, the Committee will continue to work with local, regional and state partners and stakeholders to explore solutions for mitigating the drought hazard on its campuses by accessing the best available data and resources on climate change and its relationship to drought.

Identified Data Limitations

Data is limited concerning campus-related agricultural assets as well as data on campus tree mortality.

**Earthquake**

Description of the Hazard

An earthquake is a sudden motion or shaking caused by the release of pressure accumulated along the edge of tectonic plates covering the earth. These huge plates are constantly moving and move ever so slowly under, over, or by passing one another. This movement is gradual however the plates may lock together accumulating enormous amounts of energy. When this energy builds, stress develops, and the adjoining plates will eventually break free and result in ground shaking – an earthquake.

Large earthquakes may result in fissuring, ground settlement, and/or vertical or horizontal displacement. Earthquakes occur without warning and can result in extensive damages and human casualties. Damages associated to earthquake generated ground shaking is normally confined to a narrow area along fault trend from the earthquake epicenter. However, seismic waves may generate ground shaking resulting in damages in areas outside of the fault trend.

**Fault Rupture** – The rupture of faults is the differential movement of the two sides of the earth’s plates at the point of the fault. Horizontal or vertical displacement may be significant and occur over great distances. The movement and energy that occurs along a fault is released in waves resulting in ground shaking. The intensity of ground shaking varies based on the magnitude of the earthquake, the proximity to the earthquake epicenter, the composition of the ground sediment or rock the waves travel through, and the depth of the earthquake.

**Liquefaction** – In addition to the primary fault rupture that occurs right along a fault during an earthquake, the ground many miles away can also fail during intense shaking. As seismic waves travel through saturated granular soil; the soil begins to liquefy and act as a fluid. Soil strength and stability is lost causing the effects of ground shaking to intensify and for ground deformation to occur. These water saturated soils when shaken quickly lose the ability to support buildings, bridges, utilities, and other structures. Areas
susceptible to liquefaction include places where sandy sediments have been deposited by rivers along their course or by wave action along beaches. The greater the magnitude of an earthquake and longer duration of strong ground shaking will result in an enhanced potential for liquefaction to occur. Settlement can cause damage when the amount settlement varies significantly across the length of a structure. Lateral spreading occurs when liquefaction occurs on gently sloping ground and the liquefied material at depth allows the area to slide, often toward a vertical discontinuity or “free face” such as a creek or stream channel. Liquefaction can occur in susceptible soils below bodies of water, and settlement and lateral spreading can damage structures built on or adjacent to these areas. Transportation bridges across water bodies, wharves, piers and other structures at ports and harbors, and underwater utility lines can be severely damaged by this hidden hazard.

**Subsidence** - Changes in the local environment that cause subsidence or sinkholes are called triggering mechanisms. Water is the primary factor that affects the local environment and causes subsidence. Water level decline, changes in groundwater flow, increased loading, and deterioration (such as abandoned mines) are all triggering mechanisms. Water level decline may occur naturally, or it may be the result of human action. Factors that lead to water decline are pumping (from wells), localized drainage (for construction activities), dewatering, or drought. Changes in groundwater flow can result from an increase in the velocity of groundwater movement, and increase in the frequency of water table fluctuations, and changes in discharge (either increase or decrease). Increased loading can cause pressure in the soil, leading to the failure of underground cavities and space, such as caves. Vibrations from earthquakes, heavy machinery, and blasting may result in structural collapse, followed by surface resettlement.

**Location of the Hazard**

The State of California is particularly vulnerable to earthquake activity due to California’s location residing between two large tectonic plates. San Francisco State University is located in the San Francisco Peninsula area of the San Francisco Bay region a mile from the Pacific coastline. The campus is adjacent to Lake Merced on the west side of the university. In general, fault systems surround and traverse throughout the Bay Area and San Francisco including the area of San Francisco State University. Throughout the populated areas of San Francisco and surrounding cities, the ground is saturated with loose sediment. Liquefaction zones rated at moderate susceptibility exist in pockets throughout San Francisco.

The Pacific Plate and the North American Plate come together at the San Andreas Fault 3 miles west of the San Francisco State University campus. In addition to the San Andreas Fault, the San Francisco Peninsula is home to or near additional fault systems with the potential to generate strong ground shaking. The campus is additionally in close proximity to two powerful fault systems. The Hayward Fault traverses south to north
along the western base of the Hayward and Oakland Hills 17 miles east of the San Francisco State University campus. The Calaveras Fault extends south to north 120 miles in length from San Benito County to Contra Costa County 28 miles east of the San Francisco State University campus. The 135-mile-long San Gregorio Fault extends from south of Big Sur to Marin County 7 miles west of the campus. The entire San Francisco Bay Area is saturated with numerous additional faults mostly paralleling the San Andreas Fault to the northwest. These fault systems are located on each side of the campus.

Figure 21-5: Faults near San Francisco State University

Portions of the San Francisco State University campus reside on areas designated to be liquefaction zones. Campus facilities that are potentially located within the liquefaction zone include the Children’s Campus childcare center, the University Police Department, Student Life Events Annexes, Facilities and Service Enterprises, Lot 19 Parking Structure, Central Plant, Warehouse 1, campus Waste Management, College of Science and Engineering, and Field House 1. The liquefaction zones generally appear to extend from Lake Merced in an easterly direction onto the campus and include much of the northern portions of the campus. Liquefaction zones additionally appear throughout the majority of San Francisco and neighboring communities along the coastal edges.
Extent of the Hazard

The extent or severity of earthquake damage is expressed in terms of magnitude, intensity, and duration. The amount of energy released during an earthquake is normally conveyed as a magnitude measured from a seismogram. Magnitude is expressed in numbers and decimals representing the physical size of the earthquake. The strength and effect of the shaking on the surface of the earth is classified as the intensity. Intensity is further defined from the effects the earthquake has on people, structures, and the natural environment. The intensity of an earthquake in terms of measuring magnitude and evaluating its effects is generally expressed using the Modified Mercalli (MM) Intensity Scale. Duration is the length of time the earthquake’s energy is released.

The Richter magnitude scale was developed in 1935 by Charles F. Richter of the California Institute of Technology as a mathematical device to compare the size of earthquakes. The Richter Scale is the best-known scale for measuring the magnitude of earthquakes.

The magnitude value is proportional to the logarithm of the amplitude of the strongest wave during an earthquake. A recording of 7, for example, indicates a disturbance with ground motion 10 times as large as a recording of 6. The energy released by an earthquake increases by a factor of 31 for every unit increase in the Richter scale.

Table 21-14: Earthquake Intensity and Frequency Comparisons

<table>
<thead>
<tr>
<th>Magnitude</th>
<th>Mercalli Intensity</th>
<th>Potential Damage</th>
<th>Global Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 2.0</td>
<td>I</td>
<td>None</td>
<td>Continually</td>
</tr>
<tr>
<td>2.0 - 2.9</td>
<td>I to II</td>
<td>None</td>
<td>&gt; IM per year</td>
</tr>
<tr>
<td>3.0 - 3.9</td>
<td>II to IV</td>
<td>Light</td>
<td>&gt; 100,000 per year</td>
</tr>
<tr>
<td>4.0 - 4.9</td>
<td>IV to VII</td>
<td>Light</td>
<td>10K to 15K per year</td>
</tr>
<tr>
<td>5.0 - 5.9</td>
<td>VI to VII</td>
<td>Moderate</td>
<td>1K to 1,500 per year</td>
</tr>
<tr>
<td>6.0 - 6.9</td>
<td>VII to X</td>
<td>Heavy</td>
<td>100 to 150 per year</td>
</tr>
<tr>
<td>7.0 - 7.9</td>
<td>VII &lt;</td>
<td>Very Heavy</td>
<td>10 - 20 per year</td>
</tr>
<tr>
<td>8.0 - 8.9</td>
<td>VII &lt;</td>
<td></td>
<td>1 per year</td>
</tr>
<tr>
<td>&gt; 9.0</td>
<td>VII &lt;</td>
<td></td>
<td>1 per 10-50 years</td>
</tr>
</tbody>
</table>

The Modified Mercalli Intensity Scale provides descriptive values of earthquake intensity that may provide greater meaning to the broader population as the description of intensity refers to the effects actually experienced. This scale uses an arbitrary ranking based on observed earthquake effects. The scale is composed of increasing levels of intensity ranging from shaking that is not recognizable to intense shaking resulting in catastrophic damages and casualties. The Modified Mercalli Intensity Scale is demonstrated below:
<table>
<thead>
<tr>
<th>Intensity</th>
<th>Shaking</th>
<th>Description / Damage</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Not felt</td>
<td>Not felt except by a very few under especially favorable conditions.</td>
</tr>
<tr>
<td>II</td>
<td>Weak</td>
<td>Felt only by a few persons at rest, especially on upper floors of buildings.</td>
</tr>
<tr>
<td>III</td>
<td>Weak</td>
<td>Felt quite noticeably by persons indoors, especially on upper floors of buildings. Many people do not recognize it as an earthquake. Standing motor cars may rock slightly. Vibrations similar to the passing of a truck. Duration estimated.</td>
</tr>
<tr>
<td>IV</td>
<td>Light</td>
<td>Felt indoors by many, outdoors by few during the day. At night, some awakened. Dishes, windows, doors disturbed; walls make cracking sound. Sensation like heavy truck striking building. Standing motor cars rocked noticeably.</td>
</tr>
<tr>
<td>V</td>
<td>Moderate</td>
<td>Felt by nearly everyone; many awakened. Some dishes, windows broken. Unstable objects overturned. Pendulum clocks may stop.</td>
</tr>
<tr>
<td>VI</td>
<td>Strong</td>
<td>Felt by all, many frightened. Some heavy furniture moved; a few instances of fallen plaster. Damage slight.</td>
</tr>
<tr>
<td>VII</td>
<td>Very strong</td>
<td>Damage negligible in buildings of good design and construction; slight to moderate in well-built ordinary structures; considerable damage in poorly built or badly designed structures; some chimneys broken.</td>
</tr>
<tr>
<td>VIII</td>
<td>Severe</td>
<td>Damage slight in specially designed structures; considerable damage in ordinary substantial buildings with partial collapse. Damage great in poorly built structures. Fall of chimneys, factory stacks, columns, monuments, walls. Heavy furniture overturned.</td>
</tr>
</tbody>
</table>

Violent

Damage considerable in specially designed structures; well-designed frame structures thrown out of plumb. Damage great in substantial buildings, with partial collapse. Buildings shifted off foundations.

Extreme

Some well-built wooden structures destroyed; most masonry and frame structures destroyed with foundations. Rails bent.

The graph below illustrates the increasing intensity of energy that is released and as the measured magnitude increases. While each whole number increases in magnitude represents a tenfold increase in the measured amplitude, it represents an increasing rate of 32 times more energy released in the same increase in magnitude. As the magnitude of an earthquake is measured higher, the intensity of the earthquake worsens progressively from one category to the next.

Figure 21-7: Earthquake Magnitude and Equivalent Energy Release

Campus facilities are located near liquefaction zones rated as moderately susceptible. In addition, numerous powerful fault systems traverse and surround the campus, and the Bay area has experienced catastrophic events. The impacts of a major earthquake would be felt beyond the campus and have long reaching effects. The risk of casualties and damages would likely extend to the homes and workplaces of members of the campus community including students, staff, and faculty. As such, the planning committee ranks the extent of the hazard as **High**.

**History of the Hazard**

The State of California has a long history of chronic and destructive earthquakes throughout the state. On average, earthquakes strong enough to result in structural damages occur three to four times a year in California, while earthquakes Magnitude 6.0 to 6.9 occur once every two to three years. Likewise, San Francisco also has a long history of earthquake activity. The entire area of San Francisco and the Bay Area is at risk to seismic activity and has a history of significant earthquakes resulting in damages.

Table 21-16: Historic Earthquakes Near San Francisco, CA

<table>
<thead>
<tr>
<th>Date</th>
<th>Location</th>
<th>Magnitude</th>
<th>Damages</th>
</tr>
</thead>
<tbody>
<tr>
<td>10/21/1868</td>
<td>Hayward</td>
<td>6.8</td>
<td>Extensive destruction; 20-mile rupture</td>
</tr>
<tr>
<td>4/18/1906</td>
<td>San Francisco</td>
<td>7.9</td>
<td>Extensive destruction; 3000 fatalities</td>
</tr>
<tr>
<td>3/22/1957</td>
<td>Daly City</td>
<td>5.3</td>
<td>$1 million, 1 fatality</td>
</tr>
<tr>
<td>8/6/1979</td>
<td>Gilroy</td>
<td>5.7</td>
<td>Minor</td>
</tr>
<tr>
<td>4/24/1984</td>
<td>Morgan Hill</td>
<td>6.2</td>
<td>$8 million</td>
</tr>
<tr>
<td>10/17/1989</td>
<td>Loma Prieta</td>
<td>6.9</td>
<td>$5.9 billion, 63 fatalities</td>
</tr>
<tr>
<td>9/3/2000</td>
<td>Yountville</td>
<td>5.0</td>
<td>Minor</td>
</tr>
<tr>
<td>10/30/2007</td>
<td>Alum Rock</td>
<td>5.6</td>
<td>Minor</td>
</tr>
<tr>
<td>8/24/2014</td>
<td>American Canyon</td>
<td>6.0</td>
<td>$400 million</td>
</tr>
</tbody>
</table>

The April 18, 1906 San Francisco Earthquake became one of the most well-known earthquakes in California history. The earthquake caused extensive damage to buildings, bridges, water systems, and critical facilities. Damage was experienced well beyond San Francisco including areas such as Monterey and Santa Cruz. 3,000 people were killed and thousands more injured. The San Francisco Earthquake was found to shift the course of northern California rivers. The shaking was felt from Oregon to Los Angeles.

The October 17, 1989 Loma Prieta Earthquake shook a large part of northern California, especially the San Francisco Bay Area. The earthquake caused $5.9 billion in damages, most extensively in San Francisco, the East Bay, and South Bay areas. The earthquake...
resulted in extensive infrastructure damages, 12,000 displaced, 3,757 injuries, and 63 fatalities. The earthquake was provided a federal disaster declaration (DR-845).

**Potential Impacts of the Hazard**

The shaking of the ground from earthquakes can result in building collapse, bridge failure, utility disruptions and other structural collapse. Large earthquakes can additionally cause natural gas lines to break resulting in structure fires. The proximity to the unstable soils surrounding the campus presents a potential for liquefaction creating greater ground instability during seismic events. A major earthquake in the San Francisco area would likely result in region-wide social disruptions in addition to structural damages. The region-wide structural damages may disrupt lifelines and supply chain routes limiting the campus from effective evacuation routes and receiving necessary supplies or equipment.

Most injuries resulting from earthquakes are from collapsing walls, flying glass, or other objects moved by ground shaking. The lack of warning allows individuals minimal time to react and find areas of safety. A moderate earthquake occurring near San Jose could cause injuries or fatalities to members of the campus community or support networks the campus relies on. These earthquake effects might be aggravated by collateral incidents such as fire, flooding, hazardous material spills, dam/levee compromises, and other cascading events. A catastrophic earthquake near San Francisco could result in extensive casualties, expansive structural damages, panic, widespread utility outages, communication failures, and secondary emergencies such as fire. A catastrophic earthquake would certainly affect the broader San Francisco Bay Area region limiting immediate assistance that the campus may normally expect.

Local impacts to the San Francisco State University campus caused by an earthquake could include:

- Injuries and damage related casualties
- Ground rupture
- Potential hazardous material releases on and off campus
- Infrastructure damage to freeway and roadway system
- Landslides blocking primary access routes including US 101 and CA SR 1
- Damage to rail lines transiting through San Francisco and surrounding counties
- Structural damage to underground utilities
- Damage to power grid and widespread power outages
- Disruption in water services
- Potential isolation of campus from community
- Potential isolation among on-campus residents
- Structural damage to parking structure facilities
- Structural damage to campus academic and support buildings
- Damage or loss of academic research, documents, electronic storage, art, and literature.
- Structural damage to residence halls resulting in displaced student populations
- Structural damage to nearby residences
- Community members arriving on campus for refuge from damaged homes
- Damaged university communications, computer systems, and networks
- Gaps in service delivery to vulnerable populations
- Considerable stress and fear among community
- Spontaneous creation of tent cities or outdoor camping on personal property
- Closure or reduction of service to campus operations
- Reduction of campus revenue

**Probability of Future Occurrence of the Hazard**

The Working Group on California Earthquake Probabilities (WGCEP), a collaboration between the United States Geological Survey (USGS), the Southern California Earthquake Center (SCEC), and the California Geological Survey (CGS) develops Uniform California Earthquake Forecasts (UCERFs) using the best currently available science and technology. The UCERF version 3 provides a three-dimensional view of the likelihood a region in California will experience a Magnitude 6.7 or greater earthquake in the next 30 years. The likelihood for the San Francisco Bay Area fault systems surrounding San Francisco is included in the following table.

Table 21-17: Major Potentially Active Faults in Proximity to San Francisco State University

<table>
<thead>
<tr>
<th>Fault Zone</th>
<th>Recurrence</th>
<th>Maximum Magnitude</th>
<th>UCERF3 Likelihood</th>
</tr>
</thead>
<tbody>
<tr>
<td>Calaveras</td>
<td>Varies: 125-850 years</td>
<td>6.2 to 7.2</td>
<td>14-17%</td>
</tr>
<tr>
<td>Franklin</td>
<td>Historic: &gt; 9000 years</td>
<td>Unknown</td>
<td>1%</td>
</tr>
<tr>
<td>Greenville</td>
<td>Historic: Unknown</td>
<td>6.5</td>
<td>4-6%</td>
</tr>
<tr>
<td>Hayward</td>
<td>Varies: 20-300 years</td>
<td>6.8 to 7.0</td>
<td>14-21%</td>
</tr>
<tr>
<td>Mission</td>
<td>Historic: Unknown</td>
<td>6.0 to 6.5</td>
<td>1-2%</td>
</tr>
<tr>
<td>Monte Vista-Shannon</td>
<td>Historic: Unknown</td>
<td>6.0 to 6.5</td>
<td>1%</td>
</tr>
<tr>
<td>Mount Diablo</td>
<td>Historic: 400-1000 years</td>
<td>&gt;6.7</td>
<td>2-3%</td>
</tr>
<tr>
<td>Pilarcitos</td>
<td>Historic: Unknown</td>
<td>6.5 to 7.2</td>
<td>&lt;1%</td>
</tr>
<tr>
<td>San Andreas</td>
<td>Varies: 20-300 years</td>
<td>6.8 to 8.0</td>
<td>7-15%</td>
</tr>
<tr>
<td>San Gregorio</td>
<td>Historic: 400-1000 years</td>
<td>6.5 to 7.2</td>
<td>2-4%</td>
</tr>
</tbody>
</table>

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41 City and County of San Francisco Hazard Mitigation Plan, June 2014


The City and County of San Francisco Hazard Mitigation Plan identifies that there is a strong likelihood the San Francisco area will experience a significant earthquake from one of the surrounding major faults in the next 30 years. The Plan further estimates the probability for the faults within the San Francisco Bay Area to produce a Magnitude 6.7 or greater earthquake in the next 30 years is 63%.

Based on the earthquake shaking potential in the San Francisco Bay area, the proximity to the above listed fault systems, and the moderate liquefaction potential that exists throughout the campus, the probability of seismic ground shaking generating damage is considered Possible.

Vulnerability to the Hazard

A considerable challenge regarding earthquakes is they generally occur without warning. The fault systems surrounding the region all cross major transportation routes potentially reducing the availability of access and the supply chain. The geographic location of San Francisco State University places the campus in an urban downtown community near residential, commercial, and industrial areas that is densely populated. Earthquake effects experienced in the neighboring local community will likely spill over onto the campus.

The known fault systems generating the threat to the San Francisco Bay region generally surround the area and some cross near the San Francisco State University campus. The campus resides in a region that is exposed to fault systems on all sides. The proximity and potential for large earthquake development from these surrounding systems expose significant vulnerabilities. The potential for earthquake damaged structures being left uninhabitable including campus residence halls will result in numerous displaced individuals and households. The lack of earthquake insurance will cause extreme financial burdens on those affected. Campus buildings and equipment would be vulnerable to damages from building, seismic shaking, secondary fires, and secondary building floods from broken pipes.

Elements of the vulnerability to a major earthquake on the San Francisco State University campus will vary depending on when the earthquake were to strike. The primary basis of vulnerability is based on the population affected and the built environment exposed. In general, newer construction will be more earthquake resistant than older buildings as building codes and construction technology have improved. A locally centered earthquake, even from moderate events, would have the potential for more damaging results when associated with the moderate liquefaction zones of the city. This would particularly be seen with greater damages to unreinforced masonry buildings.

The risk to the campus population will be lessened during periods when classes are not in session or during periods of breaks. Conversely, during the days and hours that classes are in session and staff are at their workplaces, the human vulnerability increases.
Generally, people are safer when at home in wood frame structures as earthquakes tend to generate less structural damage to wood construction than in commercial or industrial facilities. The greater number of people on campus at the time of an earthquake will result in more people being exposed to effects from damaged campus facilities or equipment and require greater evacuation assistance. However, in region-wide events this vulnerability may simply shift to the homes and workplaces of members of the campus community and their families.

The aftermath of a major earthquake will likely result in widespread search and rescue operations for trapped and injured individuals. The demand on emergency services will be great, potentially requiring the campus community to be prepared for these scenarios and initiate response actions as needed. There will be needs for emergency medical care, shelter, water, and food for individuals who have been displaced by the earthquake. In earthquakes causing significant damages, there may be a necessity to provide assistance with identification and support to local agencies in mass fatality management.

There may be a need to evacuate members of the campus community from the campus and to other locations that are deemed to be safer locations. This may be heightened along the northern portions of the campus as this area has been identified as being within a liquefaction zone. Certain campus populations will experience greater challenges to a post-earthquake environment. Vulnerable populations including those that rely on specific services, require electrical power, homeless students, experience disabilities, non-English speakers, those whose age make evacuating difficult, and others will be most affected. These individuals will likely need to navigate through earthquake generated debris, extreme stresses of a disaster, an inability to communicate to or gain access to support networks, and find difficulty in accessing equipment or supplies to aid in a specific need.

As the San Francisco State University campus is surrounded by densely populated residential areas, the status of traffic congestion will be needed to be taken into account in making evacuation decisions. The road and freeway network becomes easily congested in normal situations. Bridges serve as a primary access and exit source in and out of San Francisco. The remaining overland routes out of the peninsula are through San Mateo County, these routes can become quickly congested. A major earthquake has the potential for rendering these critical lifelines and supply routes inoperable and forcing the campus community to be self-reliant for a period of time.

**Estimate of Potential Losses**

Estimates of potential losses will be influenced by a variety of factors. The intensity of the earthquake will determine what scale of damages affecting campus infrastructure, equipment, and other impacted features. Losses will be generated by the physical damages, the loss of revenue, loss of academic research, loss of building contents, and community wide economic reductions.

Based on estimate replacement costs of facilities and structures on campus, the maximum total replacement costs due to earthquake are $448,726,927.
Table 21-18: HAZUS Peak Ground Acceleration Zone (PGA) Estimated Losses

<table>
<thead>
<tr>
<th>PGA Zone Designation</th>
<th>Intensity</th>
<th>No of Buildings</th>
<th>Maximum Replacement Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Extreme</td>
<td>X+</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Violent</td>
<td>IX</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Severe</td>
<td>VIII</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Very Strong</td>
<td>VII</td>
<td>64</td>
<td>$448,726,927</td>
</tr>
<tr>
<td>Strong</td>
<td>VI</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Moderate</td>
<td>V</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Light</td>
<td>IV</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Weak</td>
<td>II-III</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Not Felt</td>
<td>I</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>NA</td>
<td>NA</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>No Building Value Data Provided*</td>
<td>NA</td>
<td>31</td>
<td>Unknown</td>
</tr>
</tbody>
</table>

*Buildings with no value defined are also included in the respective Zones they are found in.

The table above includes 7 facilities located at the Tiburon based San Francisco State University, Romberg Tiburon Campus. The provided cost estimates for the Romberg Tiburon Campus includes $257,012. However, 2 facilities do not have costs included.

Vulnerability Assessment Conclusions

It is difficult to predict the severity of casualties, property, and cascading impacts generated by future seismic events affecting the greater San Francisco Bay region and the San Francisco State University campus. Each of the earthquake generated effects will vary widely based on the intensity of the earthquake, location of the epicenter, proximity to people and development, time of day and year, the soil composition under the impacted structures, building construction, among others. In any case, the potential for a major earthquake exists affecting the campus and causing extensive challenges to the San Francisco State University campus and community.

In the event that a major earthquake was to strike along the many fault systems surrounding San Francisco, the effects could be significant to the campus community and campus operations. The widespread impacts generated by a major earthquake would extend the effects of casualties, damages, and other impacts to the broader San Francisco Bay region creating large-scale regionwide needs for critical assistance and a heavy demand on limited emergency resources. The threat and impacts presented to the campus will be shared with the campus community from their homes and places of work. The campus will likely be required to address critical needs independently during early phases of the disaster.

The campus population are additionally vulnerable to the effects of major ground shaking that are far reaching. The psychological and social impacts a major earthquake will give rise to will potentially harm individuals and cause tremendous fear. The willingness to return indoors may be hampered especially as after-shocks continue.
Identified Data Limitations

Data limitations include missing campus structural replacement costs, and lack of a complete inventory of building construction types to include status of earthquake retrofitting. HAZUS generated analysis is focused on the broader community level versus fine-tuning the analysis to the micro-level for facilities such as a university campus.

Erosion

Description of the Hazard

The US Geological Survey (USGS) defines erosion as “the process whereby materials of the earth’s crust are loosened, dissolved, or worn away and simultaneously moved from one place to another.”

Erosion may occur in areas of streams and rivers, along bluffs, around immovable objects (such as buildings or bridge abutments), or as a cascading result of other natural hazards, such as earthquakes or wildfires. When erosion occurs along bodies of water, the removal of material causes the shore to move further landward.

Forces such as sea level rise and changes in sediment supply impact erosion gradually and can be difficult to recognize. In contrast, the impacts of short-term events, such as storms and flooding, can be severe and are immediately recognizable. Along the Pacific coast, rain, wind, and waves can induce significant short-term erosion.

Location of the Hazard

Erosion is a severe hazard in coastal communities, where sea level rise and storms contribute to de-sedimentation and the retreat of coastal cliffs, bluffs, and beaches. While coastal erosion can happen in any storm, it is more likely during El Nino events, which occur every 5-7 years. For the purpose of this campus-level analysis, the erosion hazard poses an equal risk across these areas of terrain on the San Francisco State University (SFSU) campus with erosion prone characteristics, and can occur in any locations with conducive soil structure and a source of movement, such as water or wind. An area’s potential for erosion is determined by several factors, including rainfall, topography, soil characteristics, and vegetative cover. While it is known that such characteristics are present on campus in general, currently no data is available on the discovery or identification of specific erosion-prone locations.

Extent of the Hazard

Erosion is occurring on the Pacific coastline west of SFSU. While there is no published scale of severity or extent for this geologic hazard on the SFSU campus, erosion is likely to occur if conditions are favorable. However, even though no historical occurrence of

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erosion on campus, the planning committee ranks the extent of this hazard as Moderate due to its location near ongoing erosion challenges along the nearby coastal zone.

History of the Hazard

The San Francisco coastline has been continuously eroding and mitigation projects, such as coastline armoring, are being regularly maintained. There have been no erosion occurrences on the SFSU campus.

Potential Impacts of the Hazard

Coastal erosion can result in severe impacts to local infrastructure, including the undermining of foundations, exposure of underground infrastructure, and breaches of natural or constructed protections. The latter can expose communities to the destructive forces of floodwaters, surge, and debris impacts. On campus, areas of erosion can create pedestrian and transportation hazards, and structures may become unsafe if erosion is not controlled. Public health and safety, structures, and infrastructure can all be negatively impacted, damaged, or destroyed by the erosion hazard.

Probability of Future Occurrence of the Hazard

Erosion is an on-going and dynamic process that occurs regularly. As climate change raises sea levels and induces more frequent and intense weather events, coastal and other erosion may generally become more widespread or severe. These events can cause erosion or exacerbate areas already experiencing erosion. That said, with regard to the campus, although no historical events have taken place, it is not known to what extent existing conditions favorable to erosion are present in specific locations. That said, the probability of at least a limited degree of erosion taking place in the future somewhere on the campus is High over the long term but Low on an annual basis. However, conditions could emerge in the future which increase the annual probability, precipitated by climate change, changes in land-use or other factors.

Vulnerability to the Hazard

Topography, soil structure, land use, and precipitation are all factors of erosion. SFSU’s infrastructure and buildings located on steep slopes, in areas with little vegetation, or in areas with conducive soil types are more vulnerable to erosion. CSU leadership would consider performing an analysis to identify such at-risk buildings, infrastructure, slopes and soil types in the future.

In the wider San Francisco community, erosion vulnerabilities include agricultural sector job loss, degradation of riverine ecosystems and coastlines, and loss of water quality.

Estimate of Potential Losses

The historic and potential impacts of erosion on property statewide include reduced agricultural productivity, lower surface water quality, and damaged drainage networks.
Current modeling is not precise enough to allow for an assessment of potential losses to buildings and infrastructure on campus.

Vulnerability Assessment Conclusions

While the ability to predict future erosion on the SFSU campus is limited, the core issues shaping erosion vulnerability on campus are flora and landscaping. If left unchecked, erosion can cause significant damage to campus infrastructure and the surrounding environment.

Identified Data Limitations

The complex interactions between soil erosion factors make predictive modeling, determination of hazard areas, and quantification of loss difficult. Localized data on this hazard is also limited, resulting in more generalized findings.

**Extreme Temperatures (Includes Extreme Cold and Extreme Heat)**

**Heat**

**Description of the Hazard**

What is considered an excessively hot temperature varies according to the normal climate for that region. However, when temperatures are extremely high, people are at higher risk for heat-related illnesses, such as dehydration, heat exhaustion, heat stroke, and in severe cases, death.45

Hazards from extreme heat are made worse when high temperatures are accompanied by high levels of humidity, which is defined as the amount of moisture in the air.46 As the temperature climbs, the air is able to hold more moisture. High humidity prevents the human body from cooling down naturally, which leads people to perceive that the temperatures “feel” hotter. The combination of temperature and humidity is known as the heat index.47

Heat stroke, the most serious heat-related illness, occurs when the body is unable to control its temperature. Body temperature rises rapidly, the sweating mechanism fails, and the body cannot cool down.48 In extreme causes, heat stroke can cause confusion and unconsciousness, so the victim is unable to seek treatment without assistance.

There are several groups of people who are uniquely vulnerable to the effects of extreme heat, such as infants and children, older adults aged 65 and up, athletes and outdoor

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47 Ibid.
workers, low-income households, and individuals with certain chronic medical conditions.49

Location of the Hazard

Extreme heat events are a non-spatial hazard, and may occur at the San Francisco State campus.

Extent of the Hazard

Extreme heat has a wide range of extent and severity markers and characteristics. Monthly average maximum temperatures in June through October range approximately from the high 60s to low 70s in the City of San Francisco. According to data from the National Climatic Data Center (NCDC), the highest daily temperature recorded in downtown San Francisco is 106°F on September 1, 2017. This record was reached during a statewide heat wave when many locations reached all-time high temperatures. Based on mild average maximum temperatures and only two recorded excessive heat events, the planning committee ranks the extent4 of the hazard as Low.

The National Weather Service issues a Heat Advisory when the heat index value is expected to reach 100° – 104° F within the next 12 to 24 hours. Excessive Heat Warnings are issued when there is an anticipated heat index of 105° F or greater that will last for two (2) or more hours. Excessive Heat Warnings are issued by the county when any location in the county is expected to reach that criteria.50 In anticipation of an Excessive Heat Warning, an Excessive Heat Watch may be issued 1 to 2 days in advance, when the Heat Warning criteria is 50 – 79% likely to occur.

Figure 21-5 (following) depicts the National Weather Service’s methodology for determining the heat index, using the % humidity and the actual temperature.

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As the heat index rises, so does the potential danger to people and animals. Table 21-21 (following) shows the health hazards associated with extreme heat.

Table 21-19: Health Risks Associated with Heat Index

<table>
<thead>
<tr>
<th>Category</th>
<th>Heat Index</th>
<th>Health Hazards</th>
</tr>
</thead>
<tbody>
<tr>
<td>Extreme Danger</td>
<td>130° F or higher</td>
<td>Heat stroke / sunstroke is likely with continued exposure.</td>
</tr>
<tr>
<td>Danger</td>
<td>105° – 129° F</td>
<td>Sunstroke, heat cramps, and/or heat exhaustion is likely with prolonged exposure and/or physical activity.</td>
</tr>
<tr>
<td>Extreme Caution</td>
<td>90° – 104° F</td>
<td>Sunstroke, heat cramps, and/or heat exhaustion is possible with prolonged exposure and/or physical activity.</td>
</tr>
<tr>
<td>Caution</td>
<td>80° – 89° F</td>
<td>Fatigue is possible with prolonged exposure and/or physical activity.</td>
</tr>
</tbody>
</table>

History of the Hazard

Date gathered from the National Centers for Environmental Information (NCEI) Storm Events Database show that there have been two excessive heat events in San Francisco County since 1950:

**September 1, 2017:** This excessive heat event was declared on the same day when San Francisco hit its all-time highest recorded temperature. There were three deaths attributable to this heat event.

**June 10, 2019:** This heat event occurred in the middle of a stretch of excessively hot days in the Bay Area, particularly for the early summer months. San Francisco reached 100° F.

Potential Impacts of the Hazard

San Francisco State may experience impacts from extreme heat due to cancelled classes or postponed outdoor events in order to protect students, faculty, and staff from the weather.

In addition to the threat extreme heat poses to humans, high temperatures also pose a threat to utility production, which in turn threaten facilities and operations that rely on utilities. As temperatures rise, more people stay indoors, increasing the demand for air conditioning, fans, and other electronics. This puts a strain on the electrical grid, which can cause temporary outages. These outages can impact operations throughout campus, resulting in interruptions and delays in service. Outages may also negatively impact research efforts on campus, as the inability to maintain a steady, constant temperature may impact research specimens and experimental results.

Probability of Future Occurrence of the Hazard

Because the City of San Francisco is surrounded on three sides by water, the San Francisco Bay and the Pacific Ocean, the city is well-positioned for moderate temperatures. However, this can make residents more vulnerable to extreme heat events when they do occur, primarily because many residential units in San Francisco lack air conditioning.\(^{52}\)

Given the increasing number of extreme heat events in California, possibly including San Francisco, it is Possible that the hazard will occur annually in the future.

Vulnerability to the Hazard

When dealing with an extreme heat event, the most common impacts are those generally felt by the people living in the targeted area. For people in particular, heat can kill when the body is pushed beyond its limits. Most heat disorders occur because the victim has been overexposed to heat. As discussed, the major human risks associated with extreme

\(^{52}\) Hazards and Climate Resilience Plan. 4.7 Extreme Heat. Print. Retrieved 01.28.21 from: https://onesanfrancisco.org/hazard/overview
heat include dehydration, sunburn, fatigue, heat exhaustion, heat stroke, and in severe cases, death.

Some portions of the population are more at risk to the effects of extreme heat. The very young, the elderly, and certain groups with chronic medical conditions (such as asthma or other pulmonary illnesses, heart disease, poor blood circulation, neurological illnesses, and obesity) are generally more vulnerable to the effects of extreme heat, and are more likely to suffer illness or death as a result. This is especially true if exposure is extended for a period of time and preventative measures are not taken immediately.

The San Francisco State Emergency Procedures Handbook does not profile extreme or excessive heat as a campus hazard, nor does it mention the risk of power outages during a prolonged heat wave. However, the City of San Francisco’s comprehensive Hazards and Climate Resilience Plan specifically profiles extreme heat as a growing hazard and projects that by 2100, the city may experience as many as 90 extremely hot days per year. In addition, one of the City’s main mitigation strategies is to develop redundant and resilient electric power capacity, both to avoid severe power outages (as a result of PSPS or due to severe strain on the power grid) as well as to increase the response time after an emergency incident.

As this is a hazard that the campus may experience with increasing regularity, the campus may want to consider strategies to increase its ability to handle the risks and vulnerabilities.

Estimate of Potential Losses

Based on the previous historical occurrences, annualized losses are considered to be negligible. In an extreme heat event, loss of human life or health impacts are a greater concern than is property damage.

Vulnerability Assessment Conclusions

While the ability to predict future heat events at the San Francisco State campus is limited, the effects of climate change may provide some information. According to the Environmental Protection Agency (EPA), Central California has warmed about two degrees on average over the last century, with less rainfall. This may lead to stronger and more frequent heat events, drought, and an increased risk of wildfires.

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55 Ibid
Cold

Description of the Hazard

What is considered an excessively cold temperature varies according to the normal climate for that region. However, when temperatures are far below normal, with higher wind speeds, heat leaves the human body more rapidly, which increases the possibility of negative effects from these extreme temperatures.57

The greatest danger from extreme cold is to people, as prolonged exposure can cause frostbite or hypothermia, and can become life threatening. When someone is suffering from hypothermia, body temperatures can become so low that they affect the brain, making it difficult for the victim to think clearly or move well. In the case of frostbite, the frozen tissue becomes numb and the victim may be unaware that anything is wrong until someone else notices.58 This makes hazards from extreme cold particularly dangerous, as people may not understand what is happening to them or what to do about it.

The primary hazards from extreme cold are frostbite and hypothermia. Frostbite is caused by freezing of the skin and underlying tissue. It causes a loss of feeling and color in the affected areas of the body, and most often affects the nose, chin, fingers, or toes.59 It can be permanently damaging if not treated promptly and can lead to infection, nerve damage, or amputation in severe cases.60 The risk of frostbite is increased in people with preexisting conditions, the elderly, people with reduced blood circulation, and people who are not dressed warmly enough for the conditions.

Hypothermia occurs when the body loses heat faster than it can produce heat, causing a dangerously low body temperature. A normal body temperature is around 98.6° F. Hypothermia occurs when your body temperature falls below 95° F.61 As this happens, the heart and other essential organs cannot work properly. If hypothermia is not treated, it can lead to heart failure, respiratory failure, and eventually to death.

Excessive or extreme cold can accompany severe winter weather, or it can occur without severe weather. For this reason, extreme cold is a separate hazard from severe winter storms.

60 Ibid.
Location of the Hazard

Extreme cold events are a non-spatial hazard, and may occur throughout the San Francisco State campus.

Extent of the Hazard

Extreme cold has a wide range of extent and severity markers and characteristics. Average nighttime winter temperatures in the City of San Francisco are typically in the high 40s. According to data from the National Climatic Data Center (NCDC), the lowest daily temperature recorded in San Francisco was 27° F on December 11, 1932.

The National Weather Service issues Extreme Cold Warnings when the temperature feels like it is -30° F or colder across a wide area for a period of at least several hours. When possible, these advisories are issued a day or two in advance of the conditions.62

The most common extent/severity marker for extreme cold is the Wind Chill scale. Figure 21-6 (following) depicts the National Weather Service’s methodology for determining the wind chill, using wind speed and actual temperature. Although wind chill is not necessarily related to extreme cold as a single cause, the advisory system that the NWS currently uses relies on wind chill to relay warning and advisory information to the public. Extreme cold severity is a function of wind chill and other factors, such as precipitation amount (rain, sleet, ice, and/or snow). Given the low frequency of occurrence of freezing temperatures, and a low probability of extreme cold, the planning committee ranks the extent of the hazard as Low.

In 2011, the National Weather Service introduced an experimental program that issued warnings for extreme cold events, independent of other severe weather warnings. The test areas included North and South Dakota and Minnesota. However, in 2012, after a single season of use, the program was abandoned, based on reports of confusion among test audiences.63

History of the Hazard

Based on data gathered from the National Centers for Environmental Information (NCEI) Storm Events Database, San Francisco County has had 1 frost/freeze event on December 8, 2009, but no extreme cold hazards. [Records for this hazard were first recorded in 1996].

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Potential Impacts of the Hazard

Should an extreme cold event occur, San Francisco State might experience impacts due to cancelled classes.

In addition to the threat posed to humans, extreme cold weather poses a significant threat to utility production, which in turn threatens facilities and operations that rely on utilities, specifically climate stabilization. As temperatures drop and stay low, increased demand for heating places a strain on the electrical grid, which can lead to temporary outages. These outages can impact operations throughout the campus, which can result in interruptions and delays in services. These outages may also negatively impact research efforts throughout the campus, as the inability to maintain a steady, constant temperature may result in unintended effects on research specimens.

Probability of Future Occurrence of the Hazard

The City of San Francisco has experienced a freeze/frost event, but has never experienced an extreme cold event. Due to the campus’s location in a fairly temperate climate, it is Unlikely that this hazard will occur annually.

Vulnerability to the Hazard

When dealing with an extreme cold event, the most common impacts are those generally felt by the people living in the targeted area. For people in particular, extreme cold can kill when the body is pushed beyond its limits. Most danger due to the cold is because the victim has been overexposed to low temperatures. As discussed, the major human risks associated with extreme cold include frostbite, hypothermia, and in severe cases, death.

Some portions of the population are more at risk to the effects of extreme cold. The elderly, those with certain preexisting conditions (hypothyroidism, diabetes, and high blood pressure, just to name a few), those with poor blood circulation, and people who are not dressed warmly enough for the cold are generally more vulnerable and are more likely to suffer illness or death as a result.64 This is especially true if exposure is extended for a period of time and preventative measures are not taken immediately.

Neither the campus nor the City of San Francisco have addressed this hazard in their Emergency Response or Hazard Mitigation Plans. Given the infrequency of frost/freeze and extreme cold events in San Francisco, this likely does not increase the campus’s risk or vulnerability to threats.

Estimate of Potential Losses

Based on the previous historical occurrences of extreme cold events, annualized losses are considered to be negligible. In an extreme cold event, loss of human life or health impacts are a greater concern than is property damage.

Vulnerability Assessment Conclusions

While the ability to predict future extreme cold events at the San Francisco campus is limited, the effects of climate change may provide some information. According to the Environmental Protection Agency (EPA), Central California has warmed approximately two degrees on average over the last century, with less rainfall. This may lead to fewer frost/freeze events in the future.65

If an extreme cold event occur, San Francisco State might experience impacts due to cancelled classes. The most likely cause of cold weather for the campus would be a severe winter storm with high winds and rain, which can cause flooding, extended power outages, and road closures.66 The campus regularly monitors weather conditions in order to prepare before a storm hits. If conditions are dangerous, the campus will close and cancel classes.

Power outages are also a concern for the university. The university is on the main power grid and power is supplied by Pacific Gas & Electric (PG&E). A number of facilities are equipped with back-up generators that can allow for partial function during outages, but long-lasting outages may threaten the safety of well water for drinking as well as the use of telecommunication systems.67

Identified Data Limitations

Numerous public and private actors conduct research, acquire data and disseminate meteorological information and forecasting to the general public, including the CSU university system. Currently, it is assumed that, apart from regular access to climate change models on changes to temperature extremes over time, the CSU community maintains sufficient access to the data needed to plan for, respond to, and mitigate the effects of extreme heat and cold.

Flood

Description of the Hazard


66 Sonoma State University Emergency Plan. 11.7 Severe Weather and Environmental Flood. Retrieved 03.24.21 from http://emergency.sonoma.edu/planning-operations/emergency-plan#weather

67 Sonoma State University Emergency Plan. 11.8 Significant Utility Outage. Retrieved 03.24.21 from http://emergency.sonoma.edu/planning-operations/emergency-plan#weather
The incredible geographic diversity in California presents tremendous challenges for flood planning and response. The state is home to extensive mountain ranges such as the Sierra Nevada, Cascades, Klamath, Coastal Ranges, and the Southern California Transverse Range all creating tremendous watersheds. Large river systems drain the mountains traveling through populated communities including the Sacramento and San Joaquin Rivers draining into the California Delta. The state has a complex system of reservoirs, dams, and levees providing water storage and flood protection. Finally, California’s 840-mile coastline exposes the coastal regions to tidal influences.

Floods are characterized by the rising and overflowing of excess water from a water source such as a stream, river, lake, canal, or coastal body onto an area of normally dry floodplain. A floodplain is a lowland area downstream and adjacent to water bodies that are subject to flood events. Flooding is a naturally occurring event that become hazardous when populations and property are affected.

Flooding can result from excessive precipitation from weather systems generating prolonged rainfall, excessive snowmelt from watersheds upstream from the floodplain, infrastructure failure, exceeding the capacity of dams or levees, tidal influences, or a combination from any of the previous factors.

Flooding represents one of the costliest and most frequent natural disasters that influences human suffering and economic impact in the United States. Flooding will likely result in significant damage to structures, infrastructure, utilities, landscapes, and the environment. Erosion of stream banks, roadways, other feature may result from the movement of flood waters. The saturated ground resulting from standing flood waters may cause ground instability, collapse, erosion, or other damages. Further, floods will often generate substantial debris that will accumulate and be deposited throughout the flooded areas.

Flooding can be either slow-rise or rapid onset floods. With slow rise floods, there is often warning preceding water rise by hours or days before dangerous conditions present themselves. Slow rise floods that are expected to enter into populated areas generally allow for some time to initiate evacuation and sand bagging efforts. Flooding that occurs rapidly conversely are water events that present with extremely limited warning times and a limited ability to take response actions until flooding has already begun to occur.

Flooding may take on different forms:

- **Flash Flooding** – Flash flooding is typically characterized by a rapid rise, short duration, and large volume of water in a localized area. Heavy rainfall in areas that have limited drainage capacities often contribute to flash flooding conditions. These flooding events frequently occur with limited notice requiring immediate evacuation or rapid response efforts such as sand bagging. Flash flooding may arrive with fast moving water creating added hazardous conditions.

- **Riverine Flooding** – Riverine flooding is usually caused by prolonged rainfall or rainfall combined with heavy snowmelt. When soils are already saturated, the ability for the ground to absorb water is minimized. In a riverine flood, the water
way exceeds channel capacity and extends into areas outside of the channel, often in developed communities. In California, riverine flooding is most likely to occur from November through April. The duration of riverine floods may vary from a period of hours to weeks.

- **Localized Flooding** – Localized flooding is commonly the result of stormwater drainage systems being overwhelmed by unusually heavy rainfall. These flooding events frequently occur in areas that are urbanized or developed with greater amounts of impervious surfaces not allowing ground absorption. This generates added runoff into the drainage systems and onto roadways creating backups.

- **Infrastructure Failure** – Failures of dams or levees presents a serious flooding concern for areas downstream from the compromised structure. This situation may result in a catastrophic flood with limited warning time and widespread areas affected.

- **Coastal Flooding** – Coastal flooding can occur in multiple areas along the California coastline. Flooding may result from intense storms coming from the Pacific Ocean that generate elevated water levels or storm surge. The size, duration, winds generated, and intensity of the storm will influence the effect the waves will have on the shoreline. Periods of high tide can aggravate the conditions allowing greater wave impingement into coastal areas.

**Atmospheric Rivers**

California, including the location of this campus, is subject to the effects of a phenomenon referred to as atmospheric rivers. These weather events consist of long, narrow regions in the atmosphere transporting tremendous amounts of water vapor from the tropics. These weather regions behave like rivers in the sky. They can carry heavy volumes of water vapor compared to the amount of water flow at the mouth of the Mississippi River. As these atmospheric rivers arrive into California, they tend to generate significant rain and snow.

Atmospheric rivers can arrive in many different shapes and sizes. The larger events are able to generate extreme rainfall amounts resulting in flooding. They can stall over watersheds vulnerable to flooding, often saturated with heavy snow amounts. The atmospheric rivers known as a “Pineapple Express” coming from the tropics and arriving with warmer air may produce heavy rains that will melt ground snow adding to the water volume that will be added in the flood runoff.

These events can produce heavy amounts of precipitation creating extensive damages. However, these events may present as weaker systems that produce precipitation that is enough to be beneficial for the local water supply. At the higher elevations in the California mountains, these events have the potential to generate a tremendous snowpack providing a source of water during the dry summer months.
Location of the Hazard

San Francisco is located in the San Francisco Bay Area of northern California. San Francisco can experience flooding from overflowing streams and heavy precipitation events in low lying areas of the city. These areas may experience shallow flooding impacting roadways and other areas where drainage is inadequate. The western side of San Francisco is a coastal plain along the Pacific coastline that gradually rises to the east toward the campus. The communities in San Francisco are densely populated with extensive residential neighborhoods. Adjacent to the campus is Lake Merced presenting hydrologic influences on the campus. Immediately to the north of the campus is a commercial zone containing a shopping mall.

The San Francisco State University campus is located in a transition between the low-lying plain that joins with the coastline and the rise of the peninsula hills. The campus is situated in a densely populated urban area. Dense residential neighborhoods are to the south, east, and north of the campus. Lake Merced to the west and the associated water table has influenced high water levels occasionally occurring in the northwestern portions of the campus. The San Francisco State University campus is entirely located in a designated Zone X: Area of Minimal Flood Hazard. The access routes into and out of the campus servicing locations in all directions are also found in areas primarily designated as Zone X.

Extent of the Hazard

The San Francisco State University campus is entirely located in a designated Zone X: Area of Minimal Flood Hazard. The access routes into and out of the campus servicing locations in all directions are also found in areas primarily designated as Zone X: Area of Minimal Flood Hazard. The San Francisco State University, Romberg Tiburon Campus is also entirely located in a designated Zone X: Area of Minimal Flood Hazard. The access
routes into and out of the campus servicing locations in all directions are also found in areas primarily designated as Zone X: Area of Minimal Flood Hazard.

In support of the NFIP, FEMA identifies those areas that are more vulnerable to flooding by producing Flood Hazard Boundary Maps (FHBM), Flood Insurance Rate Maps (FIRM), and Flood Boundary and Floodway Maps (FBFM). Several areas of flood hazards are commonly identified on these maps, including the 1% annual chance flood zone. Flood zones are further delineated by risk and are assigned a letter signifier. The flood zone designations are defined and described in the following table.

Table 21-20: Flood Zone Designations and Descriptions

<table>
<thead>
<tr>
<th>Zone Designation</th>
<th>Percent Annual Chance of Flood</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Zone V</td>
<td>1%</td>
<td>Areas along coasts subject to inundation by the 1% annual chance of flooding with additional hazards associated with storm-induced waves. Because hydraulic analyses have not been performed, no BFEs or flood depths are shown.</td>
</tr>
<tr>
<td>Zones VE and V1-30</td>
<td>1%</td>
<td>Areas along coasts subject to inundation by the 1% annual chance of flooding with additional hazards associated with storm-induced waves. BFEs derived from detailed hydraulic analyses are shown within these zones. (Zone VE is used on new and revised maps in place on Zones V1-30.)</td>
</tr>
<tr>
<td>Zone A</td>
<td>1%</td>
<td>Areas with a 1% annual chance of flooding and a 26% chance of flooding over the life of a 30-year mortgage. Because detailed analyses are not performed for such areas, no depths or base flood elevations are shown within these areas.</td>
</tr>
<tr>
<td>Zone AE</td>
<td>1%</td>
<td>Areas with a 1% annual chance of flooding and a 26% chance of flooding over the life of a 30-year mortgage. In most instances, base flood elevations derived from detailed analyses are shown at selected intervals within these zones.</td>
</tr>
<tr>
<td>Zone AH</td>
<td>1%</td>
<td>Areas with a 1% annual chance of flooding where shallow flooding (usually areas of ponding) can occur with average depths between 1 – 3 feet.</td>
</tr>
<tr>
<td>Zone AO</td>
<td>1%</td>
<td>Areas with a 1% annual chance of flooding, where shallow flooding average depths are between 1 – 3 feet.</td>
</tr>
</tbody>
</table>
Zone X (shaded)  0.2%  Represents areas between the limits of the 1% annual chance of flooding and 0.2% chance of flooding.

Zone X (unshaded)  Undetermined  Areas outside of the 1% annual chance floodplain and 0.2% annual chance floodplain, areas of 1% annual chance sheet flow flooding where average depths are less than 1 foot, areas of 1% annual chance stream flooding where the contributing drainage area is less than 1 square mile, or areas protected from the 1% annual chance flood by levees.

No BFE or depths are shown within this zone.

History of the Hazard

Flooding in San Francisco and the broader San Francisco Bay Area have typically occurred during the winter months when Pacific storms are more common. The occurrences of significant flooding typically have been the result of successive intense storms with heavy precipitation. The region has experienced flood events that have caused tens of millions of dollars in damages and casualties. The following provides insight into information of past flooding events that are significant to the San Francisco State University campus. No history of flood events are reported for the campus. That said, occasional heavy rainfall events can produce isolated pockets of ponding in low lying areas on campus.

Table 21-21: Historic Flooding Events in San Francisco

<table>
<thead>
<tr>
<th>Date</th>
<th>Event</th>
<th>Declaration</th>
<th>Damage</th>
</tr>
</thead>
<tbody>
<tr>
<td>February 2017</td>
<td>Flood; Winter Storms</td>
<td>DR-4308-CA</td>
<td>Localized urban flood</td>
</tr>
<tr>
<td>January 2017</td>
<td>Flood; Winter Storms</td>
<td>DR-4301-CA</td>
<td>Localized urban flood</td>
</tr>
<tr>
<td>February 1998</td>
<td>Flood; Winter Storms</td>
<td>DR-1203-CA</td>
<td>Localized urban flood</td>
</tr>
<tr>
<td>January 1997</td>
<td>Flood; Winter Storms</td>
<td>DR-1155-CA</td>
<td>Localized urban flood</td>
</tr>
<tr>
<td>March 1995</td>
<td>Flash Flood; Heavy Rains</td>
<td>DR-1046-CA</td>
<td>Localized urban flood</td>
</tr>
</tbody>
</table>

Potential Impacts of the Hazard

A flood will potentially result in extensive amounts of water entering onto developed areas. The force and volume of water that is generated by a flood may cause extensive structural damage in areas subject to standing or moving water. The effects of flooding may spread over significant distances covering large areas of land. The extent of the impacts would vary based on a number of factors such as the volume of water flooding, the time of the flood event, the amount of warning provided, the location and extent of

69 City and County of San Francisco Hazard Mitigation Plan, June 2014
the flood boundary, facility elevation, and distance from the flood source. Potential impacts resulting from flooding include:

- Injuries or loss of life
- Property destruction or damage
- Loss of property contents
- Infrastructure damage including roadways, bridges, other transportation means
- Public health hazards resulting from mold, mildew, and disease due to flood water
- Flooded or destroyed lifelines/supply routes
- Damaged or destroyed utilities,
- Loss of community economic base
- Employment losses
- Agricultural (crops and livestock) damages or destruction
- Environmental damage
- Prolonged periods of necessary dewatering
- Flooding erosion may alter natural drainage channels
- Residence halls requiring evacuation and sheltering of occupants
- Threat, inundation, or damage to on campus childcare facilities and occupants
- Societal and community impacts
- Psychological impacts of impacted populations
- Disruptions to education delivery to community
- Damage or destruction of academic materials, fine arts, and research
- Damage or destruction of university computer systems and networks
- Damaged university infrastructure
- Inability for campus operations to resume
- Reduced or eliminated student engagement with academic programs
- Reductions in campus revenues

Individuals who were unable to evacuate in time or refused to leave will likely need assistance or rescue from the flooded area. Remaining in or being trapped by flood waters places individuals in significant risk of injury or death. The impacts extend beyond the danger placed upon the affected individual and places greater resource demands on agencies and organizations making efforts to rescue trapped individuals.

**Probability of Future Occurrence of the Hazard**

San Francisco is generally not considered to be at high risk from flooding except along coastal areas. The repeated historic occurrences have shown that the region is subject to flooding in any given year. Floods can occur at any time but are most common in the San Francisco Bay Area with winter storms that are saturated with subtropical moisture. The area surrounding the San Francisco State University campus does not generally promote conditions for flood waters to accumulate. There are specific buildings and areas of the campus that have a greater risk for isolated flooding. The San Francisco State University campus is located within a Zone X Special Flood Hazard Area (Area of Minimal Flood Hazard) and not in close proximity to areas with greater flood risk. However, there during high tides or when water levels are higher, additional water enters into Lake Merced
immediately west of the campus. This additional water often causes street flooding along the lower portions of the campus along the western boundary. There is a historic record of isolated urban or street flood events provides a demonstration of potential flood activity.

The probability of future occurrence for flooding is **Unlikely**.

**Vulnerability to the Hazard**

The San Francisco State University campus is subject to the effects of limited and isolated flooding resulting primarily from excessive precipitation and isolated strong storms. Flooding also may result from overflow from Merced Lake. There is limited potential for flooding and damage on campus and surrounding residential and commercial areas of San Francisco due to overflow or damage to municipal drainage systems. The flood control channels and drainage systems that are upstream from the campus have limited storage or volume capacities.

Vulnerability to flooding on the San Francisco State University campus will vary depending on when the flood were to occur. The risk to the campus population will be lessened during periods when classes are not in session or during periods of breaks. Conversely, during the days and hours that classes are in session and staff are at their workplaces, the human vulnerability increases. During rare, severe flood events, members of the campus community may become trapped on campus depending on the level and location of isolated flooding occurring on surface streets. However, in region-wide events this vulnerability may be extended to the homes and workplaces of members of the campus community and their families.

San Francisco State University is in proximity to a variety of industrial and commercial facilities in the surrounding communities. When these facilities are inundated with flood water, the potential for chemical or other hazardous materials release exists presenting possible exposures to individuals from the campus community. These facilities additionally line many of the primary access routes in and out of the campus.

During low probability, severe flood events, some campus buildings and infrastructure might be vulnerable to large-scale flooding if it reaches the university. Campus utilities and communication capabilities might be impacted by flood waters rendering them disabled. An extremely low probability flood covering a large portion of the city might affect communication capabilities well beyond the boundaries of the campus. Remaining flood waters will leave behind molds and other health concerns in affected campus buildings and facilities likely requiring extensive restoration or demolishing. The residents of the on-campus residence halls may have transportation limitations requiring evacuation and alternative housing procedures to be implemented if populated. Flood waters may result in damage to campus equipment, communication systems, protected documents, artwork, academic materials, computer systems, research, and other critical activities on lower levels of buildings located in areas of localized flooding.

Certain campus populations will experience greater challenges to a post-flood / failure environment. Vulnerable populations will likely need to navigate through flood generated
debris, face extreme health safety issues from flood waters, experience extreme stresses of a disaster, an inability to communicate to or gain access to support networks, and find difficulty in accessing equipment or supplies to aid in a specific need. Students remaining on campus such as those residing in the residence halls would be particularly vulnerable especially those without access to adequate transportation.

Estimate of Potential Losses

Estimates of potential losses will be influenced by a variety of factors. The volume and force of the water will determine the scale of damages affecting campus infrastructure, equipment, and other impacted features. The location and elevation above flood waters will affect the level of damage and individuals exposed. The time of the academic year, the day of week, and hour in which the flooding was to occur will influence the number of people on campus and potential casualties. The severity of the storms producing precipitation, the speed of the storms moving across the area, the level of snowpack in the higher elevations, and amount of resulting snowmelt will produce varying effects on damages produced and costs incurred. Losses will be generated by the physical damages, the loss of revenue, loss of academic research, loss of building contents, and community wide economic reductions.

Based on estimate replacement costs of facilities and structures on campus, the maximum total replacement costs due to flood are $448,726,927. However, it is unlikely for flood to cause destructive losses to the entire campus.

Table 21-22: Special Flood Hazard Area (SFHA) Estimated Losses

<table>
<thead>
<tr>
<th>Zone Designation</th>
<th>No of Buildings</th>
<th>Maximum Replacement Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Zone V</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Zone VE &amp; V 1-30</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Zone A</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Zone AE</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Zone AH</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Zone AO</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Zone X .2%</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Zone X Minimal Risk</td>
<td>64</td>
<td>$448,726,927</td>
</tr>
<tr>
<td>Not in a SFHA</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>No Building Value Data Provided*</td>
<td>31</td>
<td>Unknown</td>
</tr>
</tbody>
</table>

*Buildings with no value defined are also included in the respective Zones they are found in.

The table above includes 7 facilities located at the Tiburon based San Francisco State University, Romberg Tiburon Campus. The provided cost estimates for the Romberg Tiburon Campus includes $257,012. However, 2 facilities do not have costs included.

Vulnerability Assessment Conclusions
While the campus is located in an area of minimal flood potential (Zone X), the primary vulnerabilities to flood on campus are people and assets exposed to mostly localized flooding and ponding from overflow of campus creeks or isolated or large-scale storms that produce heavy amounts of precipitation directly over the campus and surrounding neighborhoods.

The potential for highly unlikely but severe flooding on the campus generates the potential for a number of cascading effects such as disruptions to the local economy, utility failures, disruptions to providing for the needs of the community, and development of public health hazards. These effects would be exacerbated by effects of seasonal flooding, ongoing heavy precipitation, or excessive run-off from the watershed contributing to the river system. The potential for widespread flooding and damage of structures due to the force of water, while unlikely, has exponentially powerful impacts on particular populations among the campus community including those with access or functional needs, international students, the homeless, and students residing in the residence halls.

Identified Data Limitations

Data limitations include missing campus structural replacement costs, and an incomplete inventory of both building construction features and mitigation efforts to lessen the impact due to flood inundation. HAZUS generated analysis is focused on the broader community level versus fine-tuning the analysis to the micro-level for facilities such as a university campus.
**Hazardous Materials**

Description of the Hazard

A hazardous material is defined in California’s State Hazardous Materials Incident Contingency Plan (1991) as “a substance or combination of substances which, because of quantity, concentration, physical, chemical, or infectious characteristics may: cause, or significantly contribute to an increase in deaths or serious illnesses; and/or pose a substantial present or potential hazard to humans or the environment.”

Hazardous materials are one or more of the following: flammable, corrosive or an irritant, oxidizing, explosive, toxic (poisonous or infectious), thermally unstable or reactive, or radioactive. Hazardous materials are ubiquitous in modern society and may be found at all stages of production, consumption, and disposal.

Federal and state laws permit the intentional release of some hazardous materials into the environment such that the risk to human health and the environment is thought to be acceptable. However, sometimes releases are unintentional, resulting from leaks, accidents, or natural hazards. This section focuses on such accidental releases and fall into the following key categories:

**Fixed Hazardous Materials Incident:** A fixed hazardous materials incident is the accidental release of chemical substances or mixtures during production or handling at a fixed facility.

**Transportation Hazardous Materials Incident:** A transportation hazardous materials incident is the accidental release of chemical substances or mixtures during highway, waterway or air transport. Populations, built and natural environments are potentially impacted.

**Pipeline Incident:** A pipeline transportation incident occurs when a break in a pipeline creates the potential for an explosion or leak of a dangerous substance (oil, gas, etc.) possibly requiring evacuation. An underground pipeline incident can be caused by environmental disruption, accidental damage, or sabotage. Incidents can range from a small, slow leak to a large rupture where an explosion is possible. Inspection and maintenance of the pipeline system along with marked gas line locations and an early warning and response procedure can lessen the risk to those near the pipelines.

Hazardous materials can also be classified according to worker safety and health. Information provided by California Division of Safety and Health includes guidelines related to:

- **Safety hazards:** fire and fire byproducts, electricity, flammable gases, unstable structures, demolition, sharp or flying objects, excavations)

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71 California Department of Industrial Relations. *Worker Safety and Health During Fire Cleanup.* Retrieved 04.18.2021 from: [https://www.dir.ca.gov/dosh/wildfire/Worker-Health-and-Safety-During-Fire-Cleanup.html](https://www.dir.ca.gov/dosh/wildfire/Worker-Health-and-Safety-During-Fire-Cleanup.html)
- **Health hazards**: carbon monoxide ash, soot and dust; asbestos; hazardous liquids; other hazardous substances; heat illness

**Natural-Technological Incidents (Natechs):** During the past two decades, increasing attention has been given to hazardous materials releases resulting from *Natechs* or a natural disaster event that triggers a technological hazard event. Natechs are of particular concern for the following reasons:

- They can produce a simultaneous effect on many industrial facilities
- Can overwhelm response capacity
- Containment systems may fail
- May produce cascading disasters
- Response may be hindered by a disaster’s impact on the physical environment

**Location of the Hazard**

Hazardous materials and infrastructure such as fuel tanks, rail lines, chemicals, hazardous waste sites and gas pipelines to varying degrees are located within the CSU system and/or within its surrounding communities. The planning committee indicates that chemicals are located in science labs on campus, and the campus maintains an underground fuel storage tank. Mapping indicates that a hazardous waste site, a rail line and a gas line are approximately ¼ mile from the campus. And a chemical industry site about ½ mile away. At larger scales (beyond the campus planning area) hazardous materials and infrastructure are located throughout the city and county of San Francisco, and reflect different types, configurations and scales dispersed across these geographic areas.

**Extent of the Hazard**

There is no comprehensive statewide vulnerability assessment available at this time. As such, the true extent of the hazardous materials risk in California and its communities is not known, meaning no overarching conclusions have been reached which have been able to integrate all qualitative and quantitative risk factors to produce a comprehensive measure of the extent of the hazard.

For the SFSU planning committee, chemicals are managed in campus science labs, and fuel is stored underground. Two events respectively have taken place on campus. Based on these factors, as well as the fairly close proximity of other materials and infrastructure, the extent of the hazard for the SFSU campus is Moderate. That said, it is prudent to

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consider worst case scenarios as the main driver of policy in order to fully mitigate all possible hazardous materials event outcomes.

For example, according to the 2018 CA State Hazard Mitigation Plan, 400 hazardous materials problems are tied to 32 past earthquakes, including over 150 problems from the Loma Prieta Earthquake alone. That said, the plan indicates that it is likely that many such hazardous materials releases have received little attention in the past because public authorities, the media, and the public have overlooked them in the rush to address and recover from immediate disaster threats, and that responsible parties may have an incentive to understate the extent of releases or not to report them at all.

History of the Hazard

According to the CA Governor’s Office of Emergency Services’ Hazardous Materials Spill Report, the state experiences from 10 to 30 spill events daily. As of April 20th, 2021 already 2096 spill events had occurred. Such events have occurred in all the cities and/or counties where CSU campuses are located.

According to the campus planning committee, in 2016, a chemical spill incident required the evacuation and shut-down of the science building. In addition, a campus vendor accidentally spilled 2,000 gallons of unleaded fuel into the campus parking lot (date unknown).

Potential Impacts of the Hazard

A large hazardous materials release could affect an entire community or city under certain conditions related to direction of air flow (air-based chemical release) and population density or the contamination of a community’s main water supply. Either type of release could necessitate large scale evacuation. By contrast, in the rural unincorporated areas where population densities are low, even in the event of a large release, the number of homes that may need to be evacuated would be significantly lower than in an urban environment. The occurrence of a hazmat incident can also result in the shut-down of transportation corridors which can last for hours at a time while the impacted area is stabilized.

The release of some toxic gases may cause immediate death, disablement, or sickness if absorbed through the skin, injected, ingested, or inhaled. Contaminated water resources become unsafe and unusable, depending on the amount of contaminant. Some chemicals cause painful and damaging burns if they come in direct contact with skin. Prolonged and concentrated exposure to such chemicals can produce severe long-term impacts to respiratory, endocrine and nervous systems, heart and brain health.

The potential impacts of chemicals and toxic gases discussed here also apply to the students, staff, and environment on the SFSU campus. With regard to the natural environment overall, contamination of air, ground, or water may result in harm to fish, wildlife, livestock, and crops. The release of hazardous materials into the environment may cause debilitation, disease, or birth defects over a long period of time. Loss of livestock and crops may lead to economic hardships within the community.

Recent California examples include the 2016 Aliso Canyon methane gas leak, which caused evacuation of nearby residents, many of whom experienced temporary health problems such as difficulty breathing and eye irritation; and the 2016 Fruitland metal recycle plant fire in Maywood, which released heavy metals such as lead, magnesium, copper, aluminum, antimony, calcium, iron, sulfur, tin, potassium, and zinc which pose severe risks to public health. Health effects from exposure to these metals included short-term symptoms such as irritation to the eyes, nose, throat, and lungs.

Potential Impacts of the Hazard (Natechs)

Natural disasters, including earthquake, flood, and fire also pose risks to public health and the environment. For example, following the Northridge Earthquake, California State University (CSU) Northridge laboratories and chemical storage rooms experienced multiple chemical spills. Such incidents, triggered by a natural disaster, pose a significant risk to students, faculty, staff, and first responders. At a minimum, all CSU campuses with a science lab (including SFSU) are at risk of potential impact from a natural-technological (combined impact) event.

In a severe flood event, floodwaters are often contaminated with hazardous materials posing a threat to public and animal health, groundwater, and other parts of the environment. These hazardous materials may be released from damaged or flooded underground tank sites (e.g., gas stations or chemical storage facilities), propane tanks, manure or human waste handling facilities, fertilizer and pesticide storage, agricultural sites, and household hazardous waste.

In a fire event, (such as the October 2017 Northern California firestorms which destroyed approximately 6,000 residences) entire neighborhoods can be burned to the ground. Hazardous material release creates public health concerns which can delay the initial steps of fire recovery, including reopening burned areas to residents and initiating debris removal activities. The post-fire “toxic sweep” poses a risk of coming into contact with toxic substances due to the presence of synthetic and hazardous materials.

78 2018 California State Hazard Mitigation Plan, section 9.2.
Probability of Future Occurrence of the Hazard

The probability of occurrence for a hazmat event on the SFSU campus can be viewed in two different ways: the history of occurrence serves as a sound predictor of future probability assuming current risk and vulnerability factors remain somewhat constant. For the purposes of the current estimate, no current data clearly indicates otherwise. As such, the probability of occurrence is Moderate - the campus has experienced two hazmat events in recent years. In addition, hazardous materials and infrastructure are only ¼ mile away which may increase vulnerability and the probability of a campus-related event. Moreover, hazmat occurrences are largely based on human error, and any changes in risk and vulnerability factors such as a decreased vigilance in materials oversight and handling practices or changes in the amount of chemicals or exposure will likely increase the probability on campus.

Vulnerability to the Hazard

Hazardous materials pose a risk to the SFSU campus. As identified by the campus planning committee and on the hazmat map (see section X), the following vulnerabilities are present on campus: chemicals are located in science labs on campus, and the campus maintains an underground fuel storage tank. Mapping indicates that a hazardous waste site, a rail line and a gas line are approximately ¼ mile from the campus. And a chemical industry site about ½ mile away. Gases and chemicals or hazardous waste, if spilled or released, could impact human health and campus operations.

Although it is quite difficult to produce a quantitative measure of vulnerability because (unlike natural hazards) the probability of occurrence is dependent on human error, which itself is variable based upon a fluctuating set of interrelated factors, some of which lack prediction or control, given the complexity of how all natural and built environments and hazmat risks factors interrelate at the local or campus level, it is prudent to assume for planning purposes that the campus’ vulnerability is a sub-set of the larger community’s vulnerability. As such, the SFSU leadership maintains vigilance to mitigate the campus’ vulnerabilities identified above at a minimum.

Estimate of Potential Losses

As discussed previously, it is difficult if not impossible to produce an accurate quantitative measure of vulnerability because of the variable nature of a hazardous materials spill. For example, the release of a toxic airborne chemical in a populated area has severe impact potential, whereas the impact potential of a small chemical spill in a remote or rural area is most likely limited to remediation of soil. And, in both cases, the probability of occurrence is dependent on human error, which itself is variable based upon a fluctuating set of interrelated factors, some of which lack prediction or control. In all cases, different types and amounts of hazardous materials interact with fluctuating combinations of human error to produce different event outcomes with variable impact costs.
Vulnerability Assessment Conclusions

It is well understood that with regards to hazmat vulnerability, each campus and its surrounding community (including SFSU) operates through a complex and dynamic interaction between industrial and commercial inputs and outputs and the natural and built environment. Such activity produces hazardous materials that move through the environment along both convergent and divergent routes and across all levels of land-use from site to campus to city and county and beyond. It is also clear from a review of the San Francisco County hazard mitigation plan and Cal OES’ records of hazardous material spills, that such events occur with great frequency and varying degrees of severity across jurisdictions statewide. As such, in assessing the vulnerability of the SFSU campus, campus-level risks and vulnerabilities are not discreet or isolated but can become exacerbated or augmented through connections to broader community-level hazmat risks and vulnerabilities.

Finally, in order to draw conclusions on vulnerability, it should be noted that any identified vulnerabilities at the campus level and/or community level are circumscribed and potentially reduced by targeted policy and program interventions. Numerous policies and programs have been established in recent years in response to California’s widespread and complex and integrated hazardous materials risks - California established the Unified Program which consolidates and integrates the administrative requirements, permits, inspections, and enforcement activities of the following environmental and emergency response programs: the Aboveground Petroleum Storage Act (APSA) Program, Area Plans for Hazardous Materials Emergencies, the California Accidental Release Prevention (CalARP) Program, the Hazardous Materials Release Response Plans and Inventories (Business Plans), Hazardous Material Management Plan (HMMP) and Hazardous Material Inventory Statement (HMIS) requirements (California Fire Code), the Hazardous Waste Generator and Onsite Hazardous Waste Treatment (tiered permitting) Programs, and the Underground Storage Tank Program.

Identified Data Limitations

The SFSU planning committee has provided information on campus-level hazmat materials and risks. Data limitations pertain to a comprehensive understanding of human activity and error related to materials control over the long term.
Landslide

Description of the Hazard

A landslide is a down-slope movement of soil, rock, or other debris, and can also be referred to as a mass movement or slope failure. These geological hazards can range in size from a few feet to over a mile in length and width and, when heavy and rapidly moving, can cause serious damage and loss of life.

Landslides are classified based on the type of material and type of movement involved. They can range from slow-moving earth flows to fast-moving debris flows, though many large slope failures involve more than one type of movement. The primary natural triggers of slope failures are water, seismic activity, and volcanic activity. Slope saturation by water can occur from intense rainfall, snowmelt, changes in ground-water levels, and surface-water level changes along coastlines. In winter months, El Nino storms or other high rainfall events may saturate soils and trigger slope failure.

Deep-Seated Landslides

Deep-seated landslides, ranging in depth from ten to several hundred feet, occur as a result of geologic and hydraulic changes, such as earthquakes or increased levels of groundwater. These landslides can move slowly or quickly and can cause extensive property damage, but rarely result in loss of life.

Debris Flows Related to Shallow Landslides

Shallow landslides may mobilize into rapidly moving debris flows and typically occur after sudden saturation of the ground. These types of debris flows are typically more dangerous because they move rapidly, causing both property damage and loss of life.

Debris flows may also occur as a result of post-fire conditions, where wildfires have left barren ground exposed to heavy rainfall. Intense rainfall, generally greater than .5 inch per hour, has the potential to trigger a post-fire debris flow. These landslides may

impact lives and properties within its deposition zone, and can result in downstream flooding. These post-fire debris flows often occur during the fall and winter following major summer fires.

Location of the Hazard

The susceptibility of an area to landslides depends on several variables, including magnitude of slope gradients, water content, ground cover, presence of erosion, and slope material and structure. However, landslides are most prevalent in terrain with weak material and steep slopes, and the highest risk is found in areas with high rainfall or high earthquake potential. Slope failures are also most likely to occur in areas where they have occurred in the past. In California, the most landslide-prone areas are found along the coast and in the northern Franciscan Formation.

General landslide vulnerability can be estimated from the distribution of weak rocks and steep slopes as seen in Figure 21-13. As seen on the map, San Francisco State University (SFSU) is not located an area susceptible to landslides, but is located adjacent to such areas.
In San Francisco, landslides are more likely to occur along eroding coastlines. However, the indirect impacts of landslides in the region may cover a larger geographical extent. Based on the location of the campus outside the landslide risk area, the planning committee ranks the extent of the hazard as **Low**, though nearby transportation routes could be affected.

**History of the Hazard**

NOAA recorded one debris flow event in San Francisco County, occurring on February 22, 2019. The landslide occurred a short distance from campus and resulted in one fatality. FEMA declared one major disaster involving landslides and mud flows as a result of a severe storm in 1995.

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Potential Impacts of the Hazard

SFSU may be impacted by the disruption of services as a result of landslides in the region. Landslides can result in physical damage to buildings and property and have the potential to significantly effect infrastructure. As a landslide moves, it distresses structural foundations by settlement, cracking, and tilting. Fast-moving flows can remove entire structures in one instance, while other types of flows can cause damage gradually.

Transportation and utility infrastructure are particularly vulnerable to landslides, since the failure of any component can disrupt service over a large area. The loss of power and communication and disruption of transportation can have cascading effects throughout an area, including impaired disposal of sewage, contamination of water supplies, and the release of flammable fuels.\(^\text{12}\) Transportation routes are also often expensive to clean up, and prolonged obstruction can disrupt the movement of people and goods for long periods of time.

Probability of Future Occurrence of the Hazard

Slope failures are often triggered by other natural hazards such as heavy rainfall and earthquakes, so landslide frequency is often related to the frequency of these other hazards. As climate change impacts the frequency and intensity of triggers such as rain events, fires, and coastal erosion, landslides may generally occur more often. Historically, landslides have occurred rarely in San Francisco and therefore are unlikely to occur in the future. Given the location of the campus beyond landslide risk zones, the planning committee ranks the probability of the landslide hazard for the campus as Unlikely. That said, based on the occasional occurrence of landslides to the east, the probability of experiencing secondary effects of a landslide such as loss of power or transportation disruption is Possible.

Vulnerability to the Hazard

The vulnerability of the built environment to landslides depends on exposure and is more likely to incur damage as a result of proximity, rather than inferior structural design. The structures most vulnerable to landslides are buildings and utility/transportation lifelines, which can be impacted by either impact or ground deformation. Utilities and transportation infrastructure are particularly vulnerable, due to their geographic extent and susceptibility to physical distress. Any population proximal to a landslide when it occurs is vulnerable to its impacts. That said, the campus’ vulnerability is limited to secondary effects of a landslide such as power outage or transportation disruption.

Estimate of Potential Losses

There are no current models for estimating potential losses from a landslide directly impacting the campus.

Although the economic impact of landslide damage can exceed that of the direct repair costs, there are currently no applicable methods for estimating indirect costs related to SFSU.
Vulnerability Assessment Conclusions

Community exposure to landslides varies depending on their physical locations – whether in flat plains or on steep hillsides – and on their dependence on critical infrastructure located in landslide hazard zones.

Landslides could impact the campus in a variety of ways, primarily related to indirect impacts to transportation and utilities. Utility outages can impact health, particularly for vulnerable populations, and can cause interruptions in operations. Interruptions may impact student and employee’s ability to travel to campus and the delivery of classes and events.

Identified Data Limitations

The ability to predict future landslides at the SFSU campus is limited. However, the USGS estimates that climate change-induced shifts in weather will increase the frequency of post-wildfire landslides, which are expected to occur almost every year in California.13

Power Outage

Description of the Hazard

San Francisco State University (SFSU) is located in the Bay Area of California, within the city (and County) of San Francisco. San Francisco is the fourth most populous city in California, with a population of 883,255; it is also one of the most densely populated cities in California, at 18,569 residents per square mile. Furthermore, San Francisco is part of the 12th-largest metropolitan statistical area in the United States by population (i.e., 4.7 million people).

Most aspects of modern life, and almost all aspects of urban life, rely on the availability of reliable utilities, such as electricity, water, and natural gas. An interruption in the supply or distribution of these commodities can leave highly and densely populated areas like San Francisco without basic services, such as electricity or sanitation. These interruptions can be cascading effects from other hazard events, such as windstorms, floods, wildfires, and earthquakes, or they can be caused by intentional disruptions of transmission lines.

A power outage event can interrupt day-to-day operations of the SFSU campus, like in-person classes, impede or limit digital, telephonic or radio communications, create traffic jams around the busy avenues and boulevards surrounding the campus, close the student health center, and close restaurants around campus and outside the campus. Additionally, thousands of SFSU student residents in on-campus housing would also be affected by a power outage on campus and in the area.

Additionally, a severe outage to San Francisco would also directly affect the campus and the community.
and close restaurants around campus and outside the campus. Additionally, thousands of SFSU student residents in on-campus housing would also be affected by a power outage on campus and in the area.

Electric power disruptions and outages fall into two categories: intentional and unintentional.

The four types of **intentional** disruptions are:

- **Planned:** Some disruptions are intentional and can be scheduled based on maintenance or upgrading needs.
- **Unscheduled:** Some intentional disruptions must be done "on the spot" in response to an emergency.
- **Demand-Side Management:** Some customers (i.e., on the demand side) have entered into an agreement with their utility provider to curtail their demand for electricity during periods of peak system loads.
- **Load Shedding:** When the power system is under extreme stress due to heavy demand and/or failure of critical components, it is sometimes necessary to intentionally interrupt the service to selected customers to prevent the entire system from collapsing. These intentional interruptions result in rolling blackouts.

**Unintentional** or unplanned disruptions are outages that come with essentially no advance notice or warning. This type of disruption is the most problematic. The following are categories of unplanned disruptions:

- Accident by the utility, utility contractor, or others.
- Malfunction or equipment failure.
- Equipment overload (utility company or customer).
- Reduced capability (equipment that cannot operate within its design criteria).
- Tree contact other than from storms.
- Vandalism or intentional damage.
- Weather, including lightning, wind, earthquake, flood, and broken tree limbs taking down power lines.
- Wildfire that damages transmission lines.

**Location of the Hazard**

Although power outages can take place within a certain area, it has the potential to affect the entire planning area equally.

**Extent of the Hazard**

In order to anticipate outage conditions and reduce impacts, campus facility managers and others keep track of conditions and data provided by the media, municipal utilities and the California Independent System Operator (CAISO). CAISO is tasked with managing the power distribution grid that supplies most of California, except in areas served by municipal utilities, and is thus the entity that coordinates statewide flow of electrical supply. CAISO uses a series of stage alerts to the media based on system conditions. The alerts are:
- Stage 1 - reserve margin falls below 7 percent.
- Stage 2 - reserve margin falls below 5 percent.
- Stage 3 - reserve margin falls below 1.5 percent.

Rotating blackouts become a possibility when Stage 3 is reached. Utility agencies aim to advise affected areas approximately 48 hours in advance of a potential PSPS event and will attempt notification again approximately 24 hours before power is shut off. Campus staff respond accordingly.

Given the prevalence of rolling blackouts and other power outages in California, the campus maintains safety precautions, situational awareness, access to emergency power generators and other protocols for managing campus power outages. Given that recorded outages have taken place on campus, the planning committee ranks the extent of the power outage hazard as **Moderate**.

**History of the Hazard**

The City of San Francisco has experienced power outages over time. Their electric utility provider, the Power, Gas and Electric (PG&E) has experienced outages, which have affected the residents of San Francisco over the years. Any major power outages impacting the City of San Francisco in recent years can affect the University campuses.

San Francisco State did not report any power outages in the recent years at San Francisco State, but did advise that the university is within a zone affected by PSPS power outages.

**Potential Impacts of the Hazard**

Instructors, campus residents, staff, and administration rely on electricity for basic operations. During a widespread power failure, it may take anywhere from several hours to days to restore operations if a significant event occurs. Electrical power may be the only cooling source for many individuals around the campus and its community, and long-term outages can potentially put people’s health and life at risk. Disruptions in the supply of heating fuel may put people and property at risk during extremely cold weather if it relies on electric generation or heating mechanisms instead of gas. Additionally, many medical devices, communications devices, and security rely on power to maintain their functions.

**Climate Change and Energy Shortage**

Climate change is expected to bring more frequent and intense natural disasters. These changes have created a variability at a rate that makes historical data a poor predictor of future climate. For example, the warmest years on record in California occurred in 2014, 2015, and 2016. The 2016 - 2017 year broke the record as the wettest ever recorded in the northern Sierra Nevada Mountains.

Changes in temperatures, precipitation patterns, extreme events, and sea-level rise have the potential to decrease the efficiency of thermal power plants and substations, decrease the capacity of transmission lines, render hydropower less reliable, spur an increase in electricity demand, and put energy infrastructure at risk of flooding.
With climate warming, higher costs from increased demand for cooling in the summer are expected to outweigh the decreases in heating costs in the cooler seasons. Hotter temperatures in California will mean more energy (typically measured in “cooling-degree days”) needed to cool homes and businesses both during heat waves and on a daily basis, during the daytime peak of the diurnal temperature cycle. During future heat waves, historically cooler coastal cities (e.g., San Francisco and San Francisco) are projected to experience greater relative increases in temperature, such that areas that never before relied on air conditioning will experience new cooling demands.

Secondary impacts of energy shortages are most often felt by vulnerable populations. For example, those who rely on electric power for life-saving medical equipment, such as respirators, are extremely vulnerable to power outages. Also, during periods of extreme heat emergencies, the elderly and the very young are more vulnerable to the loss of cooling systems requiring power sources.

**Probability of Future Occurrence of the Hazard**

The probability of California experiencing a power outage can be difficult to quantify but is a hazard that occurs annually during the same seasonal periods of temperature variance throughout the calendar year. The City and County of San Francisco experiences such outages. As such, the probability ranking for the San Francisco area is **Likely**. Although the San Francisco State University campus has not reported any power outage events, it is within a zone affected by Public Safety Power Shutoff (PSPS) events; therefore, it is prudent to assign this same ranking for the campus.

Climate models suggest summer global temperatures are likely to increase while changes between temperature extremes would be more pronounced. As such, it is expected that power outages will occur more frequently in the future.

**Vulnerability to the Hazard**

Based on the data available, and in consideration of the increasing effects of climate change, the probability of future occurrences prompting intentional outages and creating unintentional power outages the hazard is high for the county in different areas but not specifically influencing the San Francisco State. Nonetheless, it would serve the campus to ensure to be able to mitigate and cope with an interruption to electrical power.

Although the campus has specific power outage protocols, an outage can impact the operations of the university depending on the severity of the outage. During daytime hours, the University may remain open and business and instructional operations will remain on-going at the maximum extent possible. It will be expected that the areas surrounding the campus, including streetlights, will have also experienced a blackout.

During dark hours staff, students and faculty are to remain on campus for fifteen minutes in the event that power returns. In the event that the power returns business and
instructional operations will resume. If power is not restored, instruction will stop, and business operations will stop for the remainder of the evening.

Classes and university operations and projects utilizing hazardous materials are required to immediately stop to avoid additional hazards.

**Estimate of Potential Losses**

The data provided by San Francisco State does not report any value for potential losses due to power outage.

**Vulnerability Assessment Conclusions**

Elevators, entry ways, air filtration systems and lighting provide the campus community with the necessary infrastructure and systems to function and navigate through the campus and to maintain a safe campus environment and visibility during nighttime hours. The primary concern for campus leadership is that a loss of power can lead to potential hazards to students, faculty, and staff at San Francisco State. Vulnerable populations (especially students with physical disabilities) may be the most heavily affected by loss of power, as they rely on elevators, entry ways with automatic doors, and locks and lights; a power outage would impede a disabled student’s ability to travel and utilize the campus and its structures safely.

The use of communication devices, billing, records, and electrical tools may also become unusable due to a loss of electricity. Many records and billing items may have to revert to “by-hand” procedures and paper copies may have to be kept to continue operations. Additionally, classrooms may not be usable if lighting equipment is not functioning impacting a semester or quarter’s progress for the academic year.

**Identified Data Limitations**

San Francisco State did not report any monetary or life losses due to a power outage.
Volcano (Associated Air Quality)

Description of the Hazard

The US Geological Service defines volcanoes as “openings or vents where lava, tephra (small rocks), and steam erupt on to the Earth’s surface. Through a series of cracks within and beneath the volcano, the vent connects to one or more linked storage areas of molten or partially molten rock (magma). This connection to fresh magma allows the volcano to erupt over and over again in the same location.”

A volcanic eruption occurs when magma, lighter than surrounding rock, is driven upwards by its buoyancy and by pressure from the dissolved gases contained within it. Gases are released from magma as it reaches the surface and pressure decreases. Magma can be erupted in several ways and violent eruptions typically cause tiny pieces of tephra (ash) to be carried away by the wind. This ash is hard, does not dissolve in water, is extremely abrasive and mildly corrosive, and conducts electricity when wet.

The gases released in an eruption include carbon dioxide, sulfur dioxide, hydrogen sulfide, and hydrogen halides. Depending on their concentration, these are potentially hazardous to people, animals, agriculture, and property.

Location of the Hazard

There are eight volcanic areas located throughout California. Seven of these - Medicine Lake Volcano, Mount Shasta, Lassen Volcanic Center, Clear Lake Volcanic Field, Long Valley Volcanic Region, Coso Volcanic Field, and Salton Buttes – are considered active volcanoes. No portion of San Francisco State University (SFSU) or San Francisco County is located within a volcano hazard zone.

Extent of the Hazard

Volcanic hazards are most severe within a few miles of the volcano vent and the severity generally decreases with distance. Ash impact zones can range from tens to hundreds of miles from the vent source. The US Geological Survey has estimated zones surrounding active volcanoes wherein 2 inches or more of ashfall following an eruption is possible. While C SFSU does not fall within an estimated ashfall zone, lighter dustings of ash outside of those areas may directly or indirectly impact the campus. As such, the planning committee ranks the extent of the hazard for the campus as Low.

History of the Hazard

No historical eruption events in California have affected the campus. Over the last 1,000 years, there have been at least 12 eruptions in California. The most recent volcanic

eruption in California occurred at Lassen Peak about 100 years ago, when a major explosion delivered windborne ash over 275 miles away.\textsuperscript{12}

Potential Impacts of the Hazard

The specific impacts vary widely and depend on which type of volcano erupts, the style of explosion, the volume of lava, the eruption duration, and the local water conditions. As SFSU is not proximal to an active volcano, only the potential impacts of ashfall and gases have been detailed. While both these hazards can be widespread, their most severe impacts are generally seen closer to the volcanic source.

Although ashfall is typically a nonlethal volcanic hazard, it is the most widespread and disruptive. Falling ash can damage crops, electronics, and machinery. It can also impact human health by irritating the respiratory tract, eyes, and skin. The particles may enter drinking water and structures and may cause structure failure if it is thick and heavy enough. Even a fine layer of ash can disrupt utilities. A portion of California’s major electric transmission lines, aerial telecommunication lifelines, transportation corridors, and water storage and conveyance lie within the state’s volcano hazard zones. Impacts to any of these can impact operations at SFSU.

The potential impacts of gases released during volcanic eruptions are as follows:

- Carbon dioxide typically becomes diluted very quickly and is not life threatening. However, it can become trapped in higher concentrations in low-lying areas and has the potential to be fatal.
- Sulfur dioxide can cause acid rain and air pollution downwind of a volcano.
- Hydrogen sulfide can cause irritation of the upper respiratory tract. At high concentrations it can cause unconsciousness and death.
- Hydrogen halides can coat ash particles and, once deposited, poison drinking water, agricultural crops, and grazing land.

Probability of Future Occurrence of the Hazard

The US Geological Survey, based on the record of volcanic activity in California, estimates that the probability of another small- to moderate-sized eruption in the next thirty years is about 16 percent. As such, the annual probability of future occurrence for the campus is ranked by the committee as \textit{Unlikely}.

Vulnerability to the Hazard

Populations living near volcanoes are the most vulnerable to eruptions and lava flows. However, volcanic ash can travel and affect populations miles away. The location and thickness of ash in any given area is a function of the severity of the eruption and wind speed and direction. For SFSU, there is low vulnerability to the immediate impacts of volcanic eruptions due to the limited area affected and remote potential of an eruption. In the event of a widespread ashfall event, the elderly, infants, and populations with existing respiratory disease will be at higher risk.
Estimate of Potential Losses

Impacts to critical infrastructure, agriculture, and property from ashfall have the potential to cause widespread disruption, damage, and economic loss throughout the state. In the event of a widespread ashfall event, impacts will be immediate.

Current modeling is not precise enough to allow for an assessment of potential losses from ashfall to structures or infrastructure on or surrounding the campus.

Vulnerability Assessment Conclusions

SFSU is unlikely to experience the direct impacts of a volcanic event. While the campus may be indirectly impacted by ashfall elsewhere in the state, direct ashfall impacts are generally unlikely but possible in a widespread event. However, the likelihood of any volcanic eruption in the state impacting the campus is very low.

Identified Data Limitations

Not all active volcanoes in California have been zoned for hazards by the US Geological Survey. This, together with the infrequent occurrence of volcanic explosions and number of factors determining type and extent of impacts, make the quantification of potential loss difficult.

Wildfire

Description of the Hazard

While wildfires are a natural part of California’s ecosystem, wildfires in California represent a hazard that presents one of the greatest probabilities of destruction along with a demonstrated history of catastrophic fire events in recent years. The destructive fire seasons of 2017 to 2020 illustrated the destructive forces fire presents to communities across the state. Wildfires may result in the structural loss, infrastructure loss, dangerous air quality, environmental damages, economic impacts, injuries, and loss of life. In many communities throughout California, wildfire presents greatest risk to human life and property.

Wildfires have been defined as any free burning vegetation fire that initiates from an unplanned ignition, whether natural or human caused demanding fire suppression actions to contain. These fires are prone to become uncontrolled, spreading through vegetative fuels rapidly exposing people and structures to harm. Wildfires present a significant risk to communities across the state, as evidenced by increasing trends of structural losses from wildland fires. This risk is elevated in areas where development and community growth has intersected, also known as the wildland-urban interface (WUI). In the interface setting, development itself can provide additional fuel for large fires. Recent fires have also demonstrated the ability of fire to consume populated areas in extreme conditions.

84 State of California Hazard Mitigation Plan, September 2018
California’s Mediterranean climate in combination with its geography and vast population create a combination of factors that promotes an optimal environment for large fire growth and consequences. As there is great diversity of geographic characteristics across the state, the risks and potential consequences of wildfire must be assessed locally. The physical location, weather patterns, local fuel types and volume, extent of the WUI, topography, and additional factors will factor differently from part of the state to another.

The behavior of wildfires in California is significantly influenced by three distinct geographic factors. These factors will help shape the size, direction of spread, rate of combustion, fire intensity, and ability to pre-heat fuels. The physical factors contributing to wildfire behavior include:

- **Topography** – The rate in which wildfires spread increases with greater slopes in topography. The greater the slope will result in more pre-heating of fuel above the advancing fire. The direction that a slope faces will also influence fire behavior as south facing slopes receive greater solar radiation and thus drier vegetation that is more susceptible to combustion. Ridgetops often denote the end of fire spread as fire has greater difficulty spreading downhill.

- **Weather** – Weather factors substantially influence the behavior of wildfires. Wind, temperature, humidity, lightning, and lack of precipitation all contribute to a fire’s ability or inability to spread and intensify. California routinely experiences conditions in which these factors are in alignment to contribute to extreme fire behavior during the summer and fall seasons. High winds, low humidity, and high temperatures provide an environment promoting extreme fire activity.

- **Fuels** – Certain types of vegetation are increasingly prone to igniting and promote more intense burning. Areas with greater “fuel loading” (amount of fuel present in terms of weight of fuel per unit of area) increases the amount of fuel to fuel a fire. Greater volumes of dead or dry vegetation compared to live plants is a critical factor. Vegetation during drought conditions will experience decrease in moisture content increasing the conditions for combustion. Fuels close proximity to one another allows for rapid spread through contact or radiant exposures.

A risk assessment for wildfires should be implemented within a geospatial context focusing on the specific location features and incorporates the three components of the wildfire risk triangle – likelihood, intensity, and susceptibility.

**Location of the Hazard**

Substantial portions of the State of California are exceptionally vulnerable to wildfire activity or reside in a wildland-urban interface (WUI) area due to the vast open spaces, rangelands, forests and other lands with high susceptibility to fire occurring throughout the state. San Francisco State University (SFSU) and the San Francisco Peninsula are located in a densely populated area of the Bay Area. This area near the university is dominated by urban and suburban communities with limited direct exposures to wildland fire. San Francisco State University has extensive residential neighborhoods to the north, east, and south of campus. The western side of the campus is open parkland, lakes, and coastline.
The San Francisco State University campus is located in the southwestern portion of the City of San Francisco. The campus is 2 miles northwest of the San Bruno Mountains, the closest area designated as having a high fire hazard where there are large areas of hillsides with moderate to heavy vegetative fuels. The campus is not located next to areas with a fire hazard potential making direct impacts by fire on the campus unlikely.

However, the San Francisco State University campus is in a region surrounded by mountains and extensive areas of fire hazards further away. Surrounding the Bay Area are large mountain ranges and hills including the Santa Cruz Mountains, Oakland Hills, Hayward Hills and the mountains of Marin, Sonoma, and Napa Counties. These mountain ranges host forests with extensive history of large fire development. The fires that burn in these areas have the potential to develop vast quantities of smoke that can fill the Bay Area in the right wind conditions. The geography of the San Francisco Bay and surrounding valleys creates a topography that can capture and direct air pollutants including smoke through the movement of offshore winds. The San Francisco State University campus is located in a region in which wildfire smoke can saturate the air around the campus.

Figure 21-13: Fire Hazard Severity Zones near San Francisco State University

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Extent of the Hazard

The area immediately surrounding the San Francisco State University campus is not in proximity to fire hazard zones designated as a High Fire Hazard Severity Zones, and the campus does not have a history of wildfire activity occurring within proximity to the campus. Although the campus is not surrounded by High fire severity zones, it is surrounded by mountain ranges containing forests with an extensive history of large wildfire development and smoke generation. As a result, the planning committee ranks the extent of the wildfire hazard for the SFSU campus as Moderate.

The National Fire Danger Rating System (NFDRS) is the current system in use for rating and classifying the potential danger of fire. The NFDRS tracks the effects of previous weather events on both dead and live fuel loads and adjusts accordingly based on future or predicted weather conditions. These complex relationships and equations are computed, and the outputs are expressed in terms that users can quickly and easily understand. The current NFDRS is used by all federal and most state agencies to assess fire danger conditions.

The following table depicts the NFDRS, from the US Forest Service’s Wildland Fire Assessment System.
<table>
<thead>
<tr>
<th>Rating</th>
<th>Basic Description</th>
<th>Detailed Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>CLASS 1: Low Danger (L)</td>
<td>Fires not easily started</td>
<td>Fuels do not ignite readily from small firebrands. Fires in open or cured grassland may burn freely a few hours after rain, but wood fires spread slowly by creeping or smoldering and burn in irregular fingers. There is little danger of spotting.</td>
</tr>
<tr>
<td>COLOR CODE: Green</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CLASS 2: Moderate Danger (M)</td>
<td>Fires start easily and spread at a moderate rate</td>
<td>Fires can start from most accidental causes. Fires in open cured grassland will burn briskly and spread rapidly on windy days. Woods fires spread slowly to moderately fast. The average fire is of moderate intensity, although heavy concentrations of fuel -- especially draped fuel -- may burn hot. Short-distance spotting may occur but is not persistent. Fires are not likely to become serious and control is relatively easy.</td>
</tr>
<tr>
<td>COLOR CODE: Blue</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CLASS 3: High Danger (H)</td>
<td>Fires start easily and spread at a rapid rate</td>
<td>All fine dead fuels ignite readily, and fires start easily from most causes. Unattended brush and campfires are likely to escape. Fires spread rapidly and short-distance spotting is common. High intensity burning may develop on slopes or in concentrations of fine fuel. Fires may become serious and their control difficult, unless they are hit hard and fast while small.</td>
</tr>
<tr>
<td>COLOR CODE: Yellow</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CLASS 4: Very High Danger (VH)</td>
<td>Fires start very easily and spread at a very fast rate</td>
<td>Fires start very easily and immediately after ignition, spread rapidly and increase quickly in intensity. Spot fires are a constant danger. Fires burning in light fuels may quickly develop high-intensity characteristics - such as long-distance spotting - and fire whirlwinds when they burn into heavier fuels. Direct attack at the head of such fires is rarely possible after they have been burning more than a few minutes.</td>
</tr>
<tr>
<td>COLOR CODE: Orange</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CLASS 5: Extreme (E)</td>
<td>Fire situation is explosive and can</td>
<td>Fires under extreme conditions start quickly, spread furiously, and burn intensely. All fires are potentially serious. Development into high</td>
</tr>
</tbody>
</table>
Due to the impacts of wildfires on public health, agencies across the nation have adopted the use of the Air Quality Index (AQI) to communicate and provide a consistent approach to air quality measurements and categorization. The AQI primarily focuses on the health effects caused by pollutants in the air such as smoke. The goal of the AQI is to provide advisories to assist the public in determining when to reduce exposures to inhalation of air pollution as pollution levels rise.
History of the Hazard

The State of California has a long history of chronic and destructive wildfires throughout the state. On average, 8,300 wildfires have caused burnt 928,245 acres across the state over the 20-year period between 2000 and 2020. The San Francisco Bay Area also has a long history of wildfire activity primarily in the foothills and coastal mountains. Wildfires occurring in the Bay Area have resulted in thousands of acres burned and hundreds of millions of dollars in damages.

The area immediately surrounding the San Francisco State University campus is not in proximity to fire hazard zones designated as a High Fire Hazard Severity Zones. The campus does not have a history of wildfire activity occurring within proximity to the campus. However, the County is surrounded by areas that are considered to be of high fire threat that would produce vast quantities of smoke and particulates into the air. The San Francisco campus has experienced multiple days of poor air quality due to fires burning in throughout northern California. The 2017, 2018, and 2020 fire seasons in particular illustrated the increase in wildfire generated smoke saturating the air of communities throughout the state including San Francisco. San Francisco State University personnel reported the ongoing development of policies and procedures to address the response to poor air quality days.

88 California Department of Forestry and Fire Protection, Stats and Events, [https://www.fire.ca.gov/stats-events/](https://www.fire.ca.gov/stats-events/)
Potential Impacts of the Hazard

The location of the San Francisco State University campus surrounded by areas of urban development removed from areas with a fire hazard places a minimal direct threat from wildfire to the campus. The potential impacts to wildfire exist with members of the campus community who reside or work in these fire hazard zones.

Potential impacts to the campus community resulting from wildfires include:

- Injuries or loss of life
- Campus property destruction or damage
- Residential property destruction or damage
- Commercial property destruction or damage
- Loss of property contents
- Infrastructure damage
- Damaged or destroyed lifelines/supply routes
- Damaged or destroyed utilities
- Damaged or destroyed critical facilities supporting campus emergency support needs
- Loss of community economic base
- Employment losses
- Loss to ground supporting vegetation on hillsides resulting in erosion or landslides in future precipitation events
- Agricultural (crops and livestock) damages or destruction
- Environmental damage
- Societal and community impacts
- Damage to organizations and facilities providing support services to vulnerable populations
- Greater evacuation challenges for those most vulnerable
- Psychological impacts of impacted populations
- Disruptions to education delivery to community

Potential impacts resulting from wildfire generated smoke include:

- Dangerous levels of air pollution
- Human Health Effects
  - Similar health impacts to pets

89 City and County of San Francisco Hazard Mitigation Plan, June 2014
- Air conditioning systems overwhelmed
- Greater demands on air filtration systems
- Greater demands on healthcare systems
- Reduced outdoor work productivity
- Closures of academic sessions

Additionally, there remains a number of secondary impacts from wildfires that could affect the campus community. Utilities feeding areas of San Francisco including the campus may be damaged resulting in power outages. Fire-related damage in the watersheds will likely cause future landslides, degradation to plants supporting hillsides, and impact the hydroelectric power capabilities. Fires may present threats to areas of recreation, scenic value, and wildlife that are a part of the culture of the campus community. Finally, the campus may experience effects of evacuated individuals arriving on campus from other areas as a location of refuge.

Probability of Future Occurrence of the Hazard

Based on the minimal wildfire threat potential in the area surrounding the San Francisco State University campus, including the distance to Fire Hazard Severity Zones and density of residential and commercial development, the probability of wildfire related damage is considered **Unlikely**.

Based on the wildfire threat potential in the area surrounding Northern California and San Francisco Bay Area including the hills and mountains throughout the region, the volume of areas in elevated Fire Hazard Severity Zones throughout the southern portions of the state, and the historic occurrences of smoke, the probability of wildfire generated smoke impacts to air quality is considered **Possible**.

Vulnerability to the Hazard

The San Francisco State University campus is not likely to be subject to direct impact from wildfire due to the campus location in an urban area of San Francisco. The vulnerabilities to the effects of wildfire would largely lie within the campus community who may reside or work in locations that are exposed to the Fire Hazard Severity Zones outside of San Francisco. Wildfires occurring in other areas of the region may result in the displacement of large numbers of people or the generation of smoke. These effects may spill onto the campus.

Fire directly threatening the campus would likely take the form of localized fires involving single structures or small areas. Smaller vegetation fires are remotely possible surrounding the campus in the urban forest or fields surrounding the city. These incidents would likely have little impact to the campus.

The primary basis of vulnerability is based on the population affected and the built environment exposed. In general, newer construction will be more fire resistant than older buildings as building and fire codes and construction technology have improved. Density of buildings and proximity of fuels to buildings or equipment at risk of combustion would additionally influence the fire’s ability to spread to structures.
Some areas of particular vulnerability on the campus includes:

- Students and staff engaging in outdoor activities when the air is determined to be unhealthy are vulnerable to adverse health effects.
- Buildings with ineffective HVAC or do not have HVAC will cause limitations in filtering of air during smoke filled days.
- Some buildings are not equipped with HVAC as the local climate typically does not produce extreme temperatures.
- Power outages or brownouts during days with high levels of smoke will limit shelter in place options during heat events in summer.

The greater concerns regarding vulnerabilities to wildfire on San Francisco State University are related to the smoke that fires in the area would produce. The recent summer seasons have clearly demonstrated the reality of large wildfires producing enough smoke to fill the San Francisco Bay Area even from substantial distances away. These recent fires have displayed how the effects of this smoke impact the general population and especially vulnerable populations. San Francisco State University students, faculty, and staff both on campus and off campus face these same vulnerabilities related to smoke filled air.

Smoke generated from large wildfires pose a threat in terms of diminished air quality that would be exposed to the population within the area of smoke distribution. Individuals with existing health problems such as respiratory or cardiac illnesses are increasingly vulnerable to wildfire generated smoke. Staff who work in roles requiring outdoor activity will be increasingly exposed during days where the air quality index is considered unhealthy or worse. Student athletes participating in outdoor sports and engaging in aerobic activities are increasingly vulnerable to the effects of wildfire.

The vulnerability to members of the campus community in which wildfire generated smoke on the San Francisco State University campus will vary depending on when the air quality was to reach unhealthy levels. The risk to the campus population will be lessened during periods when classes are not in session or during periods of breaks. Conversely, during the days and hours that classes are in session and staff are at their workplaces, the human vulnerability increases. However, in region-wide events this vulnerability may be shared with the homes and workplaces of members of the campus community and their families.

Vulnerable populations will likely face disproportionate health safety issues from smoke filled air, experience increased stresses, may require the need to remain away from the campus enclosed at home, and may find difficulty in accessing equipment or supplies to aid in a specific need.

**Estimate of Potential Losses**

Estimates of potential losses will be influenced by a variety of factors. Costs would also be likely to include mitigation or repairs of HVAC systems, sealing of doors and windows, and other methods of keeping smoke from entering buildings. Secondary costs would
include lost academic days during campus closures, lost staff on campus productivity, and health and medical interventions for affected members of the campus community.

Based on estimate replacement costs of facilities and structures on campus, the maximum total replacement costs due to wildfire are $448,726,927. Due to the lack of a complete inventory of building and facility costs, the total replacement estimate is likely much higher. However, the location of the campus in an urban/suburban setting removed from hazard prone areas makes wildfire related damages unlikely.

Table 21-25: Wildfire Hazard Potential (WHP) Zone Estimated Losses

<table>
<thead>
<tr>
<th>WHP Zone</th>
<th>No of Buildings</th>
<th>Maximum Replacement Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Extreme</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Very High</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>High</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Moderate</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Low</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Very Low</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Non-Burnable</td>
<td>64</td>
<td>$448,726,927</td>
</tr>
<tr>
<td>No Building Value Data Provided*</td>
<td>31</td>
<td>Unknown</td>
</tr>
</tbody>
</table>

*Buildings with no value defined are also included in the respective Zones they are found in.*

The table above includes 7 facilities located at the Tiburon based San Francisco State University, Romberg Tiburon Campus. The provided cost estimates for the Romberg Tiburon Campus includes $257,012. However, 2 facilities do not have costs included.

Vulnerability Assessment Conclusions

The occurrence of wildfires has been a frequent event in the San Francisco Bay Area; however, wildfire incidents do not pose a direct risk to the San Francisco State University campus. The urban location of the San Francisco State University campus surrounded by densely developed residential and commercial land uses mitigates any vulnerabilities of wildfire hazards to the campus community or facilities.

Communities located within or near the Wildland Urban Interface may be subject to damaging fires. These same communities may be home to members of the campus community. The students, faculty, and staff of San Francisco State University who live or work in these hazard areas may experience vulnerabilities to the direct exposure to wildfire not likely at the campus. These effects may create tremendous challenges that could impact their ability to maintain engagement with university academic or professional activities. The potential for large-scale wildfires in the region further generates the added potential for a number of cascading effects such as disruptions to the local economy, utility failures, disruptions to providing for the needs of the community, and development of public health hazards.
Additionally, the topography and weather patterns of Northern California often creates conditions that allows for smoke filled air to linger in the valleys of the San Francisco Bay Area with the potential for unhealthy air quality depending on wind conditions. Fires in surrounding mountains and forests some distance away that generate tremendous quantities of smoke present tremendous health related vulnerabilities to members of the campus community. The campus community exposed to these unhealthy air conditions are vulnerable to a variety of potential health related effects.

**Identified Data Limitations**

Data limitations include missing campus structural replacement costs, and lack of both a complete inventory of building construction types and mitigation efforts to lessen the impact due to fire activity. HAZUS generated analysis is focused on the broader community level versus fine-tuning the analysis to the micro-level for facilities such as a university campus.

**Severe Weather (Wind, Tornado, Hail, and Lightning)**

**Description of the Hazard**

Severe weather can be described as a variety of weather or climate events that are beyond or near the ends of the range of observed weather patterns and behavior. These events can include high or extreme winds, storms, lightning, hail, tornadoes, heat waves, unusually cold temperatures, extreme rainfall, and flooding.\(^90\) According to the Intergovernmental Panel on Climate Change (IPCC), to be classified as severe (or extreme), the occurrence of each value of a climate or weather variable (e.g., wind, hail, lightning, tornado, etc.) must be “above (or below) a threshold value near the upper (or lower) ends of the range of observed values of the variable.”\(^91\)

Severe weather in California can be generated by local, regional, and/or global weather and climate influences. From the individual thunderstorm to the Santa Ana wind event to the strong El Niño, damaging weather elements that are produced by and accompany severe weather and climate phenomena (e.g., damaging winds, hail, lightning, and tornadoes) occur throughout California and the California State University (CSU) system.

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Global Scale Influences on Severe Weather in California: El Niño, La Niña, and ENSO

The El Niño-Southern Oscillation (ENSO) is a recurring climate pattern involving changes in the temperature of waters in the central and eastern tropical Pacific Ocean. On periods ranging from about three (3) to seven (7) years, the surface waters across a large swath of the tropical Pacific Ocean warm or cool by anywhere from 1°C to 3°C, compared to normal. This oscillating warming and cooling pattern, referred to as the ENSO cycle, directly affects rainfall distribution in the tropics and can have a strong influence on weather across the United States and other parts of the world.

El Niño and La Niña are extreme phases of the ENSO cycle, with a third phase occurring between them called the Neutral phase. The El Niño phase is characterized by unusually warm ocean temperatures and weaker-than-normal east winds in the Equatorial Pacific, while the La Niña phase is characterized by unusually cold ocean temperatures and stronger-than-normal east winds in the Equatorial Pacific. Both extreme ENSO phases lead to significant differences from the average ocean temperatures, winds, surface pressure, and rainfall across parts of the tropical Pacific. The Neutral phase indicates that conditions are near their long-term average.

The extreme ENSO phases affect the frequency and intensity of weather events across the world, including in California. On average, areas across California experience exceptionally stormy winters with increased precipitation under El Niño conditions, but experience less stormy and drier winters under La Niña conditions. This variability in storminess and precipitation brought on by El Niño and La Niña events affects the both the frequency and intensity of severe weather conditions experienced by all CSU campuses, including San Francisco State University.

Regional Climate Influences on Severe Weather across California

References:
92 Retrieved on 07.18.2021 from https://www.weather.gov/mhx/ensowhat
94 Retrieved on 07.17.2021 from https://www.climate.gov/news-features/understanding-climate/el-ni%C3%B1o-and-la-ni%C3%B1a-frequently-asked-questions
95 Retrieved on 07.16.2021 from https://www.pmel.noaa.gov/elnino/what-is-el-nino
Most of the weather in California is influenced by the wet-winter/dry-summer Mediterranean climate pattern. In the summer months, Pacific storm tracks are deflected north due to the position of the Pacific High (i.e., a large-scale atmospheric circulation over the Northeast Pacific Ocean), preventing Pacific storms from reaching California. As a result, most summer storms are generated due to the incursion of moist air from the Gulf of Mexico or the Gulf of California, and occur as scattered, locally heavy showers in the desert and mountain regions of the state. In the winter months, the Pacific High decreases in intensity and moves south, permitting powerful Pacific storms to move into and across the state; these storms can produce extreme winds, heavy rains (including “atmospheric river” events), and widespread coastal and inland flooding. (Please see the Flood Hazard profile in this document for information on Floods.) As a result, storm events accompanied by precipitation in California are far more frequent in the winter months than they are in the summer months.97

While the Mediterranean climate pattern influences the seasonal frequency, intensity, geographic spread, and type of some severe weather events CSU campuses experience (including San Francisco State), other severe weather phenomena may occur in California at any time of the year. For example, near the coast and over the Central Valley, there appears to be no defined seasonality to thunderstorms, and these storms are usually light and infrequent. Thunderstorms are more intense and more frequent in the intermediate and higher elevations of the Sierra Nevada, and occur with greater frequency during the summer months.98

Types of Storms in California

The 2018 California State Hazard Mitigation Plan (SHMP) defines a storm as a violent atmospheric disturbance occurring over land and/or water that is distinguished by its strength, characteristics, and the scale of the resulting damage.99 The SHMP also lists the following types of storms that produce hazardous conditions and potential damage throughout the state of California.100 These storms affect (in varying degrees) all CSU campuses, including San Francisco State.

- **Thunderstorm**: A rain-bearing cloud that also produces lightning. Thunderstorms can produce some of nature’s most destructive and deadly weather including tornadoes, hail, strong winds, lightning and flooding.101 Thunderstorms are caused by an atmospheric imbalance from warm unstable air rising rapidly into the atmosphere. Lightning, which occurs during all thunderstorms, can strike

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97 Retrieved on 07.17.2021 from [https://wrcc.dri.edu/Climate/narrative_ca.php](https://wrcc.dri.edu/Climate/narrative_ca.php)
98 Retrieved on 07.17.2021 from [https://wrcc.dri.edu/Climate/narrative_ca.php](https://wrcc.dri.edu/Climate/narrative_ca.php)
Thunderstorms can produce some of nature’s most destructive and deadly weather including tornadoes, hail, strong winds, lightning and flooding. Severe thunderstorms are more intense, violent, and dangerous thunderstorms. The National Oceanic and Atmospheric Administration (NOAA) defines a severe thunderstorm as any storm that produces one or more of the following elements: Damaging winds or speeds of 58 mph (50 knots) or greater, hail 1 inch in diameter or larger, and/or a tornado.

- **Hailstorm**: a type of storm that precipitates round chunks of ice. Hailstorms usually occur during regular thunderstorms.
- **Wind storm**: marked by high wind with little or no precipitation.
- **Winter storm**: A storm that can produce a combination of freezing rain, sleet, heavy snow, and/or strong winds.
- **Coastal storm**: large wind-driven waves and/or storm surge that strike the coastal zone.
- **Ice storm**: Ice storms are one of the most dangerous forms of winter storms. When surface temperatures are below freezing, but a thick layer of above-freezing air remains aloft, rain can fall into the freezing layer and freeze upon impact into a glaze of ice. In general, 8 millimeters (0.31 inch) of accumulation is all that is required, especially in combination with breezy conditions, to start downing power lines as well as tree limbs. Ice storms also make unheated road surfaces too slick to drive on. Ice storms can vary in time range from hours to days and can cripple small towns and large urban centers alike.
- **Snowstorm**: A heavy fall of snow accumulating at a rate of more than 5 centimeters (2 inches) per hour that lasts several hours. Snowstorms, especially

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104 Retrieved on 07.15.2021 from https://www.noaa.gov/explainers/severe-storms
105 Retrieved on 07.15.2021 from https://www.weather.gov/safety/thunderstorm
ones with a high liquid equivalent and breezy conditions, can down tree limbs, cut off power, and paralyze travel over a large region.\textsuperscript{111}

**Severe Weather Hazard Elements: Wind Hazards, Hail, and Lightning**

This hazard profile concentrates on the following types of severe weather hazards: \textit{wind hazards (including tornadoes), hail, and lightning}. These hazards are produced by a variety of weather phenomena, including thunderstorms, coastal storms, winter storms, and topographically-enhanced downslope winds. While storm and downslope wind hazards are responsible for severe weather events across the CSU system, only the wind, tornado, hail, and lightning elements generated by these hazards are covered in this profile. (Storm-related hazards such as flooding and extreme temperatures are covered in other sections of this document.)

**Wind Hazards**

\textit{Wind} is the horizontal movement of air past any given point. Wind begins with differences in air pressures; pressure that is higher at one point than another sets up a force, pushing the high towards the low pressure.\textsuperscript{112} Wind gusts are defined as “rapid fluctuations in the wind speed with a variation of 10 knots or more between peaks and lulls.”\textsuperscript{113}

Wind hazards in California take several forms: High Wind, Strong Winds, Thunderstorm Winds, Mountain-Valley (Downslope) Winds, and Tornadoes. These hazards are encountered across California, and have the potential to cause harm to or loss of life and/or property throughout California and the CSU system (including San Francisco State).

**High Winds, Strong Winds, and Thunderstorm Winds**

The National Weather Service reports three (3) types of wind events that occur areas over land: High Winds, Strong Winds, and Thunderstorm Winds. Collectively, these reports are used to determine the frequency with which wind hazard events have affected areas across the U.S., including California.

**High Winds**

High winds are defined as sustained non-convective winds of 35 knots (40 mph) or greater lasting for 1 hour or longer, or gusts of 50 knots (58 mph) or greater for any duration (or otherwise locally/regionally defined). In some mountainous areas, the above numerical values are 43 knots (50 mph) and 65 knots (75 mph), respectively.\textsuperscript{114}

\textsuperscript{113} Retrieved on 07.15.2021 from https://forecast.weather.gov/glossary.php?word=wind%20gust
\textsuperscript{114} Retrieved on 07.17.2021 from https://www.nws.noaa.gov/directives/sym/pd01016005curr.pdf
Strong Winds

Strong winds are defined as non-convective winds gusting less than 50 knots (58 mph), or sustained winds less than 35 knots (40 mph), resulting in a fatality, injury, or damage.\textsuperscript{115}

Thunderstorm Winds

Thunderstorm winds are winds that arise from thunderstorm convection (occurring within 30 minutes of lightning being observed or detected), with speeds of at least 50 knots (58 mph). They can also be winds of any speed (non-severe thunderstorm winds below 50 knots (58 mph)) producing a fatality, injury, or damage.\textsuperscript{116}

Please note: \textbf{Straight-line wind} is a term used to define any thunderstorm wind that is not associated with rotation. It is used mainly to differentiate from the rotational winds found in tornado-producing storms.\textsuperscript{117} However, it is not a term used in the NCEI Storm Events Database, and therefore cannot be used to determine severe weather history of or potential impacts to CSU campuses.

Tornadoes

A tornado is an extreme severe weather wind hazard. A tornado is a rapidly rotating column of air extending from a thunderstorm to the surface of the Earth.\textsuperscript{118} This column extends between cloud and the Earth’s surface. The damage from tornadoes comes from the strong winds they contain and the flying debris they create. It is generally believed that rotational wind speeds can be as high as 300 mph in the most violent tornadoes.\textsuperscript{119} On a local scale, tornadoes are the most violent and most destructive of all atmospheric phenomena.\textsuperscript{120}


\textbf{Santa Ana Winds}. A type of wind hazard that is peculiar to Southern California is called a \textit{Santa Ana Wind}. Santa Ana winds are strong, topographically-enhanced, extremely dry downslope winds that originate inland and affect coastal southern California and northern Baja California (Mexico).\textsuperscript{121} They occur when air from a region of high pressure over the dry, desert region of the southwestern U.S. flows westward towards low pressure located off the California coast. This creates dry winds that flow east to west through the mountain passages in Southern California. These winds have a strong seasonal

\textsuperscript{115} Retrieved on 07.17.2021 from \url{https://www.nws.noaa.gov/directives/sym/pd01016005curr.pdf}
\textsuperscript{117} Retrieved on 07.15.2021 from \url{https://www.nssl.noaa.gov/education/svrwx101/wind/types/}
\textsuperscript{118} Retrieved on 07.15.2021 from \url{https://www.earthnetworks.com/tornado/}
\textsuperscript{119} Retrieved on 07.15.2021 from \url{https://www.nssl.noaa.gov/education/svrwx101/tornadoes/faq/}
\textsuperscript{120} Retrieved on 07.15.2021 from \url{https://www.weather.gov/bgm/severe_definitions}
component; they are most common during the cooler months of the year, occurring from September through May. Santa Ana winds typically feel warm (or even hot) because as the cool desert air moves down the side of the mountain, it is compressed, which causes the temperature of the air to rise. If strong enough, Santa Ana winds can cause major property damage, and may present difficulties for airborne and seagoing transportation. They also may increase wildfire risk because of the dryness of the winds and the speed at which they can spread a flame across the landscape.\textsuperscript{122} (Note: The Wildfire hazard is profiled elsewhere in this document.)

Figure below illustrates the mechanisms involved in the generation of Santa Ana winds across Southern California.

Figure 21-15: What Drives a Santa Ana Wind?\textsuperscript{123}

\textbf{Diablo Winds}. The Diablo wind is another type of topographically-enhanced downslope wind phenomenon that occurs in the North-Central areas of California. Diablo winds are offshore wind events that flow northeasterly over Northern California’s Coast Ranges, often creating high wind speeds downwind of major canyons and over ridges, and

\textsuperscript{122} Retrieved on 07.13.2021 from \url{https://www.weather.gov/safety/wind-mountain-valley}

\textsuperscript{123} Retrieved on 07.14.2021 from \url{https://twitter.com/nwslosangeles/status/933049473034579968}
extreme fire danger for the San Francisco Bay Area. Diablo winds are driven by a surface pressure gradient that forms in response to an inverted pressure trough that develops over California.\footnote{124}

**Sundowner Winds.** Sundowner winds are significant and potentially damaging downslope wind and warming events that periodically occur along a short segment of the southern California coast in the vicinity of Santa Barbara, CA. The unique topography of this coastal region promotes the development of Sundowner wind events: over a length of about 100 km, the coastline is oriented approximately west–east, with the adjoining narrow coastal plain bounded by a steeply rising (to elevations greater than 1200 m) and coast-parallel mountain range. Called Sundowner winds because they often begin in the late afternoon or early evening, their onset is typically associated with a rapid rise in temperature and decrease in relative humidity, and the winds tend to blow from the north from the Santa Ynez Mountains to the coast of Santa Barbara County, California. During the more intense Sundowner wind events, wind speeds can be of gale force 39-54 miles per hour) or higher, and can even reach hurricane force (≥ 74 miles per hour) in the most extreme cases. Temperatures over the coastal plain, and even at the coast itself, can rise significantly above 37.8°C (100°F). Seasonally, Sundowner winds peak in March, April, and May, with a minimum during summer and a secondary peak in winter that often corresponds with Santa Ana winds. In addition to causing a dramatic change from the more typical marine-influenced local weather conditions, Sundowner wind episodes have produced significant wind-related property and agricultural damage, as well as conditions of extreme fire danger.\footnote{125} \footnote{126} \footnote{127}

**Hail**

Hail is a form of precipitation consisting of solid ice that forms inside thunderstorm updrafts.\footnote{128} It is roughly round in shape and at least 0.2‘ in diameter. Hail develops in the upper atmosphere as ice crystals that are bounced about by high velocity updraft winds; the ice crystals accumulate frozen droplets and fall after developing enough weight. The size of hailstones varies and is a direct consequence of the severity and size of the storm that produces them – the higher the temperatures at the Earth’s surface, the greater the strength of the updrafts and the amount of time hailstones are suspended, and therefore the greater the size of the hailstone.\footnote{129}

\footnote{124 Retrieved on 07.13.2021 from https://www.fireweather.org/diablo-winds}
**Lightning**

Lightning is an electrical discharge produced by a thunderstorm. Lightning rapidly heats the air in its immediate vicinity to about 50,000°F - about five times the temperature of the surface of the sun. This compresses the surrounding air and creates a supersonic shock wave, which decays to an acoustic wave that is heard as thunder.¹³⁰

The discharge may occur within or between clouds, between the cloud and air, between a cloud and the ground, or between the ground and a cloud.¹³¹ Lightning that is produced from thunderstorms in which precipitation evaporates before reaching the ground is called “dry lightning.”

**Location of the Hazard**

Severe weather is a non-spatial hazard, and can occur anywhere in the CSU system, including either at the San Francisco State University main campus or at satellite campus facilities owned by the school. No one area of each campus – or of the surrounding community – is subject to experiencing severe weather more than any other area.

There is geographic variability among the different types of mountain and valley wind events (as a sub-category of the severe weather hazard). Santa Ana winds occur in Southern California, Diablo winds occur in North-Central California, and Sundowner winds occur almost exclusively in Santa Barbara County, California.

**Extent of the Hazard**

Severe weather hazards are non-spatial hazards that potentially affect all San Francisco State campus areas equally. However, the smallest geographic unit of measurement for almost all official severe weather event data is at the county level. Because the severe weather data used do not exist at the campus level, it is assumed that the same (or similar) severe weather risks to San Francisco State campuses reflect those of the surrounding communities and counties. As a result, all assets and people at San Francisco State campuses are at risk from the effects of severe weather and can expect to experience at least some (or the complete range of) endemic severe weather hazards. In consideration of the campus’ design, layout, and operations, the severe weather history and degree of severity in the San Francisco (San Francisco County), Tiburon (Marin County), and Calpine (Sierra County) areas, and the history and degree of severity of each severe weather sub-type identified by the extent scales (below), the campus planning committee ranks the overall extent of the Severe Weather hazard as **MODERATE**. See each sub-hazard below for the planning committee’s sub-type extent ranking.

**Wind Hazard: Non-Rotational**

The Beaufort Scale is an empirical measure that relates wind speed to observed conditions at sea or on land. Its full name is the Beaufort wind force scale. First developed in 1805, it is still used today to estimate wind strengths.

Table 21-26: Beaufort Wind Force Scale

<table>
<thead>
<tr>
<th>Force</th>
<th>Speed (mph)</th>
<th>Speed (knots)</th>
<th>Description</th>
<th>Specifications for use at sea</th>
<th>Specifications for use on land</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0-1</td>
<td>0-1</td>
<td>Calm</td>
<td></td>
<td>Sea like a mirror.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Calm; smoke rises vertically.</td>
</tr>
<tr>
<td>1</td>
<td>1-3</td>
<td>1-3</td>
<td>Light Air</td>
<td>Ripples with the appearance of scales are formed, but without foam crests.</td>
<td>Direction of wind shown by smoke drift, but not by wind vanes.</td>
</tr>
<tr>
<td>2</td>
<td>4-7</td>
<td>4-6</td>
<td>Light Breeze</td>
<td>Small wavelets, still short, but more pronounced. Crests have a glassy appearance and do not break.</td>
<td>Wind felt on face; leaves rustle; ordinary vanes moved by wind.</td>
</tr>
<tr>
<td>3</td>
<td>8-12</td>
<td>7-10</td>
<td>Gentle Breeze</td>
<td>Large wavelets. Crests begin to break. Foam of glassy appearance. Perhaps scattered white horses.</td>
<td>Leaves and small twigs in constant motion; wind extends light flag.</td>
</tr>
<tr>
<td>4</td>
<td>13-18</td>
<td>11-16</td>
<td>Moderate Breeze</td>
<td>Small waves, becoming larger; fairly frequent white horses.</td>
<td>Raises dust and loose paper; small branches are moved.</td>
</tr>
<tr>
<td>5</td>
<td>19-24</td>
<td>17-21</td>
<td>Fresh Breeze</td>
<td>Moderate waves, taking a more pronounced long form; many white horses are formed.</td>
<td>Small trees in leaf begin to sway; crested wavelets form on inland waters.</td>
</tr>
</tbody>
</table>

132 Retrieved on 07.15.2021 from https://www.rmets.org/resource/beaufort-scale
133 Retrieved on 07.15.2021 from https://www.weather.gov/mfl/beaufort
<table>
<thead>
<tr>
<th>6</th>
<th>25-31</th>
<th>22-27</th>
<th>Strong Breeze</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Large waves begin to form; the white foam crests are more extensive everywhere.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Large branches in motion; whistling heard in telegraph wires; umbrellas used with difficulty.</td>
</tr>
<tr>
<td>7</td>
<td>32-38</td>
<td>28-33</td>
<td>Near Gale</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Sea heaps up and white foam from breaking waves begins to be blown in streaks along the direction of the wind.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Whole trees in motion; inconvenience felt when walking against the wind.</td>
</tr>
<tr>
<td>8</td>
<td>39-46</td>
<td>34-40</td>
<td>Gale</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Moderately high waves of greater length; edges of crests begin to break into spindrift. The foam is blown in well-marked streaks along the direction of the wind.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Breaks twigs off trees; generally impedes progress.</td>
</tr>
<tr>
<td>9</td>
<td>47-54</td>
<td>41-47</td>
<td>Severe Gale</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>High waves. Dense streaks of foam along the direction of the wind. Crests of waves begin to topple, tumble and roll over. Spray may affect visibility</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Slight structural damage occurs (chimney-pots and slates removed)</td>
</tr>
<tr>
<td>10</td>
<td>55-63</td>
<td>48-55</td>
<td>Storm</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Very high waves with long overhanging crests. The resulting foam, in great patches, is blown in dense white streaks along the direction of the wind. On the whole the surface of the sea takes on a white appearance. The tumbling of the sea becomes heavy and shock-like. Visibility affected.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Seldom experienced inland; trees uprooted; considerable structural damage occurs.</td>
</tr>
<tr>
<td>11</td>
<td>64-72</td>
<td>56-63</td>
<td>Violent Storm</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Exceptionally high waves (small and medium-size ships might be for a time lost to view behind the waves). The sea is completely covered with long white patches of foam lying along the direction of the wind. Everywhere the edges of the wave crests are blown into froth. Visibility affected.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Very rarely experienced; accompanied by widespread damage.</td>
</tr>
</tbody>
</table>
The air is filled with foam and spray. Sea completely white with driving spray; visibility very seriously affected.

Based on those extent ranking factors identified (above), the planning committee ranks the extent of non-rotational wind hazards as **MODERATE**.

**Extent: Tornado**

Tornadoes have their own severity/extent scale. Until 2007, tornadoes were measured and described according to the Fujita Scale.\(^{135}\)

In February 2007, use of the Fujita Scale was discontinued. In its place, the Enhanced Fujita (EF) Scale is used. The Enhanced Fujita scale considers how most structures are designed and is thought to be a much more accurate representation of the surface wind speeds in the most violent tornadoes. Like the original Fujita scale, the Enhanced Fujita scale is a set of wind estimates (not measurements) based on damage.

It is important to note the **date** that a tornado occurred. Tornadoes that occurred prior to February, 2007 are classified using the original Fujita scale and will not be converted to the Enhanced Fujita Scale.

Table below illustrates the Fujita Scale in use prior to February 2007.

Table 21-27: Fujita Tornado Scale (Pre-February 2007) \(^{136}\)

<table>
<thead>
<tr>
<th>F-Scale Number</th>
<th>Intensity Phrase</th>
<th>Wind Speed</th>
<th>Type of Damage</th>
</tr>
</thead>
<tbody>
<tr>
<td>F0</td>
<td>Gale tornado</td>
<td>40-72 mph</td>
<td>Some damage to chimneys; breaks branches off trees; pushes over shallow-rooted trees; damages sign boards.</td>
</tr>
<tr>
<td>F1</td>
<td>Moderate tornado</td>
<td>73-112 mph</td>
<td>The lower limit is the beginning of hurricane wind speed; peels surface off roofs; mobile homes pushed off foundations or overturned; moving autos pushed off the roads; attached garages may be destroyed.</td>
</tr>
<tr>
<td>F2</td>
<td>Significant tornado</td>
<td>113-157 mph</td>
<td>Considerable damage. Roofs torn off frame houses; mobile homes</td>
</tr>
</tbody>
</table>

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\(^{135}\) Retrieved on 07.19.2021 from [https://www.weather.gov/tae/ef_scale](https://www.weather.gov/tae/ef_scale)

demolished; boxcars pushed over; large trees snapped or uprooted; light object missiles generated.

F3  Severe tornado  158-206 mph  Roof and some walls torn off well-constructed houses; trains overturned; most trees in forest uprooted.

F4  Devastating tornado  207-260 mph  Well-constructed houses leveled; structures with weak foundations blown off some distance; cars thrown and large missiles generated.

F5  Incredible tornado  261-318 mph  Strong frame houses lifted off foundations and carried considerable distances to disintegrate; automobile sized missiles fly through the air in excess of 100 meters; trees debarked; steel reinforced concrete structures badly damaged.

F6  Inconceivable tornado  319-379 mph  These winds are very unlikely. The small area of damage they might produce would probably not be recognizable along with the mess produced by F4 and F5 wind that would surround the F6 winds. Missiles, such as cars and refrigerators would do serious secondary damage that could not be directly identified as F6 damage. If this level is ever achieved, evidence for it might only be found in some manner of ground swirl pattern, for it may never be identifiable through engineering studies.

The table below illustrates the Enhanced Fujita (EF) Scale, currently in use. Tornadoes that have occurred since February, 2007 are classified using the Enhanced Fujita Scale.
<table>
<thead>
<tr>
<th>Enhanced Fujita Category</th>
<th>Wind Speed</th>
<th>Potential Damage</th>
</tr>
</thead>
<tbody>
<tr>
<td>EF0</td>
<td>65-85 mph</td>
<td>Light damage. Peels surface off some roofs; some damage to gutters or siding; branches broken off trees; shallow-rooted trees pushed over.</td>
</tr>
<tr>
<td>EF1</td>
<td>86-110 mph</td>
<td>Moderate damage. Roofs severely stripped; mobile homes overturned or badly damaged; loss of exterior doors; windows and other glass broken.</td>
</tr>
<tr>
<td>EF2</td>
<td>111-135 mph</td>
<td>Considerable damage. Roofs torn off well-constructed houses; foundations of frame homes shifted; mobile homes completely destroyed; large trees snapped or uprooted; light-object missiles generated; cars lifted off ground.</td>
</tr>
<tr>
<td>EF3</td>
<td>136-165 mph</td>
<td>Severe damage. Entire stories of well-constructed houses destroyed; severe damage to large buildings such as shopping malls; trains overturned; trees debarked; heavy cars lifted off the ground and thrown; structures with weak foundations blown away some distance.</td>
</tr>
<tr>
<td>EF4</td>
<td>166-200 mph</td>
<td>Devastating damage. Well-constructed houses and whole frame houses completely leveled; cars thrown and small missiles generated.</td>
</tr>
<tr>
<td>EF5</td>
<td>&gt;200 mph</td>
<td>Incredible damage. Strong frame houses leveled off foundations and swept away; automobile-sized missiles fly through the air in excess of 100 m (107 yd); high-rise buildings have significant structural deformation; incredible phenomena will occur.</td>
</tr>
</tbody>
</table>

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Based on the extent ranking factors identified (above), the planning committee ranks the extent of tornados as **LOW**.

**Extent: Hail**

The National Oceanic and Atmospheric Administration and the Tornado and Storm Research Organization (TORRO) have combined efforts to create the Hailstorm Intensity Scale. Table below provides details of this scale.

Table 21-29: Combined NOAA/TORRO Hailstorm Intensity Scale

<table>
<thead>
<tr>
<th>Size Code</th>
<th>Intensity Category</th>
<th>Typical Hail Diameter</th>
<th>Approximate Size</th>
<th>Typical Damage Impacts</th>
</tr>
</thead>
<tbody>
<tr>
<td>H0</td>
<td>Hard Hail</td>
<td>Up to 0.33”</td>
<td>Pea</td>
<td>No damage</td>
</tr>
<tr>
<td>H1</td>
<td>Potentially Damaging</td>
<td>0.33” – 0.60”</td>
<td>Marble or Mothball</td>
<td>Slight damage to plants and crops</td>
</tr>
<tr>
<td>H2</td>
<td>Potentially Damaging</td>
<td>0.60” – 0.80”</td>
<td>Dime or grape</td>
<td>Significant damage to fruit, crops, and vegetation</td>
</tr>
<tr>
<td>H3</td>
<td>Severe</td>
<td>0.80” – 1.20”</td>
<td>Nickel to Quarter</td>
<td>Severe damage to fruit and crops, damage to glass and plastic</td>
</tr>
</tbody>
</table>

| H4 | Severe | 1.20” – 1.60” | Half Dollar to Ping Pong Ball | Widespread glass damage, vehicle body damage |
| H5 | Destructive | 1.60” – 2.0” | Silver Dollar to Golf Ball | Wholesale destruction of glass, damage to tiled roofs, significant risk of injuries |
| H6 | Destructive | 2.0” – 2.4” | Lime or Egg | Aircraft body dented; brick walls pitted |
| H7 | Very Destructive | 2.4” – 3.0” | Tennis Ball | Severe roof damage, risk of serious injuries |
| H8 | Very Destructive | 3.0” – 3.5” | Baseball to Orange | Severe damage to aircraft body |
Based on those extent ranking factors identified (above), the planning committee ranks the extent of the hail hazard as **LOW**.

**Extent: Lightning**

The National Weather Service (NWS) uses a Lightning Activity Level (LAL) scale to indicate the frequency and character of cloud-to-ground (C/G) lightning. The scale uses a range of 1 – 6, with 6 being the high end of the scale. Table 21-XX provides details of the LAL scale.

Table 21-30: Lightning Activity Level (LAL) Scale

<table>
<thead>
<tr>
<th>Rank</th>
<th>Cloud and Storm Development</th>
<th>Areal Coverage</th>
<th>Counts C/G per 5 Minutes</th>
<th>Counts C/G per 15 Minutes</th>
<th>Average C/G per Minute</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>No Thunderstorms</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>2</td>
<td>Cumulus clouds are common but only a few reaches the towering stage. A single thunderstorm must be confirmed in the rating area. The clouds mostly produce virga, but light rain will occasionally reach ground. Lightning is very infrequent.</td>
<td>&lt;15%</td>
<td>1-5</td>
<td>1-8</td>
<td>&lt;1</td>
</tr>
</tbody>
</table>

139 Retrieved on 07.19.2021 from [https://graphical.weather.gov/definitions/defineLAL.html](https://graphical.weather.gov/definitions/defineLAL.html)
## Lightning Activity Level Scale

<table>
<thead>
<tr>
<th>Rank</th>
<th>Cloud and Storm Development</th>
<th>Areal Coverage</th>
<th>Counts C/G per 5 Minutes</th>
<th>Counts C/G per 15 Minutes</th>
<th>Average C/G per Minute</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>Cumulus clouds are common. Swelling and towering cumulus cover less than 2/10 of the sky. Thunderstorms are few, but 2 to 3 occur within the observation area. Light to moderate rain will reach the ground, and lightning is infrequent.</td>
<td>15% to 24%</td>
<td>6-10</td>
<td>9-15</td>
<td>1-2</td>
</tr>
<tr>
<td>4</td>
<td>Swelling cumulus and towering cumulus cover 2-3/10 of the sky. Thunderstorms are scattered but more than three must occur within the observation area. Moderate rain is commonly produced, and lightning is frequent.</td>
<td>25% to 50%</td>
<td>11-15</td>
<td>16-25</td>
<td>2-3</td>
</tr>
<tr>
<td>5</td>
<td>Towering cumulus and thunderstorms are numerous. They cover more than 3/10 and occasionally obscure the sky. Rain is moderate to heavy, and lightning is frequent and intense.</td>
<td>&gt;50%</td>
<td>&gt;15</td>
<td>&gt;25</td>
<td>&gt;3</td>
</tr>
<tr>
<td>6</td>
<td>Dry lightning outbreak. (LAL of 3 or greater with majority of storms producing little or no rainfall.)</td>
<td>&gt;15%</td>
<td>None</td>
<td>None</td>
<td>None</td>
</tr>
</tbody>
</table>

Based on those extent ranking factors identified (above), the planning committee ranks the extent of the lightning hazard as **LOW**.

**Extent: Thunderstorms that Generate Wind, Tornado, Hail, and Lightning Hazard Events**

Thunderstorms are not explicitly identified as a severe weather category for this hazard profile. However, they are responsible for most tornado, lightning, and hail hazard events.
– as well as a significant number of wind hazard events – across California and the CSU system. While individual thunderstorms affect relatively small areas, there are many instances in which thunderstorms can cluster together and/or travel in a line over long distances, producing significant damage over large geographic areas.

A thunderstorm is classified as “severe” when certain meteorological parameters within the thunderstorm are reached (i.e., damaging winds or speeds of 58 mph (50 knots) or greater, hail 1 inch in diameter or larger, and/or a tornado). However, there is currently no established, objective severity scale for thunderstorms.\textsuperscript{140} \textsuperscript{141} That said, according to the \textit{Glossary of Meteorology} published by the American Meteorological Society (AMS), a thunderstorm is reported as \textit{light}, \textit{medium}, or \textit{heavy} according to following five (5) characteristics:

\begin{itemize}
  \item the nature of the lightning and thunder;
  \item the type and intensity of the precipitation, if any;
  \item the speed and gustiness of the wind;
  \item the appearance of the clouds; and
  \item the effect upon surface temperature.\textsuperscript{142}
\end{itemize}

A thunderstorm may also be classified by the nature of the overall weather situation in which the thunderstorm is produced, including:

\begin{itemize}
  \item \textbf{Airmass Thunderstorm}: A thunderstorm produced by local convection within an unstable air mass;\textsuperscript{143}
  \item \textbf{Frontal Thunderstorm}: An individual thunderstorm the initiation of which results from rising motion associated with a front, or a thunderstorm within a convective system generated and organized by frontal rising motion;\textsuperscript{144} or
  \item \textbf{Squall-line Thunderstorm}: An individual thunderstorm included within a squall line (i.e., a continuous or broken line of active deep moist convection frequently associated with thunder).\textsuperscript{145} \textsuperscript{146}
\end{itemize}

\textsuperscript{140} Retrieved on 07.15.2021 from \url{https://www.noaa.gov/explainers/severe-storms}
\textsuperscript{141} Retrieved on 07.15.2021 from \url{https://www.weather.gov/safety/thunderstorm}
Based on the extent ranking factors identified (above) in relation to campus layout and operations, and past event low degree of severity, the planning committee ranks the extent of the thunderstorm hazard as **LOW**.

**History of the Hazard**

Severe weather hazards have been an annual occurrence in San Francisco County and on the San Francisco State campus. Severe weather hazards have also been an annual occurrence in Marin County and Sierra County, and on the San Francisco State University satellite campus facilities located in those counties. Historical data for these hazards are presented below.

**Historical Storm Data Collection: NCEI Storm Events Database**

Historical information regarding severe weather hazards can be found using The National Centers for Environmental Information (NCEI) Storm Events Database. The Storm Events Database contains searchable, archived National Weather Service (NWS) storm data from January 1950 to April 2021, as entered by NOAA’s National Weather Service (NWS). Due to changes in the data collection and processing procedures over time, there are unique periods of record available depending on the event type. For example, from 1950 through 1954, only tornado events were recorded; from 1955 through 1995, only tornado, thunderstorm wind, and hail events were introduced into the database; from 1996 to present, 45 additional event types are recorded, including high wind, strong wind, and lightning events. To obtain the most accurate portrayal of severe weather event frequency, searches of the Storm Events Database are conducted using data collected since 01/01/1996. As a reminder, all official severe weather event data is at the county level. Severe weather data do not exist at the campus level. That said, it may be the case that the campus to some degree experiences the severe weather events reported for the surrounding community and County.

**San Francisco County**

**Wind Hazards (excluding Tornadoes)**

Information obtained from the NCEI Storm Event Database website shows the number of events (or occurrences) of wind hazard events in San Francisco County since 1996. Here, wind hazard events include all “High Wind,” “Strong Wind,” and “Thunderstorm Wind” storm reports.

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- **High Wind**: at least 33 events, or approximately 1.30 events per year\textsuperscript{151}
- **Strong Wind**: at least 43 events, or 1.70 events per year\textsuperscript{152}
- **Thunderstorm Wind**: at least 7 events, or approximately 0.28 events per year\textsuperscript{153}
- **All Wind Hazard events** (excluding Tornadoes): at least 77 events, or approximately 3.04 events per year.\textsuperscript{154} (Note: This was determined by conducting a simultaneous search of the component wind hazards of high wind, strong wind and thunderstorm wind.)

Overall, in San Francisco County, there have been at least 77 wind hazard events since 1996, excluding tornadoes.\textsuperscript{155} That translates to an approximate average historical frequency of occurrence of **3.04** wind hazard events per year.

Please note: Differences between the sums of individual component severe weather hazard event Database searches (i.e., 83 events) and simultaneous Database searches of all severe weather hazard events (i.e., 77 events) may be due to the following factors: (1) multiple event types are in the same record (e.g., "Thunderstorm Wind/Hail" or "Hail/Tornado;" and/or (2) severe weather hazard events such as “Thunderstorm Wind” or “Hail” that are reported for San Francisco County have actually taken place hundreds of miles away, but are erroneously recorded as events that have occurred in the County.\textsuperscript{156} When such a discrepancy arises, the more conservative aggregate hazard wind

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\textsuperscript{151} National Climatic Data Center. Storm Events Database. Retrieved 07.31.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28Z%29+High+Wind&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=SAN%2BFRANCISCO%3A75&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA

\textsuperscript{152} National Climatic Data Center. Storm Events Database. Retrieved 07.31.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28Z%29+Strong+Wind&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=SAN%2BFRANCISCO%3A75&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA

\textsuperscript{153} National Climatic Data Center. Storm Events Database. Retrieved 07.31.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Thunderstorm+Wind&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=SAN%2BFRANCISCO%3A75&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA

\textsuperscript{154} National Climatic Data Center. Storm Events Database. Retrieved 07.31.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28Z%29+High+Wind&eventType=%28Z%29+Strong+Wind&eventType=%28C%29+Thunderstorm+Wind&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=SAN%2BFRANCISCO%3A75&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA

\textsuperscript{155} National Climatic Data Center. Storm Events Database. Retrieved 07.31.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28Z%29+High+Wind&eventType=%28Z%29+Strong+Wind&eventType=%28C%29+Thunderstorm+Wind&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=SAN%2BFRANCISCO%3A75&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA

event value (i.e., 77 events) is used to determine the historical frequency of occurrence for the severe weather hazard. The origin of this discrepancy is unknown at this time.

**Historical Wind Hazard Losses for San Francisco County since 1996**

According to the NCEI Storm Events Database, the wind hazard events that San Francisco County has experienced since 1996 have been costly. While there have been no deaths, there have been 4 injuries, and property damage estimates have totaled approximately $2,520,000; there has been no reported crop damage.\(^{157}\)

**Tornado Wind Hazards**

Information from the NCEI Storm Events Database indicates that since 1996, there have been no reports of tornado hazard events in San Francisco County.\(^{158}\)

**Historical Tornado Hazard Losses for San Francisco County since 1996**

Because no tornado hazard events have occurred in San Francisco County since 1996, there are no tornado-related deaths or injuries, or property or crop damages in the County.\(^{159}\)

**Hail**

Information from the NCEI Storm Events Database indicates that since 1996, there have been nine (9) reported events of hail in San Francisco County, which translates to approximately 0.36 hail events per year.\(^{160}\) (Note: The NCEI Storm Event Database search results for hail indicate that there has been a total of 10 reports of hail since 1996. However, one (1) entry is for a hail event in San Diego County, hundreds of miles away from San Francisco County. The origin of this error is unknown at this time.)

**Historical Hail Hazard Losses for San Francisco County since 1996**

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\(^{157}\) National Climatic Data Center. Storm Events Database. Retrieved 07.31.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28Z%29+High+Wind&eventType=%28Z%29+Strong+Wind&eventType=%28C%29+Thunderstorm+Wind&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=SAN%2BFRANCISCO%3A75&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA

\(^{158}\) National Climatic Data Center. Storm Events Database. Retrieved 07.31.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Tornado&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=SAN%2BFRANCISCO%3A75&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA

\(^{159}\) National Climatic Data Center. Storm Events Database. Retrieved 07.31.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Tornado&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=SAN%2BFRANCISCO%3A75&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA

\(^{160}\) National Climatic Data Center. Storm Events Database. Retrieved 07.31.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Hail&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=SAN%2BFRANCISCO%3A75&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA
According to the NCEI Storm Events Database, the hail hazard events that San Francisco County has experienced since 1996 have been negligible. There have been no deaths or injuries, and property and crop damage estimates have each totaled approximately $30.\textsuperscript{161} (Note: The San Diego County hail event erroneously included in the search results for hail events in San Francisco County has accounted for all injuries (i.e., 5) and almost all of the hail crop damage estimates (i.e., $300,000) presented in the search results.)

**Lightning**

Information from the NCEI Storm Events Database indicates that since 1996, there have been seven (7) reported events of lightning in San Francisco County, which translates to approximately **0.28** lightning events per year.\textsuperscript{162}

**Historical Lightning Hazard Losses for San Francisco County since 1996**

According to the NCEI Storm Events Database, the lightning hazard events that San Francisco County has experienced since 1996 have been costly. While there have been no deaths or injuries reported, property and crop damage estimates have totaled approximately $120,030 and $30, respectively.\textsuperscript{163}

**All Severe Weather Hazard Events Recorded by the NCEI Storm Events Database**

Information obtained from the NCEI Storm Events Database indicates that there have been 93 occurrences of the severe weather hazard in San Francisco County. This translates to **3.67** severe weather hazard occurrences per year.\textsuperscript{164}

Please note: Differences between the sums of individual component severe weather hazard event Database searches (i.e., 100 events) and simultaneous Database searches of all severe weather hazard events (i.e., 93 events) may be due to the following factors: (1)

\textsuperscript{161} National Climatic Data Center. Storm Events Database. Retrieved 07.31.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Hail&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=SAN%2BFRANCISCO%3A75&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA

\textsuperscript{162} National Climatic Data Center. Storm Events Database. Retrieved 07.31.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Lightning&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=SAN%2BFRANCISCO%3A75&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA

\textsuperscript{163} National Climatic Data Center. Storm Events Database. Retrieved 07.31.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Lightning&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=SAN%2BFRANCISCO%3A75&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA

\textsuperscript{164} National Climatic Data Center. Storm Events Database. Retrieved 07.31.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Hail&eventType=%28Z%29+High+Wind&beginDate_mm=01&beginDate_yyyy=1996&endDate_mm=04&endDate_yyyy=2021&county=SAN%2BFRANCISCO%3A75&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA
multiple event types are in the same record (e.g., “Thunderstorm Wind/Hail” or “Hail/Tornado,”) and/or (2) severe weather hazard events such as “Thunderstorm Wind” or “Hail” that are reported for San Francisco County have actually taken place hundreds of miles away, but are erroneously recorded as events that have occurred in the County.\textsuperscript{165} When such a discrepancy arises, the more conservative aggregate hazard wind event value (i.e., 93 events) is used to determine the historical frequency of occurrence for the severe weather hazard. The origin of this discrepancy is unknown at this time.

**Historical, Aggregated Severe Hazard Losses for San Francisco County since 1996**

According to the NCEI Storm Events Database, the severe weather events that San Francisco County has experienced since 1996 have been costly. While there have been no deaths, there have been four (4) injuries, and property and crop damage estimates have totaled approximately $2,649,000 and $60, respectively.\textsuperscript{166} It is important to note that for all San Francisco County severe weather hazard events recorded on the Storm Events Database, all injuries and approximately 95.1\% of all estimated property damage have been caused by wind hazard events alone. Estimated crop damage (from lightning and hail) has been negligible.

**Marin County**

*Wind Hazards (excluding Tornadoes)*

Information obtained from the NCEI Storm Event Database website shows the number of events (or occurrences) of wind hazard events in Marin County since 1996.\textsuperscript{167} Here, wind hazard events include all “High Wind,” “Strong Wind,” and “Thunderstorm Wind” storm reports.\textsuperscript{168}

- **High Wind**: at least 90 events, or approximately 3.55 events per year\textsuperscript{169}

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\textsuperscript{166} National Climatic Data Center. Storm Events Database. Retrieved 07.31.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Hail&eventType=%28Z%29+High+Wind&eventType=%28C%29+Lightning&eventType=%28Z%29+Strong+Wind&eventType=%28Z%29+Thunderstorm+Wind&eventType=%28Z%29+Tornado&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=SAN%2BFRANCISCO%3A75&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA


\textsuperscript{169} National Climatic Data Center. Storm Events Database. Retrieved on 08.05.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28Z%29+High+Wind&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=MARIN%3A41&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA
- **Strong Wind**: at least 219 events, or 8.64 events per year\(^{170}\)
- **Thunderstorm Wind**: at least 8 events, or approximately 0.32 events per year\(^{171}\)
- **All Wind Hazard events** (excluding Tornadoes): at least 311 events, or approximately 12.28 events per year.\(^{172}\) (Note: This was determined by conducting a simultaneous search of the component wind hazards of high wind, strong wind and thunderstorm wind.)

Overall, in Marin County, there have been at least 311 wind hazard events since 1996, excluding tornadoes.\(^{173}\) That translates to an approximate average historical frequency of occurrence of **12.28** wind hazard events per year.

Please note: Differences between the sums of individual component severe weather hazard event Database searches (i.e., 317 events) and simultaneous Database searches of all severe weather hazard events (i.e., 311 events) may be due to the following factors: (1) multiple event types are in the same record (e.g., "Thunderstorm Wind/Hail" or "Hail/Tornado;" and/or (2) severe weather hazard events such as “Thunderstorm Wind” or “Hail” that are reported for Marin County have actually taken place hundreds of miles away, but are erroneously recorded as events that have occurred in the County.\(^{174}\) When such a discrepancy arises, the more conservative aggregate hazard wind event value (i.e., 311 events) is used to determine the historical frequency of occurrence for the severe weather hazard. The origin of this discrepancy is unknown at this time.

### Historical Wind Hazard Losses for Marin County since 1996

\(^{170}\) National Climatic Data Center. Storm Events Database. Retrieved on 08.05.2021 from [https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28Z%29+Strong+Wind&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=MARIN%3A41&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA](https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28Z%29+Strong+Wind&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=MARIN%3A41&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA)

\(^{171}\) National Climatic Data Center. Storm Events Database. Retrieved on 08.05.2021 from [https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Thunderstorm+Wind&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=MARIN%3A41&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA](https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Thunderstorm+Wind&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=MARIN%3A41&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA)

\(^{172}\) National Climatic Data Center. Storm Events Database. Retrieved on 08.05.2021 from [https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28Z%29+High+Wind&eventType=%28Z%29+Strong+Wind&eventType=%28C%29+Thunderstorm+Wind&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=MARIN%3A41&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA](https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28Z%29+High+Wind&eventType=%28Z%29+Strong+Wind&eventType=%28C%29+Thunderstorm+Wind&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=MARIN%3A41&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA)

\(^{173}\) National Climatic Data Center. Storm Events Database. Retrieved on 08.05.2021 from [https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28Z%29+High+Wind&eventType=%28Z%29+Strong+Wind&eventType=%28C%29+Thunderstorm+Wind&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=MARIN%3A41&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA](https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28Z%29+High+Wind&eventType=%28Z%29+Strong+Wind&eventType=%28C%29+Thunderstorm+Wind&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=MARIN%3A41&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA)

According to the NCEI Storm Events Database, the wind hazard events that Marin County has experienced since 1996 have been costly. There have been five (5) deaths and five (5) injuries, and property damage estimates have totaled approximately $3,859,000; there has been no reported crop damage.\textsuperscript{175}

**Tornado Wind Hazards**

Information from the NCEI Storm Events Database indicates that since 1996, there has been one (1) reported event of a tornado (i.e., F1/EF1 severity rating) in Marin County, which translates to approximately 0.04 tornado events per year.\textsuperscript{176}

**Historical Tornado Hazard Losses for Marin County since 1996**

According to the NCEI Storm Events Database, the one (1) tornado hazard event that Marin County has experienced since 1996 has been costly. While no death or injuries have been reported, property and crop damage estimates have totaled approximately $200,000 and $5,000, respectively.\textsuperscript{177}

**Hail**

Information from the NCEI Storm Events Database indicates that since 1996, there have been 12 reported events of hail in Marin County, which translates to approximately 0.47 hail events per year.\textsuperscript{178} (Note: The NCEI Storm Event Database search results for hail indicate that there has been a total of 13 reports of hail since 1996. However, one (1) entry is for a hail event in San Diego County, hundreds of miles away from Marin County. The origin of this error is unknown at this time.)

**Historical Hail Hazard Losses for Marin County since 1996**

\textsuperscript{175} National Climatic Data Center. Storm Events Database. Retrieved on 08.05.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28Z%29+High+Wind&eventType=%28Z%29+Strong+Wind&eventType=%28C%29+Thunderstorm+Wind&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=MARIN%3A41&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitButton=Search&statefips=6%2CCALIFORNIA

\textsuperscript{176} National Climatic Data Center. Storm Events Database. Retrieved on 08.05.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Tornado&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=MARIN%3A41&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitButton=Search&statefips=6%2CCALIFORNIA

\textsuperscript{177} National Climatic Data Center. Storm Events Database. Retrieved on 08.05.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Tornado&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=MARIN%3A41&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitButton=Search&statefips=6%2CCALIFORNIA

\textsuperscript{178} National Climatic Data Center. Storm Events Database. Retrieved on 08.05.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Hail&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=MARIN%3A41&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitButton=Search&statefips=6%2CCALIFORNIA
According to the NCEI Storm Events Database, the hail hazard events that Marin County has experienced since 1996 have been costly. While there have been no deaths, injuries, or crop damage, property estimates have totaled approximately $50,000.\(^{179}\) (Note: The San Diego County hail event that was included erroneously in the search results for hail hazard events in Marin County accounted for all injuries (i.e., 5) and crop damage estimates (i.e., $300,000) presented in the search results.)

**Lightning**

Information from the NCEI Storm Events Database indicates that since 1996, there have been two (2) reported events of lightning in Marin County, which translates to approximately 0.08 lightning events per year.\(^{180}\)

**Historical Lightning Hazard Losses for Marin County since 1996**

According to the NCEI Storm Events Database, the lightning hazard events that Marin County has experienced since 1996 have been costly. While there have been no deaths, injuries, or crop damage, property estimates have totaled approximately $30,300.\(^{181}\)

**All Severe Weather Hazard Events Recorded by the NCEI Storm Events Database**

(Marin County)

Information obtained from the NCEI Storm Events Database indicates that there have been 326 occurrences of the severe weather hazard in Marin County. This translates to 12.87 severe weather hazard occurrences per year.\(^{182}\)

Please note: Differences between the sums of individual component severe weather hazard event Database searches (i.e., 333 events) and simultaneous Database searches of all severe weather hazard events (i.e., 326 events) may be due to the following factors: (1)
multiple event types are in the same record (e.g., "Thunderstorm Wind/Hail" or "Hail/Tornado;" and/or (2) severe weather hazard events such as “Thunderstorm Wind” or “Hail” that are reported for Marin County have actually taken place hundreds of miles away, but are erroneously recorded as events that have occurred in the County.  When such a discrepancy arises, the more conservative aggregate hazard wind event value (i.e., 326 events) is used to determine the historical frequency of occurrence for the severe weather hazard. The origin of this discrepancy is unknown at this time.

**Historical, Aggregated Severe Hazard Losses for Marin County since 1996**

According to the NCEI Storm Events Database, the severe weather events that Marin County has experienced since 1996 have been costly. There have been five (5) deaths and five (5) injuries, and property and crop damage estimates have totaled approximately $4,090,000 and $5,000, respectively.  It is important to note that for all Marin County severe weather hazard events recorded on the Storm Events Database, all deaths and injuries, as well as 94.4% of all property damage estimates, have been attributed to wind hazard events alone.

**Sierra County**

**Wind Hazards (excluding Tornadoes)**

Information obtained from the NCEI Storm Event Database website shows the number of events (or occurrences) of wind hazard events in Sierra County since 1996.  Here, wind hazard events include all “High Wind,” “Strong Wind,” and “Thunderstorm Wind” storm reports.

- **High Wind:** at least 108 events, or approximately 4.26 events per year

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184 National Climatic Data Center. Storm Events Database. Retrieved on 08.05.2021 from [https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Hail&eventType=%28Z%29+HighWind&eventType=%28C%29+Lightning&eventType=%28Z%29+StrongWind&eventType=%28C%29+ThunderstormWind&eventType=%28C%29+Tornado&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=MARIN%3A41&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA](https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Hail&eventType=%28Z%29+HighWind&eventType=%28C%29+Lightning&eventType=%28Z%29+StrongWind&eventType=%28C%29+ThunderstormWind&eventType=%28C%29+Tornado&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=MARIN%3A41&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA)


187 National Climatic Data Center. Storm Events Database. Retrieved on 08.05.2021 from [https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28Z%29+HighWind&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=SIERRA%3A91&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA](https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28Z%29+HighWind&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=SIERRA%3A91&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA)
- **Strong Wind**: at least 2 events, or 0.08 events per year
- **Thunderstorm Wind**: at least 7 events, or approximately 0.28 events per year
- **All Wind Hazard events** (excluding Tornadoes): at least 111 events, or approximately 4.38 events per year. (Note: This was determined by conducting a simultaneous search of the component wind hazards of high wind, strong wind and thunderstorm wind.)

Overall, in Sierra County, there have been at least 111 wind hazard events since 1996, excluding tornadoes. That translates to an approximate average historical frequency of occurrence of **4.38** wind hazard events per year.

Please note: Differences between the sums of individual component severe weather hazard event Database searches (i.e., 117 events) and simultaneous Database searches of all severe weather hazard events (i.e., 111 events) may be due to the following factors: (1) multiple event types are in the same record (e.g., "Thunderstorm Wind/Hail" or "Hail/Tornado;" and/or (2) severe weather hazard events such as “Thunderstorm Wind” or “Hail” that are reported for Sierra County have actually taken place hundreds of miles away, but are erroneously recorded as events that have occurred in the County. When such a discrepancy arises, the more conservative aggregate hazard wind event value (i.e., 111 events) is used to determine the historical frequency of occurrence for the severe weather hazard. The origin of this discrepancy is unknown at this time.

**Historical Wind Hazard Losses for Sierra County since 1996**

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188 National Climatic Data Center. Storm Events Database. Retrieved on 08.05.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28Z%29+Strong+Wind&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=SIERRA%3A91&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA

189 National Climatic Data Center. Storm Events Database. Retrieved on 08.05.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Thunderstorm+Wind&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=SIERRA%3A91&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA

190 National Climatic Data Center. Storm Events Database. Retrieved on 08.05.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28Z%29+High+Wind&eventType=%28Z%29+Strong+Wind&eventType=%28C%29+Thunderstorm+Wind&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=SIERRA%3A91&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA

191 National Climatic Data Center. Storm Events Database. Retrieved on 08.05.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28Z%29+High+Wind&eventType=%28Z%29+Strong+Wind&eventType=%28C%29+Thunderstorm+Wind&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=SIERRA%3A91&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA

According to the NCEI Storm Events Database, the wind hazard events that Sierra County has experienced since 1996 have been costly. While there have been no deaths or crop damage reported, there have been two (2) injuries, and property damage estimates have totaled approximately $4,411,000.193

**Tornado Wind Hazards**

Information from the NCEI Storm Events Database indicates that since 1996, there have been no reported events of tornadoes in Sierra County.194

**Historical Tornado Hazard Losses for Sierra County since 1996**

Because there have been no reports of tornadoes in Sierra County since 1996, there have been no tornado-related deaths, injuries, property damage, or crop damage.195

**Hail**

Information from the NCEI Storm Events Database indicates that since 1996, there have been four (4) reported events of hail in Sierra County, which translates to approximately 0.16 hail events per year.196 (Note: The NCEI Storm Event Database search results for hail indicate that there has been a total of five (5) reports of hail since 1996. However, one (1) entry is for a hail event in San Diego County, hundreds of miles away from Sierra County. The origin of this error is unknown at this time.)

**Historical Hail Hazard Losses for Sierra County since 1996**

According to the NCEI Storm Events Database, the hail hazard events that Sierra County has experienced since 1996 have been costly. There have been no deaths, injuries,
property damage, or crop damage associated with hail hazard events.\textsuperscript{197} (Note: The San Diego County hail event that was included erroneously in the search results for hail hazard events in Sierra County accounted for all injuries (i.e., 5) and crop damage estimates (i.e., $300,000) presented in the search results.)

\textit{Lightning}

Information from the NCEI Storm Events Database indicates that since 1996, there has been one (1) reported event of lightning in Sierra County, which translates to approximately 0.04 lightning events per year.\textsuperscript{198}

\textbf{Historical Lightning Hazard Losses for Sierra County since 1996}

According to the NCEI Storm Events Database, the one (1) lightning hazard event that Sierra County had experienced since 1996 was costly, as one (1) death and one (1) injury was attributed to that event; no property or crop damages were reported.\textsuperscript{199}

\textbf{All Severe Weather Hazard Events Recorded by the NCEI Storm Events Database (Sierra County)}

Information obtained from the NCEI Storm Events Database indicates that there have been 116 occurrences of the severe weather hazard in Sierra County. This translates to 4.58 severe weather hazard occurrences per year.\textsuperscript{200}

Please note: Differences between the sums of individual component severe weather hazard event Database searches (i.e., 123 events) and simultaneous Database searches of all severe weather hazard events (i.e., 116 events) may be due to the following factors: (1) multiple event types are in the same record (e.g., "Thunderstorm Wind/Hail" or "Hail/Tornado"; and/or (2) severe weather hazard events such as "Thunderstorm Wind" or “Hail” that are reported for Sierra County have actually taken place hundreds of miles away, but are erroneously recorded as events that have occurred in the County.\textsuperscript{201} When such a discrepancy arises, the more conservative aggregate hazard wind event value (i.e.,

\textsuperscript{197} National Climatic Data Center. Storm Events Database. Retrieved on 08.05.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Hail&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=SIERRA%3A91&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA

\textsuperscript{198} National Climatic Data Center. Storm Events Database. Retrieved on 08.05.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Lightning&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=SIERRA%3A91&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA

\textsuperscript{199} National Climatic Data Center. Storm Events Database. Retrieved on 08.05.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28Z%29+High+Wind&eventType=%28C%29+Lightning&eventType=%28Z%29+Strong+Wind&eventType=%28C%29+Thunderstorm+Wind&eventType=%28C%29+Tornado&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=SIERRA%3A91&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA

\textsuperscript{200} Re National Climatic Data Center. Storm Events Database. Retrieved on 08.05.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Hail&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=SIERRA%3A91&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA

116 events) is used to determine the historical frequency of occurrence for the severe weather hazard. The origin of this discrepancy is unknown at this time.

**Historical, Aggregated Severe Hazard Losses for Sierra County since 1996**

According to the NCEI Storm Events Database, the severe weather events that Sierra County has experienced since 1996 have been costly. There have been one (1) death and three (3) injuries, and property damage estimates have totaled approximately $4,411,000; there has been no reported crop damage.\(^{202}\) *It is important to note that for all Sierra County severe weather hazard events recorded on the Storm Events Database, two (2) of three (3) reported injuries, as well as all property damage estimates, have been attributed to wind hazard events alone.*
Wind Hazards Not Included in the NCEI Storm Events Database

Santa Ana Winds

Santa Ana wind events occur at least twice per month from October through April.\textsuperscript{203} From 1948 to 2012, total of 2056 events on the 65-year record were recorded in the Southern California region, yielding an average of \textbf{32 occurrences per year}. Typical Santa Ana wind events last 1–2 days and represent 27\% of the occurrences, with events lasting up to 6 days accounting for 90\% of all occurrences. The remaining 10\% are made up almost entirely of events lasting between 7 and 12 days.\textsuperscript{204, 205}

Figure below shows the mean monthly frequency per season of Santa Ana Wind events detected from 1948 to 2012. Extreme Santa Ana wind events are shown in dark red, and are defined as those events that are above the 90th percentile of all events on record.

Diablo Winds

Diablo wind events occur approximately **2.5 events per year**. These events are most frequent during the fall and early winter seasons, with the highest frequency of events occurring in October. As a result, the highest risk of Diablo-wind-related damage is in the fall and early winter.\(^{208}\)

Figure below shows the monthly frequency of Diablo winds (along with average live fuel moisture content). The Diablo Wind data are derived from a 17-year climatology of San Francisco Bay Area regional surface weather stations.\(^{209}\)

\(^{209}\) Retrieved on 07.15.2021 from [https://www.fireweather.org/diablo-winds](https://www.fireweather.org/diablo-winds)
Sundowner Winds

Strong sundowner wind events occur approximately **2-3 times per year**. These events can create sharp temperature rises, local gale force winds, and significant weather-related problems. Rare, “explosive” types of sundowner wind events occur about 6 times per century that present dangerous weather situations, generating extremely strong and hot winds that can reach gale force or higher speeds.\(^{211}\)

**Historical Frequency of All Severe Weather Hazards**

Table below shows the average historical frequency of severe weather hazard events for San Francisco County since 1996.)

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\(^{210}\) Retrieved on 07.13.2021 from [https://www.fireweather.org/diablo-winds](https://www.fireweather.org/diablo-winds)

Table 21-31: Severe Weather Hazard Event

Frequencies for San Francisco County since 1996.

<table>
<thead>
<tr>
<th>Severe Weather Hazard Category</th>
<th>Average Number of Hazard Events Per Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wind (Includes High, Strong and Thunderstorm Winds ONLY)</td>
<td>3.04</td>
</tr>
<tr>
<td>Tornado</td>
<td>0</td>
</tr>
<tr>
<td>Hail</td>
<td>0.36</td>
</tr>
<tr>
<td>Lightning</td>
<td>0.28</td>
</tr>
<tr>
<td>Diablo Wind</td>
<td>2.5</td>
</tr>
<tr>
<td>Santa Ana Wind *</td>
<td>32</td>
</tr>
<tr>
<td>Sundowner Wind*</td>
<td>2 to 3</td>
</tr>
</tbody>
</table>

* Note: The Santa Ana and Sundowner wind hazards are not present in San Francisco County. They are included here for information purposes only.

Table below shows the average historical frequency of severe weather hazard events for Marin County since 1996.)
Table 21-32: Severe Weather Hazard Event

Frequencies for Marin County since 1996.

<table>
<thead>
<tr>
<th>Severe Weather Hazard Category</th>
<th>Average Number of Hazard Events Per Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wind</td>
<td>12.28</td>
</tr>
<tr>
<td>(Includes High, Strong and Thunderstorm Winds ONLY)</td>
<td></td>
</tr>
<tr>
<td>Tornado</td>
<td>0.04</td>
</tr>
<tr>
<td>Hail</td>
<td>0.47</td>
</tr>
<tr>
<td>Lightning</td>
<td>0.08</td>
</tr>
<tr>
<td>Diablo Wind</td>
<td>2.5</td>
</tr>
<tr>
<td>Santa Ana Wind*</td>
<td>32</td>
</tr>
<tr>
<td>Sundowner Wind*</td>
<td>2 to 3</td>
</tr>
</tbody>
</table>

* Note: The Santa Ana and Sundowner wind hazards are not present in Marin County. They are included here for information purposes only.

Table below shows the average historical frequency of severe weather hazard events for Sierra County since 1996.)

Table 21-33: Severe Weather Hazard Event

Frequencies for Sierra County since 1996.

<table>
<thead>
<tr>
<th>Severe Weather Hazard Category</th>
<th>Average Number of Hazard Events Per Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wind</td>
<td>4.38</td>
</tr>
<tr>
<td>(Includes High, Strong and Thunderstorm Winds ONLY)</td>
<td></td>
</tr>
<tr>
<td>Tornado</td>
<td>0</td>
</tr>
<tr>
<td>Hail</td>
<td>0.16</td>
</tr>
<tr>
<td>Hazard</td>
<td>Frequency</td>
</tr>
<tr>
<td>-------------------------</td>
<td>-----------</td>
</tr>
<tr>
<td>Lightning</td>
<td>0.04</td>
</tr>
<tr>
<td>Diablo Wind**</td>
<td>2.5</td>
</tr>
<tr>
<td>Santa Ana Wind*</td>
<td>32</td>
</tr>
<tr>
<td>Sundowner Wind*</td>
<td>2 to 3</td>
</tr>
</tbody>
</table>

* Note: The Santa Ana and Sundowner wind hazards are not present in Sierra County. They are included here for information purposes only.

** Note: Diablo winds reportedly occur in Sierra County. 212

### Potential Impacts of the Hazard

The significance (or priority) of a hazard’s potential impacts is based primarily on the frequency and resulting damage caused by the hazard, including deaths/injuries and property, crop, and economic damage. All assets and people within all San Francisco State campus areas are at risk from the effects of severe weather hazards.

#### Wind Hazards (Including Tornadoes)

Wind hazard events have the potential to impact people, property, and operations on campuses across the CSU system. People caught in the open during an extreme wind event are exposed to high winds and debris, and could be injured or killed.

The habitability of buildings can be compromised (by damaging roofs, windows, or other weak points in the building envelope), leading to long-term operational issues for the campus. As with most university campuses, space is always at a premium at the San Francisco State campus, and the loss of any currently utilized space due to building or structural damage would likely disrupt operations and the University’s mission.

Extreme wind events can result in power failure, which would impact the operation of the campus. Fallen tree limbs and other potential transportation hazards may also cause disruption to the surrounding community and limit ingress/egress to the campus.

#### San Francisco State Main & Downtown Campuses, San Francisco (San Francisco County)

According to the 2020 Hazards and Climate Resilience Plan, strong winter storms bring significant wind gusts occasionally that can cause damage and disruption of services across the region. As a result, wind hazards have a low to moderate significance, and therefore have a minimal to moderate potential impact on San Francisco and (by

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extension) the San Francisco State Main and Downtown campuses.²¹³ Tornadoes are virtually non-existent in San Francisco, and therefore are considered to have minimal potential impact on San Francisco and (by extension) the San Francisco State Main and Downtown campuses.

**San Francisco State – Romberg Tiburon Campus, Tiburon (Marin County)**

According to the 2019 Marin County Multi-Jurisdiction Local Hazard Mitigation Plan (MCM LHMP), the entire County is affected by wind hazards (excluding tornadoes), but coastal areas are impacted more than inland areas. As a result, wind hazards are considered to be of medium significance, and therefore to have a moderate potential impact on the County and (by extension) on the Romberg Tiburon Campus.²¹⁴ Tornadoes are extremely rare in Marin County and are considered to have a minimal potential impact on the County and (by extension) on the Romberg Tiburon Campus.

**San Francisco State – Sierra Nevada Field Campus, Calpine (Sierra County)**

Sierra County does not have a local hazard mitigation plan. As a result, the potential impacts of wind hazards (including tornadoes) cannot be determined for the County and for the San Francisco State – Sierra Nevada Field Campus.

**Hail**

Hail typically impacts property by damaging structures, cars, and utilities as it falls. Dents in cars, broken glass, and holes in roofs are common impacts of hail. Injuries to people from hail are less common, though they can happen, as hail is a hard object falling in an unpredictable manner at a fairly high rate of speed.

**San Francisco State Main & Downtown Campuses, San Francisco (San Francisco County)**

Hail is not even mentioned in the 2020 Hazards and Climate Resilience Plan. Hail hazards are considered to have low significance, and therefore to have a minimal potential impact on San Francisco and (by extension) the San Francisco State Main and Downtown campuses.²¹⁵

**San Francisco State – Romberg Tiburon Campus, Tiburon (Marin County)**


According to the 2019 Marin County Multi-Jurisdiction Local Hazard Mitigation Plan (MCM LHMP), hail is extremely rare in Marin County and is considered to have a minimal potential impact on the County and (by extension) on the Romberg Tiburon Campus.216

**San Francisco State – Sierra Nevada Field Campus, Calpine (Sierra County).**

Sierra County does not have a local hazard mitigation plan. As a result, the potential impacts of hail hazards cannot be determined for the County and for the San Francisco State – Sierra Nevada Field Campus.

**Lightning**

Lightning strikes the United States about 20-25 million times a year.217 Although most lightning occurs in the summer months, people can be struck at any time of year. Since 1990, lightning has killed an average of 39 people each year in the United States, and hundreds more have been injured.218 Property losses due to lightning have been very costly across the U.S. For example, from 2005 through 2020, U.S. homeowner’s insurance claim payouts for lightning losses totaled approximately $15,334,600,000, or $958,412,500 worth of payouts per year.219 (Commercial claim payouts for lightning losses for the U.S. were not available.)

**San Francisco State Main & Downtown Campuses, San Francisco (San Francisco County)**

The 2020 Hazards and Climate Resilience Plan only mentions lightning hazards within the context of wildfires. Lightning hazards are considered to have low significance, and therefore to have a minimal potential impact on San Francisco and (by extension) the San Francisco State Main and Downtown campuses.220

**San Francisco State – Romberg Tiburon Campus, Tiburon (Marin County)**

According to the 2019 Marin County Multi-Jurisdiction Local Hazard Mitigation Plan (MCM LHMP), lightning is extremely rare in Marin County and is considered to have a minimal potential impact on the County and (by extension) on the Romberg Tiburon Campus.221

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San Francisco State – Sierra Nevada Field Campus, Calpine (Sierra County)

Sierra County does not have a local hazard mitigation plan. As a result, the potential impacts of hail hazards cannot be determined for the County and for the San Francisco State – Sierra Nevada Field Campus.

Probability of Future Occurrence of the Hazard

Areas throughout California, including all California State University (CSU) campuses, experience severe weather events every year. Future occurrences of such events are projected to increase in both their frequency and intensity.

San Francisco State Main & Downtown Campuses, San Francisco (San Francisco County)

The 2020 Hazards and Climate Resilience Plan states that San Francisco can continue to expect to experience at least one winter wind storm annually that brings strong winds and heavy rains. Also, according to the NCEI Storm Events Database, severe weather wind hazards have occurred in San Francisco County significantly more than once annually – at an average of 3.04 wind hazard events per year since 1996. Furthermore, while the severe weather hazard is a non-spatial hazard that affects all areas of San Francisco State’s Main Campus and Downtown Campus areas equally, the smallest geographic unit of measurement for almost all official severe weather event data is at the county level. Because the severe weather data used in this assessment do not exist at the campus level, it is assumed that the severe weather probabilities for the both the Main and Downtown campuses reflect those of the surrounding community and County.

Based on the data available from both 2020 Hazards and Climate Resilience Plan and the NCEI Storm Events Database, the severe weather hazard is expected to occur on (or otherwise impact) the both San Francisco State campuses located in San Francisco at least once on an annual basis. Therefore, the probability of future occurrence of the severe weather hazard for both the Main and Downtown San Francisco State campuses is HIGHLY LIKELY.

San Francisco State – Romberg Tiburon Campus, Tiburon (Marin County)

The 2019 Marin County Multi-Jurisdiction Local Hazard Mitigation Plan (MCM LHMP) states that wind events and associated damages are expected to continue to occur in Marin County several times per year. Also, according to the NCEI Storm Events Database, some of these same severe weather wind hazard events have occurred in Marin County far more than once annually – at an average of 12.28 events per year since 1996. Furthermore, while the severe weather hazard is a non-spatial hazard that affects all

areas of the San Francisco State – Romberg Tiburon Campus equally, the smallest
geographic unit of measurement for almost all official severe weather event data is at the
county level. Because the severe weather data used in this assessment do not exist at the
campus level, it is assumed that the severe weather probabilities for the Romberg
Tiburon Campus reflect those of the surrounding community and County.

Based on the data available from both the 2019 Marin County Multi-Jurisdiction Local
Hazard Mitigation Plan and the NCEI Storm Events Database, the severe weather hazard
is expected to occur on (or otherwise impact) the Romberg Tiburon Campus at least once
on an annual basis. Therefore, the probability of future occurrence of the severe weather
hazard for San Francisco State – Romberg Tiburon Campus is **HIGHLY LIKELY**.

**San Francisco State – Sierra Nevada Field Campus, Calpine (Sierra County)**

Sierra County does not have a local hazard mitigation plan, and there is no information
available from the County regarding the probability of future occurrence of severe
weather hazards. However, according to the NCEI Storm Events Database, severe weather
wind hazards have occurred in Sierra County significantly more than once annually – at
an average of 4.38 events per year since 1996. Furthermore, while the severe weather
hazard is a non-spatial hazard that affects all areas of the San Francisco State – Sierra
Nevada Field Campus equally, the smallest geographic unit of measurement for almost
all official severe weather event data is at the county level. Because the severe weather
data used in this assessment do not exist at the campus level, it is assumed that the
severe weather probabilities for the San Francisco State – Sierra Nevada Field Campus
reflect those of the surrounding community and County identified in the Table below.

Based on the data available from the NCEI Storm Events Database, the severe weather
hazard is expected to occur on (or otherwise impact) the San Francisco State – Sierra
Nevada Field Campus **at least once on an annual basis**. Therefore, the probability of
future occurrence of the severe weather hazard for the San Francisco State – Sierra
Nevada Field Campus is **HIGHLY LIKELY**.

**San Francisco State University – All Campus Areas**

The probability of future occurrence of the severe weather hazard for all San Francisco
State University campus areas is **HIGHLY LIKELY**.

The following tables show the probabilities of future occurrence for component severe
weather hazards for San Francisco State campuses and facilities in San Francisco, Marin,
and Sierra Counties.
Table 21-34: Severe Weather Hazard Probabilities of Future Occurrence for San Francisco County and San Francisco State University.

<table>
<thead>
<tr>
<th>Severe Weather Hazard Category</th>
<th>Average Number of Hazard Events Per Year</th>
<th>Probability of Future Occurrence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wind</td>
<td>3.04</td>
<td>Highly Likely</td>
</tr>
<tr>
<td>(Includes High, Strong and Thunderstorm Winds ONLY)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tornado</td>
<td>0</td>
<td>Unlikely</td>
</tr>
<tr>
<td>Hail</td>
<td>0.36</td>
<td>Possible</td>
</tr>
<tr>
<td>Lightning</td>
<td>0.28</td>
<td>Possible</td>
</tr>
<tr>
<td>Diablo Wind</td>
<td>2.5</td>
<td>Highly Likely</td>
</tr>
<tr>
<td>Santa Ana Wind**</td>
<td>32</td>
<td>Not Rated</td>
</tr>
<tr>
<td>Sundowner Wind**</td>
<td>2 to 3</td>
<td>Not Rated</td>
</tr>
<tr>
<td>** Severe Weather Hazard</td>
<td>Highly Likely</td>
<td></td>
</tr>
</tbody>
</table>

** Note: The Santa Ana, Diablo, and/or Sundowner wind hazards are not present in San Francisco County, and therefore are not rated for probability of future occurrence. They are included here for information purposes only.
Table 21-35: Severe Weather Hazard Probabilities of Future Occurrence for Marin County and San Francisco State University – Estuary and Ocean Science Center (Tiburon, CA).

<table>
<thead>
<tr>
<th>Severe Weather Hazard Category</th>
<th>Average Number of Hazard Events Per Year</th>
<th>Probability of Future Occurrence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wind (Includes High, Strong and Thunderstorm Winds ONLY)</td>
<td>12.28</td>
<td>Highly Likely</td>
</tr>
<tr>
<td>Tornado</td>
<td>0.04</td>
<td>Unlikely</td>
</tr>
<tr>
<td>Hail</td>
<td>0.47</td>
<td>Possible</td>
</tr>
<tr>
<td>Lightning</td>
<td>0.08</td>
<td>Unlikely</td>
</tr>
<tr>
<td>Diablo Wind</td>
<td>2.5</td>
<td>Highly Likely</td>
</tr>
<tr>
<td>Santa Ana Wind**</td>
<td>32</td>
<td>Not Rated</td>
</tr>
<tr>
<td>Sundowner Wind**</td>
<td>2 to 3</td>
<td>Not Rated</td>
</tr>
</tbody>
</table>

Severe Weather Hazard Highly Likely

** Note: The Santa Ana and Sundowner wind hazards are not present in Marin County, and therefore are not rated for probability of future occurrence. They are included here for information purposes only.

Table 21-36: Severe Weather Hazard Probabilities of Future Occurrence for Sierra County and San Francisco State University – Sierra Nevada Field Campus (Calpine, CA)

<table>
<thead>
<tr>
<th>Severe Weather Hazard Category</th>
<th>Average Number of Hazard Events Per Year</th>
<th>Probability of Future Occurrence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wind (Includes High, Strong and Thunderstorm Winds ONLY)</td>
<td>4.38</td>
<td>Highly Likely</td>
</tr>
<tr>
<td>Tornado</td>
<td>0</td>
<td>Unlikely</td>
</tr>
<tr>
<td>Hail</td>
<td>0.16</td>
<td>Possible</td>
</tr>
</tbody>
</table>
Vulnerability to the Hazard

People, structures, and assets on all San Francisco State campuses are all vulnerable to the impacts associated with severe weather. Infrastructure can be damaged or destroyed by hail, wind, tornadoes, thunderstorms, and lightning, which can result in service interruptions and outages. Structures can be damaged or destroyed by hail, wind, tornadoes, thunderstorms, and lightning. People can be injured or killed by lightning, flying debris, hail, or extreme wind events. San Francisco State campuses also have vehicles that are all vulnerable to a severe weather event.

Estimate of Potential Losses

Severe weather is a non-spatial hazard that affects all San Francisco State campuses. Each of the hazards associated with severe weather can result in losses throughout the planning areas.

All structures located on all San Francisco State campuses are at risk from severe weather. There are approximately 95 campus buildings that could be damaged by wind, hail, and/or lightning. If even a fraction of these assets were to be damaged, the resulting estimated losses would still be in the millions of dollars. The total replacement costs due to severe weather hazard are $448,726,927 for 64 buildings, and are unknown for the remaining 31 buildings. An analysis of projected dollar losses to campus buildings from severe weather as a percentage of building replacement costs is also not currently available, though CSU leadership may pursue such data in the future.

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The populations at all San Francisco State campuses vary throughout the day and season. As of Fall, 2019, San Francisco State had 28,880 students and 3,401 faculty and staff. All are at risk from severe weather events, with 32,281 being directly vulnerable in this scenario.

Vulnerability Assessment Conclusions

Severe weather presents a variety of hazards to all San Francisco State campuses. People, assets, infrastructure, and vehicles can all be damaged by this hazard, and losses can quickly begin to rise. In the aggregate, severe weather is a frequently occurring hazard (mostly in the form of wind hazard events) that presents a variety of risks to San Francisco State.

It is evident that San Francisco State University has vulnerabilities to and risks from severe weather hazard incidents, and that pre-event planning, communication, and mitigation efforts should be implemented. Public education and outreach regarding areas of shelter that could be used by campus populations during severe weather events is considered by campus leadership to be one viable mitigation option. The campus planning committee will continue to look for feasible and cost-effective options for the mitigation of severe weather risks going forward.

Identified Data Limitations

Numerous federal agencies maintain a variety of records regarding losses associated with hazards. Unfortunately, no single source is considered to offer a definitive accounting of all losses. The Federal Emergency Management Agency (FEMA) maintains records on federal expenditures associated with declared major disasters. The US Army Corps of Engineers (USACE) and the Natural Resources Conservation Service (NRCS) collect data on losses during the course of some of their ongoing projects and studies. Additionally, the National Oceanic and Atmospheric Administration’s (NOAA) National Centers for Environmental Information (NCEI) collects and maintains data about natural hazards in summary format, as well as occurrences, dates, injuries, deaths, and estimated costs for individual storm events. Many of these databases and other data collection services, including the NCEI, have inherent data limitations when searching for information at a scale as small as a single campus.

The best available data and records have been used throughout this section. Where no data or records exist or could be located, that deficiency is noted.

225 Retrieved on 07.19.2021 from https://www2.calstate.edu/csusystem/about-the-csu/facts-about-the-csu/enrollment/Pages/default.aspx
21.4 Social Resilience Assessment

Overview

While every person is vulnerable to risk, individuals from diverse populations such as those with access and functional needs are disproportionately more vulnerable and may be at a higher risk to harm in a disaster event. In addition to physical vulnerabilities, the intersectionality between physical hazard risks and population social vulnerabilities must be considered to holistically address overall campus risk.

As inclusivity is a high priority for CSU, addressing campus risk and resilience must be done through the lens of inclusion and equity. Addressing social vulnerability is an increasingly critical requirement of state and national doctrines and described in Section 4.4 of the HVRA Base Plan. Every individual of the campus’s richly diverse population group needs to have the capacity, skills, and knowledge in order to understand, access, and participate in risk reduction and disaster response in ways that are meaningful to their own unique situation. In a campus community, having strong social support networks and active involvement in community disaster responses may negatively or positively impact these opportunities and reduce the resilience-building process. This section offers a glimpse into the CSU San Francisco campus’s unique social construct, population demographics, strengths and concerns and presents a high-level assessment of the resilience, coping capacities and potential social vulnerabilities of students, staff and faculty. The research variables that were asked are often considered sensitive subjects, and few are traditionally included in emergency management/hazard mitigation planning.

This social resilience assessment of college campuses is the first of its kind in the nation. The research methodology unfolded as the interviews with campuses progressed. The assessment data presented are not definitive or authoritative. The answers, analysis, and suggested trends are strictly indicators for potential social risk. They do not represent an accurate data capture as limitations on the data gathering process influenced an ability to provide accuracy. This assessment provides indications of increased risk, not accuracy of response or a true reflection of the situation of the campus. The information presented is to be considered in the context of the more detailed system-wide CSU social vulnerability assessment that is included in the baseline HVRA.

Campus-Identified Populations of Concern

During the campus interviews, the following was asked: “In considering the diverse population group(s) amongst student body, faculty and staff, which are of the most concern in your emergency management planning?” However, as SFSU was early
interview the interview process and question structure for this section were not yet fully defined so responses to the question were not captured.

Resilience Variables Related to Campus Emergency Management

The interviewees were asked to reflect on a set of 12 variables for the campus populations of student, faculty and staff: homelessness (*housing insecurity*), food security, health and wellness, disability/access and functional needs (AFN), racial equity, digital equity, communications, international students, immigrants/immigration status issues (*undocumented, DACA, etc.*), LGBTQI (Lesbian Gay Bisexual Transgender Questioning (or queer) Intersex), and transportation dependency. They were also offered an opportunity to add any other factor they wanted to include. The following two questions were asked:

- Is this factor a particular issue of concern for emergency management on your campus? Responses were summarized as **Very High, High, Medium, Low**
- Is this factor reflected in the emergency plans and processes for your campus? Responses were summarized as **Yes, No, In Progress, NA**

In order to provide a high-level qualitative response for the answers, the approach of averaging response was taken. If conflicting answers were expressed by the interviewees, the answer (code) was averaged out. A detailed explanation of the response averaging approach is included in the base HVRA.
### Table 21-37: Campus-specific emergency management issues of concern and inclusion in emergency management plans and processes.

<table>
<thead>
<tr>
<th>Issue of Concern</th>
<th>Plans &amp; Processes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Homelessness (Housing Insecurity)</td>
<td>Medium</td>
</tr>
<tr>
<td>Food Security</td>
<td>Low</td>
</tr>
<tr>
<td>Health &amp; Wellness</td>
<td>Low</td>
</tr>
<tr>
<td>AFN</td>
<td>Low</td>
</tr>
<tr>
<td>Digital Equity</td>
<td>Medium</td>
</tr>
<tr>
<td>Comms.</td>
<td>Low</td>
</tr>
<tr>
<td>International Students</td>
<td>Low</td>
</tr>
</tbody>
</table>

![Color key for issue of concern and plans & processes](image)

**Qualitative Narrative: Campus Overview of Potential Resilience Vulnerabilities**

The following are interview notes of interest:

- SFSU has a large homeless population supported by an active homelessness committee and the wellness center, which is open for the homeless population to shower and bathe.
- The free food support efforts are managed by housing which is separate from the campus. The HDCS (housing, dining, conference) management team sends representative to the EOC.
- Everyone receives emergency communications, though students with no access to equipment need to go to the library for access.

**Campus High Hazards and Potentially Vulnerable Populations**

This section provides a brief introduction to the link between socially vulnerable populations and a particular hazard type. While extensive research has been conducted on the impacts of hazards, not all linkages have been documented or published, and detail for finding them are beyond the scope of this assessment. It’s important to note, the intersectional nature of what makes an individual’s personal experience and resilience to an event is played out by unique factors for that individual or population. The nuanced social vulnerabilities often come from the social and physical environment in which a person is embedded.
In order to aid in further assessing campus resilience, below is a general description of the known impacts. From some hazards, the descriptions are robust, while others are only brief introductions.

### Table 21-38: CSU San Francisco *Highly Likely, Likely and Possible* Hazards

<table>
<thead>
<tr>
<th>Hazard</th>
<th>Future Occurrence Probability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Communicable Disease</td>
<td>Highly Likely</td>
</tr>
<tr>
<td>Drought</td>
<td>Highly Likely</td>
</tr>
<tr>
<td>Earthquake</td>
<td>Possible</td>
</tr>
<tr>
<td>Extreme Temperature</td>
<td>Likely (Heat); Unlikely (Cold)</td>
</tr>
<tr>
<td>Hazardous Materials</td>
<td>Possible</td>
</tr>
<tr>
<td>Power Outage</td>
<td>Likely</td>
</tr>
</tbody>
</table>

**Drought**

The 2012-2016 drought had severe effects on two vulnerable sectors of our population: those in low-income brackets, and those, especially Native Americans, who rely on subsistence fishing for their livelihoods.227 Water bills increased throughout the state. Due to rising water prices, for the working poor, many have paid four to five percent of their income for water. Since many CSU students are commuters, and many living with families, future drought impacts may potentially affect a percentage of non-resident students. NASA’s modeling shows that future droughts are likely to last longer and be more intense, even leading to “megadroughts” in the western states.228 Fresh water supplies are predicted to be full of extremes, with both droughts and extreme precipitation events being more severe. The interrelationship between drought and other hazard conditions may lead to a set of secondary impacts. Drought conditions lead to water quality issues due to loss of drinking water, increased fire danger that leads to drought-induced fires and elevated AQI levels, as well as extreme heat or prolonged heat events.

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**Earthquake**

Impacts on populations from earthquakes are complex, with long-term implications on social stability for all populations. In addition to the physical impact exposure during a no-notice earthquake event and the social and logistical challenges of a recovering community, an earthquake can have lasting impacts long afterwards due to post traumatic stress disorder (PTSD).

Socioeconomic vulnerabilities of populations at risk were analyzed in the hypothetical yet scientifically realistic earthquake sequence that is being used to better understand hazards for the San Francisco Bay region during and after a magnitude-7 earthquake (mainshock) on the Hayward Fault and its aftershocks. In this study, the at-risk populations located in areas of concentrated damage are anticipated to experience longer recovery trajectories, increased long term housing displacement, and transportation impacts due to dependencies on transit dependencies. When neighborhood schools close, families with school age children may move to other areas to keep their children in schools. Persons with access and functions needs are likely to be more dependent on access to functioning medical, social and personal health care services that would be overwhelmed by the event and therefore increasing their vulnerabilities. For the homeless populations, the loss of social community services and damages to shelters could add to protracted relocations. For the young and mobile populations who rent, the major disruption to housing, jobs and transit will also drive relocation. Widespread housing damage and preexisting housing market constraints will make it “extremely challenging” for the socially and economically vulnerable populations to find alternative housing near their home communities. Those who utilize interim and irregular housing for months and years after a disaster are more vulnerable to physical, social, and mental disorders, including suicide, substance abuse, and physical and verbal abuse. Aftershocks and post disaster conditions delay population return and increase outmigration.229

**Extreme Temps**

People susceptible to respiratory ailments (asthma, lower and upper respiratory disease) disproportionately suffer from the effects of fire, smoke, air pollutions, allergens, heat and PSPS. Those with limited income or without resources are affected disproportionately due to the inability to provide safe shelter, air conditioning, cooling, air purification, medical care, and quality foods, and are also least able to obtain information related to climate risks and adaptation strategies.

**Heat**

Heatstroke, cardiovascular disease, respiratory disease and cerebrovascular disease are related to extreme heat events. Increased number of heat waves creates heat-related physical stress on populations and is exacerbated in the metropolitan areas where greater amounts of heat-absorbing surfaces (e.g., asphalt and concrete) trap heat and emit higher temperatures throughout the night.

The heat also extends the geographic range and the distribution of disease-carrying insects and pests. Health professionals are concerned that California’s warming climate will allow species to acclimate. Such vectors include such pests as ticks that carry Lyme disease, and mosquitos that transmit Zika, dengue fever, West Nile, plague and tularemia. Some others, such as chikungunya, Chagas disease, and Rift Valley fever virus, are threats as well.

Some communities of color and some low-income, homeless, and immigrant populations are more exposed to heat waves, as these groups often reside in urban areas affected by heat island effects. In addition, these populations are likely to have limited adaptive capacity due to a lack of adequately insulated housing, inability to afford or to use air conditioning, inadequate access to public shelters such as cooling centers, and inadequate access to both routine and emergency health care. These social, economic, and health risk factors give rise to the observed increase in deaths and disease from extreme heat in some immigrant and impoverished communities.

Heat stroke, the most serious heat-related illness, occurs when the body is unable to control its temperature. Body temperature rises rapidly, the sweating mechanism fails, and the body cannot cool down. In extreme causes, heat stroke can cause confusion and unconsciousness, so the victim is unable to seek treatment without assistance.

There are several groups of people who are uniquely vulnerable to the effects of extreme heat, such as infants and children, older adults aged 65 and up, athletes and outdoor workers, low-income households, and individuals with certain chronic medical conditions.

When dealing with an extreme heat event, the most common impacts are those generally felt by the people living in the targeted area. For people in particular, heat can kill when the body is pushed beyond its limits. Most heat disorders occur because the victim has been overexposed to heat. As discussed, the major human risks associated with extreme heat include dehydration, sunburn, fatigue, heat exhaustion, heat stroke, and in severe cases, death.

Some portions of the population are more at risk to the effects of extreme heat. The very young, the elderly, and certain groups with chronic medical conditions (such as asthma or other pulmonary illnesses, heart disease, poor blood circulation, neurological illnesses, and obesity) are generally more vulnerable to the effects of extreme heat, and are more likely to suffer illness or death as a result.
This is especially true if exposure is extended for a period of time and preventative measures are not taken immediately. Distributional implications of impacts, and even less on distributional implications of adaptation actions.” 230

**Hazardous Materials**

The severity of a hazardous materials release depends upon the type of material released, the amount of the release, and the proximity to populations or environmentally sensitive areas such as wetlands or waterways. The release of materials can lead to injuries or evacuation of nearby residents. Wind direction at the time of the release can also have a bearing on the severity (as well as the location and extent) of a hazardous materials release.

The primary threat from the hazardous materials incident hazard is to the structures located along transmission lines and transportation routes or near facilities that use or store hazardous materials. Minor incidents would likely cause no damage and little disruption, assuming they could be contained quickly. Major incidents could have fatal and disastrous consequences. The severity of a hazardous material release relates primarily to its impact on human safety and welfare and on the threat to the environment. Threats to human safety and welfare include:

- Poisoning of water or food sources and/or supply
- Presence of toxic fumes or explosive conditions
- Damage to personal property
- Need for the evacuation of people
- Interference with public or commercial transportation

Environmental risks are not uniformly distributed across groups of people. Age, poverty, and minority status place some groups at a disproportionately high risk for environmental disease.231 Poor access to health information and health care means less health promotion, less risk avoidance, a less healthy diet, and more adverse conditions that increase susceptibility to exposure. Delayed recognition of exposure, diagnosis, and treatment allows effects to accumulate.232


231 https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3222496/

**Power Outage/Public Safety Power Shutdowns (PSPS)**

Loss of power creates economic hardship to a region experiencing regular PSPS events, such as those experienced throughout the state over the recent years. Many businesses close, including gas stations, grocery stores, and local retail establishments. These impacts may deeply impact students dependent on support jobs, as well impacting family members of campus staff and faculty. PSPS increases risks to the public due to inability to use medical devices, spoilage of food and medicines, and disruption to infrastructure, such as supply of clean water and electricity used to run home medical equipment, such as lift chairs and ventilators.

**Hazard Mitigation and Emergency Management Planning**

The goal of this high-level assessment is to provide a starting point to encourage further exploring campus social risks and vulnerabilities, as well as to inform and to enhance holistic emergency management and hazard mitigation decision making, planning processes and future adaptive risk management strategies. By including the social resilience factors, mitigation investments may move beyond standardized planning and regulations, structure and infrastructure projects, and natural systems protections to embrace a more expanded, customized emergency operations plan and an education and outreach program unique to the campus.

A more robust social resilience inquiry is strongly encouraged to develop an accurate picture, based on methodical and scientific research-based data. Such an effort would be envisioned through both nuanced discussions with a variety of campus stakeholders and the invitation of nontraditional stakeholders to join in a collaborative resilience partnership. Such a forward-leaning effort would be directly in keeping with CSU’s commitment to inclusion and equity in risk reduction.
# Section 22

San Jose State University

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22.1 University Profile

University History
San Jose State University was originally known as the Minn’s Evening Normal School in San Francisco in 1857. The school began teaching in San Francisco; its first location, and then in San Jose. As the population in Los Angeles exploded, what eventually became known as the San Jose Normal School opened a branch in LA, which would eventually become known in 1927 as UCLA. By 1934, the San Jose Normal School would change its name to San Jose State College. In 1972, the university would join the CSU system and becoming known as what we know today as, San Jose State University. This would also be a momentous occasion as it would welcome its first female president, Gail Fullerton.

San Jose State University is designated as both a Hispanic-Serving Institution (HSI) and an Asian American and Native American Pacific Islander-Serving Institution (AANAPISI).

University Governance
The campus president is the chief executive officer who oversees the administration of the entire university. The president manages campus operations and fundraising, sets campus priorities, and oversees the hiring and support of staff and faculty. The president also maintains a close working relationship with the CSU’s systemwide office, reporting to the chancellor and participating in the systemwide Executive Council.

The provost is the chief academic officer of the university, overseeing all academic affairs and programs of the university. The provost reports directly to the president.

The President’s Cabinet operates in an advisory capacity. The Cabinet is comprised of senior leaders on campus who provide advice to the president in addressing strategic and operational issues and in pursuing new initiatives.

The President’s Leadership Council is made up of leadership within Academic Affairs, the Academic Senate, and Administration and Finance, Athletics, Diversity, Equity and Inclusion, Information Technology, the President’s Office, Research and Innovation, Student Affairs and finally, University Advancement used at the discretion of the president to seek advice as needed.

University Mission
“In collaboration with nearby industries and communities, SJSU faculty and staff are dedicated to achieving the university’s mission as a responsive institution of the state of California: To enrich the lives of its students, to transmit knowledge to its students along with the necessary skills for applying it in the service of our society, and to expand the base of knowledge through research and scholarship.”
San Jose State University outlines four strategic priorities in support of their goals. The priorities are centered on accountability, a relentless search for knowledge, inclusivity and intellect.

**University Location**

San Jose State calls the infamous Silicon Valley home. The Silicon Valley is the hub of thousands of tech start-up companies and headquarters to the world’s most elite high-tech companies, like Facebook, Apple, Google and Intel. Additionally, San Francisco and the rest of the Bay Area are accessible and if you venture a little further out you can find some of Northern California’s most beautiful nature destinations.

**University Population**

San Jose State University’s student population exceeds 35,400 students, where 27,327 students have enrolled into undergraduate programs and 8,073 students for graduate programs. Asian students make up 34.4% of the student population, followed by Latino students making up 28% of students on campus. An overwhelming percentage of the student population is made up by undergraduate students.

Additionally, a total of 1,945 faculty members teach at SJSU.

### 22.2 Interim Final Rule for Hazard Vulnerability and Risk Assessment

**Requirement §201.6(c)(2):** The plan **shall** include a risk assessment that provides the factual basis for activities proposed in the strategy to reduce losses from identified hazards. Local risk assessments must provide sufficient information to enable the jurisdiction to identify and prioritize appropriate mitigation actions to reduce losses from identified hazards.

**Requirement §201.6(c)(2)(i):** [The risk assessment **shall** include a] description of the type...location and extent of all natural hazards that can affect the jurisdiction. The plan shall include information on previous occurrences of hazard events and on the probability of future hazard events.

**Requirement §201.6(c)(2)(ii):** [The risk assessment **shall** include a] description of the jurisdiction’s vulnerability to the hazards described in paragraph (c)(2)(i) of this section. This description shall include an overall summary of each hazard and its impact on the community.

**Requirement §201.6(c)(2)(ii):** [The risk assessment] **must** also address National Flood Insurance Program (NFIP) insured structures that have been repetitively damaged floods.

**Requirement §201.6(c)(2)(ii)(A):** The plan **should** describe vulnerability in terms of the types and numbers of existing and future buildings, infrastructure, and critical facilities located in the identified hazard area.
Requirement §201.6(c)(2)(ii)(B): [The plan should describe vulnerability in terms of an] estimate of the potential dollar losses to vulnerable structures identified in paragraph (c)(2)(ii)(A) of this section and a description of the methodology used to prepare the estimate..

Requirement §201.6(c)(2)(ii)(C): [The plan should describe vulnerability in terms of] providing a general description of land uses and development trends within the community so that mitigation options can be considered in future land use decisions.

Requirement §201.6(c)(2)(iii): For multi-jurisdictional plans, the risk assessment must assess each jurisdiction’s risks where they vary from the risks facing the entire planning area.

22.3 Hazard Identification and Risk Assessment

Overview of San Jose State University History of Hazards

Numerous federal agencies maintain a variety of records regarding losses associated with hazards. Unfortunately, no single source is considered to offer a definitive accounting of all losses. The Federal Emergency Management Agency (FEMA) maintains records on federal expenditures associated with declared major disasters. The US Army Corps of Engineers (USACE) and the Natural Resources Conservation Service (NRCS) collect data on losses during the course of some of their ongoing projects and studies. Additionally, the National Oceanic and Atmospheric Administration’s (NOAA) National Centers for Environmental Information (NCEI) database collects and maintains data about natural hazards in summary format. The data includes occurrences, dates, injuries, deaths, and estimated costs. Many of these databases and other data collection services, including the NCEI, have inherent data limitations when searching for information at a university scale.

The best available data and records were used throughout this assessment.

Hazard Identification

As part of the initial hazard identification process, the Campus Assessment Team considered potential hazards with the most chance to significantly affect the planning area. The hazards include those that have occurred in the past and may occur in the future. A variety of sources were used to develop the list of hazards considered including national, regional, and local sources such as emergency operations plans, FEMA’s How-To Series, websites, published documents, databases, and maps, as well as discussion among the Campus Assessment Team members.

In the initial phase of the planning process, the Campus Assessment Team considered 14 hazards and the risks they create for the University and its material assets, population, and operations. The hazards initially considered, and the determinations as to the treatment of those hazards, are shown in Table 22-1 (following).
Table 22-1: Hazard Identification Determinations

<table>
<thead>
<tr>
<th>Hazard</th>
<th>Determination (Yes/No)</th>
<th>Reason for Determination</th>
<th>Future Occurrence Probability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Communicable Disease</td>
<td>Yes</td>
<td>Hazard of concern to campus</td>
<td>Highly Likely</td>
</tr>
<tr>
<td>Dam and Levee Failure</td>
<td>Yes</td>
<td>Hazard of concern to campus</td>
<td>Unlikely</td>
</tr>
<tr>
<td>Drought</td>
<td>Yes</td>
<td>Hazard of concern to campus</td>
<td>Highly Likely</td>
</tr>
<tr>
<td>Earthquake</td>
<td>Yes</td>
<td>Hazard of concern to campus</td>
<td>Possible</td>
</tr>
<tr>
<td>Erosion</td>
<td>Yes</td>
<td>Hazard of concern to campus</td>
<td>Likely</td>
</tr>
<tr>
<td>Extreme Temperature</td>
<td>Yes</td>
<td>Hazard of concern to campus</td>
<td>Likely (Heat); Unlikely (Cold)</td>
</tr>
<tr>
<td>Flood</td>
<td>Yes</td>
<td>Hazard of concern to campus</td>
<td>Possible</td>
</tr>
<tr>
<td>Hazardous Materials</td>
<td>Yes</td>
<td>Hazard of concern to campus</td>
<td>Possible</td>
</tr>
<tr>
<td>Landslide</td>
<td>Yes</td>
<td>Hazard of concern to campus</td>
<td>Unlikely</td>
</tr>
<tr>
<td>Power Outage</td>
<td>Yes</td>
<td>Hazard of concern to campus</td>
<td>Likely</td>
</tr>
<tr>
<td>Sea Level Rise</td>
<td>No</td>
<td>Not a hazard of concern to campus</td>
<td>N/A</td>
</tr>
<tr>
<td>Tsunami</td>
<td>Yes</td>
<td>Not a hazard of concern to campus</td>
<td>Possible</td>
</tr>
<tr>
<td>Volcano</td>
<td>Yes</td>
<td>Hazard of concern to campus</td>
<td>Unlikely</td>
</tr>
<tr>
<td>Wildfire</td>
<td>Yes</td>
<td>Hazard of concern to campus</td>
<td>Unlikely (Fire); Possible (Smoke)</td>
</tr>
</tbody>
</table>

**Future Occurrence Probability**

In order to determine the probability of future occurrences of each hazard profiled, the following scale was developed:

- **Highly Likely** - 76%-100% that the hazard would occur annually.
- **Likely** - 50%-75% that the hazard would occur annually.
- **Possible** - 11%-49% that the hazard would occur each annually.
- **Unlikely** - 0%-10% that the hazard would occur each annually.
Communicable Disease

Description of the Hazard

Communicable diseases are illnesses that occur due to infectious agents or their toxic products and are infectious due to their potential of transmission from one person or species to another by a replicating agent.¹ They may be transmitted from a reservoir to a susceptible host either directly as from an infected person or animal or indirectly through the agency of an intermediate plant or animal host, vector, or the inanimate environment. Communicable diseases are clinically evident illness resulting from the presence of pathogenic microbial agents, including pathogenic viruses, pathogenic bacteria, fungi, protozoa, multi-cellular parasites, and aberrant proteins known as prions.² The degree of spread of a communicable disease depends on both the ability of an organism to enter, survive and multiply in the host and the comparative ease with which the disease is transmitted to other hosts.³

Some ways in which communicable diseases spread are by:

- Travel through the air, such as tuberculosis, measles, or COVID-19;
- Physical contact with an infected person, such as through touch (staphylococcus), sexual intercourse (gonorrhea, HIV), fecal/oral transmission (hepatitis A), or droplets (influenza, TB, COVID-19);
- Contact with a contaminated surface or object (Norwalk virus), food (salmonella, E. coli), blood (HIV, hepatitis B), or water (cholera); and
- Bites from insects or animals capable of transmitting the disease (mosquito: malaria and yellow fever; flea: plague)⁴

Collectively, the twenty-three (23) campuses and Chancellor’s Office of the California State University (CSU) system have identified nine (9) communicable disease hazards that have had significant impacts on their respective student, faculty, and staff populations. Of these communicable diseases, COVID-19 is considered to be the most prominent and widespread agent across all CSU campuses. (See Table 22-2 below.)

¹ California Legislative Information. Health and Safety Code – HSC. Print. Retrieved 03.22.2021 from: https://leginfo.legislature.ca.gov/faces/codes_displaySection.xhtml?lawCode=HSC&sectionNum=120290.&text=(2)%20%E2%80%9CInfectious%20or%20communicable,has%20significant%20public%20health%20implications


Table 22-2: Communicable Diseases Identified CSU Campuses

<table>
<thead>
<tr>
<th>Collective List of Communicable Diseases Identified by All CSU Campuses</th>
<th>Number of CSU Campuses (Including Chancellor’s Office) Identifying Communicable Disease Having Significant Impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>COVID-19 (SARS-CoV-2)</td>
<td>24</td>
</tr>
<tr>
<td>Meningitis</td>
<td>7</td>
</tr>
<tr>
<td>Measles</td>
<td>6</td>
</tr>
<tr>
<td>Influenza (Including H1N1/Swine Flu)</td>
<td>6</td>
</tr>
<tr>
<td>Tuberculosis</td>
<td>5</td>
</tr>
<tr>
<td>Norovirus</td>
<td>4</td>
</tr>
<tr>
<td>Mumps</td>
<td>2</td>
</tr>
<tr>
<td>E. Coli</td>
<td>2</td>
</tr>
<tr>
<td>Sexually Transmitted Diseases (STDs)</td>
<td>2</td>
</tr>
</tbody>
</table>

(Source: Interviews with CSU campus staff at CSU campuses and at CSU Chancellor’s Office.)

With the exception of COVID-19, there is variability among CSU campuses regarding which communicable diseases have had the greatest impact on individual campus communities. Table 22-3 shows the communicable disease hazards that have had the greatest impact on each CSU campus.

Table 22-3: Communicable Disease Hazards at CSU Campuses with Greatest Impact.

<table>
<thead>
<tr>
<th>CSU Campus</th>
<th>Identified Communicable Disease Hazards with the Greatest Impact on CSU Campus</th>
</tr>
</thead>
<tbody>
<tr>
<td>CSU Bakersfield</td>
<td>COVID-19, Meningitis</td>
</tr>
<tr>
<td>CSU Channel Islands</td>
<td>COVID-19, Measles</td>
</tr>
<tr>
<td>Chico State</td>
<td>COVID-19, Tuberculosis</td>
</tr>
<tr>
<td>CSU Dominguez Hills</td>
<td>COVID-19</td>
</tr>
<tr>
<td>Cal State East Bay</td>
<td>COVID-19, Meningitis</td>
</tr>
<tr>
<td>Fresno State</td>
<td>COVID-19, Meningitis, Tuberculosis</td>
</tr>
<tr>
<td>Cal State Fullerton</td>
<td>COVID-19, Influenza</td>
</tr>
<tr>
<td>Humboldt State</td>
<td>COVID-19, Measles, Norovirus, Influenza, STDs</td>
</tr>
<tr>
<td>Cal State Long Beach</td>
<td>COVID-19</td>
</tr>
</tbody>
</table>
Cal State LA | COVID-19, E. coli, Measles
Cal Maritime | COVID-19
CSU Monterey Bay | COVID-19
CSUN (Northridge) | COVID-19, Measles
Cal Poly Pomona | COVID-19, Influenza (Swine Flu - H1N1)
Sacramento State | COVID-19
Cal State San Bernardino | COVID-19, Tuberculosis
San Diego State | COVID-19, Meningitis, Mumps
San Francisco State | COVID-19
San José State | COVID-19, H1N1
Cal Poly San Luis Obispo | COVID-19, Meningitis, Norovirus
CSU San Marcos | COVID-19
Sonoma State | COVID-19, H1N1, Norovirus
Stanislaus State | COVID-19, Tuberculosis
Office of the Chancellor | COVID-19
CSU System-Wide | COVID-19, Meningitis, Measles, Tuberculosis, Influenza-Swine Flu-H1N1, Mumps, Norovirus, E. coli, STDs

(Source: Interviews with CSU campus staff at CSU campuses and at CSU Chancellor’s Office.)

Descriptions of Identified Communicable Disease Hazards at San José State

San José State University (SJSU) has identified two (2) communicable disease hazards that have had the greatest impact on campus – COVID-19 and H1N1 (Swine Flu). The following are brief descriptions of the communicable disease hazards at SJSU.

COVID-19 (SARS-CoV-2)

Coronaviruses are a family of viruses that can cause illnesses such as the common cold, severe acute respiratory syndrome (SARS) and Middle East respiratory syndrome (MERS). In 2019, a new coronavirus was identified as the cause of a disease outbreak that originated in China. This virus is now known as the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2). The disease it causes is called Coronavirus Disease 2019 (COVID-19). In March 2020, the World Health Organization (WHO) declared the COVID-19 outbreak a pandemic.
Signs and symptoms of coronavirus disease 2019 (i.e., COVID-19) may appear two to 14 days after exposure. Common signs and symptoms can include fever, cough, and tiredness. Early symptoms of COVID-19 may also include a loss of taste or smell.

The virus that causes COVID-19 spreads easily among people, and more continues to be discovered over time about how it spreads. Data has shown that the COVID-19 virus spreads mainly from person to person among those in close contact (within about 6 feet, or 2 meters). The virus is transmitted by respiratory droplets being released when someone with the virus coughs, sneezes, breathes, sings or talks. These droplets can be inhaled or land in the mouth, nose or eyes of a person nearby. In some situations, the COVID-19 virus can spread by a person being exposed to small droplets or aerosols that stay in the air for several minutes or hours (i.e., airborne transmission). It's not yet known how common it is for the virus to spread this way. The COVID-19 virus can also spread if a person touches a surface or object with the virus on it and then touches his or her mouth, nose or eyes; however, this is not considered to be a main way it spreads.

The severity of COVID-19 symptoms can range from very mild to severe. Some people may have only a few symptoms, and some people may have no symptoms at all. However, some people may experience worsened symptoms, such as worsened shortness of breath and pneumonia. People who are older have a higher risk of serious illness from COVID-19, and the risk increases with age. People who have existing medical conditions also may have a higher risk of serious illness from COVID-19. In some cases, the disease can cause severe medical complications and may even lead to death.  

**Influenza (Including sub-type H1N1/Swine Flu)**

Influenza is a viral infection that attacks the respiratory system (i.e., nose, throat, and lungs). Influenza viruses travel through the air in droplets when someone with the infection coughs, sneezes or talks. Influenza is transmitted either by inhaling virus-laden droplets directly, or by coming into physical contact with an object (e.g., telephone or computer keyboard) and then transferring the virus to the eyes, nose or mouth. People with the virus are likely contagious from about a day before symptoms appear until about five days after symptoms begin.

Common signs and symptoms of the flu include: fever, aching muscles, hills and sweats, headache, dry and persistent cough, shortness of breath, tiredness and weakness, runny or stuffy nose, sore throat, and eye pain. (Vomiting and diarrhea are also influenza signs and symptoms, but these are more common in children than in adults.)

Influenza viruses are constantly changing, with new strains appearing regularly. As a result, antibodies against influenza viruses that have been encountered in the past may

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not offer protection from new influenza strains, as the new strains can be very different viruses from previous strains.  

**H1N1 Flu (Swine Flu)**

The H1N1 flu, commonly known as swine flu, is a type of influenza A virus and is one of several flu viruses strains that can cause the seasonal flu. It is primarily caused by the H1N1 strain of the flu (influenza) virus. Symptoms of the H1N1 flu are the same as those of the seasonal flu.

The H1N1 virus is a combination of viruses from pigs, birds and humans that causes disease in humans. The virus enters your body when you inhale contaminated droplets or transfer live virus from a contaminated surface to your eyes, nose or mouth. It then infects the cells that line your nose, throat and lungs.

**Location of the Hazard**

Communicable diseases have the potential to affect the entire San José State University (SJSU) planning area equally. As a result, the communicable disease hazard can be found at the SJSU campus located in San Jose, CA (Santa Clara County), and at the SJSU Moss Landing Marine Laboratories (MLML) located at Moss Landing, CA (Monterey County). The communicable disease hazard can also be found at the Hammer Theatre, a performing arts venue located in Downtown San Jose and operated by SJSU. Because of the ubiquitous nature of many communicable diseases, SJSU and MLML students, faculty, staff, and visitors, as well as Hammer Theatre patrons, are at risk of exposure to the communicable disease hazard.

**CSU Student Housing Locations and Populations**

Although CSU-campus-owned student housing opportunities have been severely limited due to the COVID-19 pandemic, this situation is temporary. Eventually, students will be allowed back on campus at full capacity, and many of these students will be living in campus-owned housing. When this occurs, over 53,000 students (i.e., just over 11% of the CSU total enrollment) will be at increased risk of exposure to communicable disease hazards, owing to the “close-quarters” living arrangements in student housing. For SJSU, approximately 13% of its 33,282 enrolled students (or 4,327 students) reside in student housing.

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Extent of the Hazard

Various communicable diseases are categorized by the Center for Disease Control and Prevention (CDC) by levels of containment called Biosafety Levels (or BSLs). The higher the BSL, the greater the level of containment and level of effort necessary to prevent transmission of the disease, and therefore the greater the hazard. Biosafety Levels prescribe procedures and levels of containment for a particular microorganism or material (including research involving recombinant or synthetic nucleic acid molecules) and procedures associated with that containment. BSLs also consider primary barriers (e.g., biosafety cabinets), secondary barriers, facility design, air handling, laboratory security, etc. BSLs are graded from 1 to 4; as the BSL increases so does the relative risk of the agent/procedures as well the stringency of procedures and facility design.

Figure 22-1 describes the different BSLs, and provides examples of communicable diseases that would typically fall in to these classifications, as well as the typical protections that would be necessary to prevent transmission of each of the diseases.

Figure 22-1: Biosafety Levels (BSLs)\textsuperscript{10}

The Extent of San Jose State University (SJSU) Communicable Disease Hazards Except COVID-19:

Before the COVID-19 pandemic, there were cases of Influenza - H1N1 strain at SJSU. Influenza - H1N1 strain would be classified at the BSL-3 containment level.  

The Extent of San Jose State University (SJSU) COVID-19 Communicable Disease Hazard:

As a microorganism, the SARS-CoV-2 (COVID-19) virus requires a high level of containment. It is therefore classified at BSL-3.  

History of the Hazard

Over an approximately one-year period, from mid-March, 2020 to March 23, 2021, there were a reported 208 cases of COVID-19 at SJSU. Most communicable disease data are maintained by at the state and at the county levels and are not generally available at the municipal or campus levels, unless (a) the CSU campus falls under the jurisdiction of a city-level health department, or (b) a geographically specific outbreak occurs on campus or in the local community. The exception to this is the current COVID-19 pandemic, where both campus and County-level case data have been collected. As a result, it is important to provide COVID-19 case statistics for both CSU campuses and the counties where CSU campus assets are located.

Tables 22-5, 22-6, and 22-7 show campus-level and County-level COVID-19 Case data for San José State (SJSU). These case data are updated on at least a weekly basis. (Please note that the COVID-19 case numbers here may not reflect the most recent updates.)

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Table 22-4: Cumulative Confirmed Cases at SJSU (from March, 2020 through 03/22/2021)\textsuperscript{13}

<table>
<thead>
<tr>
<th>Population</th>
<th>Case Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>Students living on campus</td>
<td>40</td>
</tr>
<tr>
<td>Students living off campus, taking on campus class or activity</td>
<td>43</td>
</tr>
<tr>
<td>Faculty on campus</td>
<td>3</td>
</tr>
<tr>
<td>Staff on campus</td>
<td>17</td>
</tr>
<tr>
<td>Other off campus</td>
<td>105</td>
</tr>
<tr>
<td><strong>Grand Total</strong></td>
<td><strong>208</strong></td>
</tr>
</tbody>
</table>

(Note: Cumulative confirmed cases include an individual’s on-campus status at the time of the confirmed case.)

Table 22-5: Santa Clara County COVID-19 Statistics (as of 07/22/2021): \textsuperscript{14}

<table>
<thead>
<tr>
<th>Cases</th>
<th>113,641</th>
</tr>
</thead>
<tbody>
<tr>
<td>Deaths</td>
<td>1,706</td>
</tr>
</tbody>
</table>

Table 22-7: Monterey County COVID-19 Statistics (as of 03/15/2021): \textsuperscript{15}

<table>
<thead>
<tr>
<th>Cases</th>
<th>42,734</th>
</tr>
</thead>
<tbody>
<tr>
<td>Deaths</td>
<td>337</td>
</tr>
</tbody>
</table>

Potential Impacts of the Hazard

Communicable disease outbreaks and pandemics potentially have (and will continue to have) direct impact on life, health, and safety across the CSU system (including the SJSU campus). The extent of this impact is contingent on the type of infection or contagion, the severity of the outbreak, and the speed at which it is transmitted. Property and infrastructure integrity may be affected if large portions of the campus population


contract communicable diseases at the same time and are therefore unable to perform maintenance, operations, and educational tasks. This would be particularly disruptive if those impacted are first responders or other essential personnel. Long-term outbreaks affecting large numbers of SJSU students could result in cancelled classes, delayed matriculation, or other disruptions to the CSU System’s mission. This has already occurred with the current COVID-19 pandemic and could occur again with more virulent strains of communicable diseases, including COVID-19.

Communicable disease hazards found across the CSU system (including SJSU) vary both by level of containment (BSL) (described previously) and by level of individual/public health risk, or Risk Group (RG) level. While BSLs describe the procedures and required levels of containment in a laboratory setting, Risk Groups (RGs) reflect the potential effects of disease exposure on humans or animals. Like BSLs, RGs range from Level 1 (RG1) to Level 4 (RG4), with Level 1 (RG1) posing minimal risk to healthy individuals and public health and Level 4 (RG4) posing a very serious or extreme risks to individuals and public. BSLs generally correlate with Risk Group (RG) Levels (e.g., a RG2 agent is worked with at BSL-2), but there are exceptions (e.g., production volumes, high-risk procedures, etc.).

The World Health Organization’s (WHO) Laboratory Biosafety Manual, 3rd ed., NIH Guidelines, categorizes Risk Groups (RGs) in the following way:

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Table 22-6: WHO Risk Group Categorization\(^{17}\)

<table>
<thead>
<tr>
<th>Risk Group (RG)</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>RG1</td>
<td>Rarely associated with disease in healthy adult humans or animals and pose no-to-little public health risk (e.g., Saccharomyces cerevisiae, E. coli K-12 strain derivatives often used for recombinant/molecular biology, many environmental organisms)</td>
</tr>
<tr>
<td>RG2</td>
<td>Associated with mild to moderate disease for which preventative measures or post exposure treatments are often available; public health impact is limited (e.g., Streptococcus pyogenes, Salmonella, hepatitis B virus)</td>
</tr>
<tr>
<td>RG3</td>
<td>Associated with serious to lethal human disease for which preventative vaccines or post-exposure therapies may be scarce. Public health impact is limited-to-moderate (e.g., Mycobacterium tuberculosis, hantaviruses, West Nile virus, SARS)</td>
</tr>
<tr>
<td>RG4</td>
<td>Associated with serious to lethal human disease for which preventative vaccines or post exposure therapies are not usually available. Public health impact is high (e.g., Ebola virus, Marburg virus, smallpox virus, etc.)</td>
</tr>
</tbody>
</table>

Table 22-8 describes the four (4) Risk Group Levels (RGs), and provides examples of communicable diseases that would typically fall in to these classifications, and the typical protections that would be necessary to prevent transmission of the disease. It is important to note that all but two (2) communicable disease hazards identified by CSU campuses fall under either the lower-risk RG1 or RG2 categories. COVID-19 and tuberculosis are the two (2) communicable diseases fall under the higher-risk RG3 category. However, with the advent of the recently-developed COVID-19 vaccine, and with the expectation of an increasingly robust vaccine supply, it is possible that the RG level for COVID-19 could be lowered in the future, thereby reducing both the extent and the potential impact of COVID-19.

Table 22-7: Risk Group Levels (RGs) with Example Diseases and Recommended Precautions

<table>
<thead>
<tr>
<th>Level</th>
<th>Examples</th>
<th>Typical Protection to Prevent Transmission</th>
</tr>
</thead>
<tbody>
<tr>
<td>RG 1</td>
<td>E. Coli</td>
<td>Precautions are minimal, most likely involving gloves and some sort of facial protection. Usually, contaminated materials are left in open (but separately indicated) waste receptacles. Decontamination procedures for this level are similar in most respects to modern precautions against everyday viruses (i.e.: washing one's hands with anti-bacterial soap, washing all exposed surfaces of the lab with disinfectants, etc.).</td>
</tr>
<tr>
<td>RG 2</td>
<td>Chicken Pox, Hepatitis A, B, C, Lyme disease, Salmonella, Mumps, Measles, Malaria, Scrapie, Dengue Fever, HIV</td>
<td>These bacteria and viruses cause mild disease in humans or are difficult to contract via aerosol. Routine diagnostic work with clinical specimens can be done safely at BSL-2, using BSL-2 practices and procedures.</td>
</tr>
</tbody>
</table>

---

| RG 3 | Anthrax  
West Nile Virus  
SARS Virus (Including COVID-19)  
Tuberculosis  
Typhus  
Yellow Fever  
Hantaviruses  
Avian Flu |
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>These bacteria and viruses cause severe to fatal disease in human, but vaccines or other treatments do exist to combat them. Laboratory personnel have specific training in handling pathogenic and potentially lethal agents and are supervised by competent scientists who are experienced in working with these agents. This is considered a neutral or warm zone.</td>
<td></td>
</tr>
</tbody>
</table>
| RG 4 | H5N1 (Bird Flu)  
Dengue Hemorrhagic Fever  
Marburg Virus  
Ebola Virus  
Smallpox  
Lassa Fever  
Crimean-Congo Hemorrhagic Fever  
Other Hemorrhagic Diseases |
| These viruses and bacteria cause severe to fatal disease in humans, for which vaccines or other treatments are not available. When dealing with biological hazards at this level the use of a Hazmat suit and a self-contained oxygen supply is mandatory. The entrance and exit of a BSL-4 lab will contain multiple showers, a vacuum room, an ultraviolet light room, autonomous detection system, and other safety precautions designed to destroy all traces of the biohazard. Multiple airlocks are employed and are electronically secured to prevent both doors opening at the same time. All air and water service going to and coming from a BSL-4 lab will undergo similar decontamination procedures to eliminate the possibility of an accidental release. |

**Probability of Future Occurrence of the Hazard**

There are significant data limitations regarding non-COVID-19 communicable disease cases, as the information thereof is outdated, anecdotal, and/or inadequate. As a result, it is not feasible to provide quantitative probabilities of future occurrence for non-COVID-19 communicable disease hazards. However, based on the limited data, it is feasible to present qualitative probabilities of future occurrence based on ranges of communicable disease frequency.
Table 22-9 shows a probability scale of future occurrence for the nine (9) communicable disease hazards profiled in this assessment. This scale is divided into four (4) levels of probability:

Table 22-8: Likelihood of Future Hazard Occurrence

<table>
<thead>
<tr>
<th>Likelihood</th>
<th>Parameters for Determining Likelihood</th>
</tr>
</thead>
<tbody>
<tr>
<td>Highly Likely</td>
<td>76 – 100% probability that hazard will occur annually (high to very high frequency)</td>
</tr>
<tr>
<td>Likely</td>
<td>50 – 75% probability that hazard will occur annually (moderate to high frequency)</td>
</tr>
<tr>
<td>Possible</td>
<td>11 – 49% probability that hazard will occur annually (low to moderate frequency)</td>
</tr>
<tr>
<td>Unlikely</td>
<td>0 – 10% probability that hazard will occur annually (very low to low frequency)</td>
</tr>
</tbody>
</table>

Due to significant data limitations surrounding non-COVID communicable diseases, the probability of future occurrence of CSU-system-wide communicable disease is measured by the proportion of campuses that have identified a particular communicable disease as having an impact on the campus community. In this measure, the more frequent a communicable disease is seen as impactful CSU-wide, the greater the probability of future occurrence.

Note: Each communicable disease’s system-wide probability ranking reflects the ranking at the individual CSU campus level unless noted otherwise.

Table 22-9: Probability of Future Occurrence of Communicable Disease Hazard for CSU Systems

<table>
<thead>
<tr>
<th>Collective List of Communicable Diseases Identified by All CSU Campuses</th>
<th>Number of CSU Campuses (Including Chancellor’s Office) Identifying Communicable Disease Having Significant Impact</th>
<th>Proportion of CSU Campuses Identifying Communicable Disease as Having Significant Impact System-Wide</th>
<th>CSU System-Wide Probability Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>COVID-19 (SARS-CoV-2)</td>
<td>24</td>
<td>1.00</td>
<td>Highly Likely</td>
</tr>
<tr>
<td>Meningitis</td>
<td>7</td>
<td>0.29</td>
<td>Possible</td>
</tr>
<tr>
<td>Measles</td>
<td>6</td>
<td>0.25</td>
<td>Possible</td>
</tr>
</tbody>
</table>
Influenza (Including H1N1/Swine Flu) | 6 | 0.25 | Possible
---|---|---|---
Tuberculosis | 5 | 0.21 | Possible
Norovirus | 4 | 0.17 | Possible
Mumps | 2 | 0.08 | Unlikely
E. Coli | 2 | 0.08 | Unlikely
Sexually Transmitted Diseases (STDs) | 2 | 0.08 | Unlikely

(Source: Interviews with staff at CSU campuses and at the CSU Chancellor’s Office.)

**Vulnerability to the Hazard**

Vulnerability to a communicable diseases hazard resides in the population of a given area – both human and animal – not in the infrastructure or physical assets. While CSU assets and infrastructure could be impacted indirectly by the communicable disease hazard, these impacts would be secondary to the impact that the communicable disease hazard would have on students, faculty, staff, and visitors at CSU campuses. CSU campus settings are geographically diverse, with locations ranging from small towns to medium-sized cities to densely populated urban areas. Hundreds of thousands of people work, study, and/or pass through CSU campuses on any given day. (As of Fall 2019, San Jose State had 33,282 students and additional faculty and staff.) Each of these persons is vulnerable to communicable disease, particularly if it is a pathogen that individual has not been immunized against, or for which no immunization exists. Prolonged outbreaks could result in a loss of services, failure of infrastructure (from lack of operators or maintenance), and closure of facilities. This exact scenario has played out in the current COVID-19 pandemic at SJSU.

**Estimate of Potential Losses**

**COVID-19 Pandemic Health Impact on CSU Campuses and Surrounding Communities**

The most prescient metric for estimating losses from COVID-19 is loss of life. The nationwide campus-related COVID-19 death rate of 0.02% remains well below the average COVID-19 death rate in the U.S. However, due to data limitations, there is no information on CSU-campus-specific deaths by COVID-19 or by any other communicable diseases. In

19 The California State University. Enrollment. Retrieved 05.03.2021 from: https://www2.calstate.edu/csu-system/about-the-csu/facts-about-the-csu/enrollment/Pages/default.aspx

20 The California State University. Employee Head Count by Campus. Retrieved 05.03.2021 from: https://www2.calstate.edu/csu-system/faculty-staff/employee-profile/csu-workforce/Pages/employee-headcount-by-campus.aspx
fact, COVID-19 is the only communicable disease for which case reports have been readily available for CSU campuses.

At some point in the future, CSU campuses will return to full capacity. Without adequate surveillance regarding campus access and student and employee interaction, CSU campuses (including SJSU) are at risk of developing an extreme incidence of COVID-19, and may become “super-spreaders” for adjacent communities.\(^\text{21}\) The emergence of more virulent COVID-19 variants would only add to the potential for high negative impacts on life safety, operations, and service delivery across the CSU system. (Other communicable diseases would also re-emerge, but with low to moderate negative impacts on life safety, operations, and service delivery.)

**Economic Impact of COVID-19 Pandemic on CSU Financial Health**

During the first few months of the COVID-19 pandemic in 2020, the CSU system suffered tremendous negative fiscal impacts. From March through July of 2020 alone, over $146 million worth of revenue losses were sustained across the CSU system due to refunds to students for parking, housing and dining service fees during Spring Semester, 2020. (See Table 22-11 below for the economic impact to the SJSU campus). Several CSU campuses saw refund losses surpass $10 million. (See Table 22-12.)

Table 22-10: CSU COVID-19 Cost Tracking Showing Revenue Refund Losses and Increased Costs\(^\text{22}\)

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Mitigative Relief from Federal Assistance

The $1.5 billion in total federal assistance sent to the CSU system will help relieve the losses of revenues from services like dorms, parking and dining services during a year of mainly empty campuses. (See Table 22-12.) However, because of staggering COVID-related revenue losses, the CSU system is planning for three (3) years of fiscal duress.

Table 22-11: Total Federal Assistance to CSU for COVID-19-Related Losses, 2020-2021

<table>
<thead>
<tr>
<th>Institution</th>
<th>December 2020 Stimulus</th>
<th>CARES Act</th>
<th>APLU Projection of HEERF Total</th>
<th>ARP Act</th>
<th>Total Estimated Federal COVID Relief Funding</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>


<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>California Polytechnic State University</td>
<td>$20,752,799</td>
<td>$14,725,000</td>
<td>$37,000,928</td>
<td>$72,478,727</td>
</tr>
<tr>
<td>California State Polytechnic University, Pomona</td>
<td>$48,614,353</td>
<td>$31,102,000</td>
<td>$86,044,649</td>
<td>$165,761,002</td>
</tr>
<tr>
<td>California State University Channel Islands</td>
<td>$14,288,099</td>
<td>$8,512,000</td>
<td>$24,915,170</td>
<td>$47,715,269</td>
</tr>
<tr>
<td>California State University Maritime Academy</td>
<td>$1,381,700</td>
<td>$1,204,000</td>
<td>$2,472,622</td>
<td>$5,058,322</td>
</tr>
<tr>
<td>California State University - Sacramento</td>
<td>$59,891,260</td>
<td>$35,643,000</td>
<td>$104,900,133</td>
<td>$200,434,393</td>
</tr>
<tr>
<td>California State University, Bakersfield</td>
<td>$22,855,632</td>
<td>$12,483,000</td>
<td>$40,285,565</td>
<td>$75,624,197</td>
</tr>
<tr>
<td>California State University, Chico</td>
<td>$31,603,856</td>
<td>$20,019,000</td>
<td>$55,754,538</td>
<td>$107,377,394</td>
</tr>
<tr>
<td>California State University, Dominguez Hills</td>
<td>$31,843,563</td>
<td>$18,312,000</td>
<td>$55,915,410</td>
<td>$106,070,973</td>
</tr>
<tr>
<td>California State University, East Bay</td>
<td>$24,243,652</td>
<td>$14,394,000</td>
<td>$42,929,208</td>
<td>$81,566,860</td>
</tr>
<tr>
<td>California State University, Fresno</td>
<td>$52,725,317</td>
<td>$32,557,000</td>
<td>$92,926,594</td>
<td>$178,208,911</td>
</tr>
<tr>
<td>California State University, Fullerton</td>
<td>$67,736,949</td>
<td>$41,088,000</td>
<td>$120,859,884</td>
<td>$229,684,833</td>
</tr>
<tr>
<td>California State University, Long Beach</td>
<td>$67,421,424</td>
<td>$41,202,000</td>
<td>$119,508,329</td>
<td>$228,131,753</td>
</tr>
<tr>
<td>Campus</td>
<td>Enrolled Students</td>
<td>Research Funding</td>
<td>Total Funding</td>
<td>Total Endowment</td>
</tr>
<tr>
<td>------------------------------------------</td>
<td>-------------------</td>
<td>------------------</td>
<td>---------------</td>
<td>-----------------</td>
</tr>
<tr>
<td>California State University, Los Angeles</td>
<td>$61,905,561</td>
<td>$40,067,000</td>
<td>$108,543,672</td>
<td>$210,516,233</td>
</tr>
<tr>
<td>California State University, Monterey Bay</td>
<td>$13,455,716</td>
<td>$8,705,000</td>
<td>$23,922,768</td>
<td>$46,083,484</td>
</tr>
<tr>
<td>California State University, Northridge</td>
<td>$74,004,088</td>
<td>$47,458,000</td>
<td>$131,021,450</td>
<td>$252,483,538</td>
</tr>
<tr>
<td>California State University, San Bernardino</td>
<td>$42,438,131</td>
<td>$27,924,000</td>
<td>$74,982,459</td>
<td>$145,344,590</td>
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<tr>
<td>California State University, San Marcos</td>
<td>$26,602,684</td>
<td>$15,542,000</td>
<td>$46,496,808</td>
<td>$88,641,492</td>
</tr>
<tr>
<td>California State University, Stanislaus</td>
<td>$22,007,207</td>
<td>$12,928,000</td>
<td>$38,636,391</td>
<td>$73,571,598</td>
</tr>
<tr>
<td>Humboldt State University</td>
<td>$16,130,016</td>
<td>$11,146,000</td>
<td>$28,831,619</td>
<td>$56,107,635</td>
</tr>
<tr>
<td>San Diego State University</td>
<td>$45,914,127</td>
<td>$30,394,000</td>
<td>$80,592,385</td>
<td>$156,900,512</td>
</tr>
<tr>
<td>San Francisco State University</td>
<td>$47,404,409</td>
<td>$30,000,000</td>
<td>$83,075,470</td>
<td>$160,479,879</td>
</tr>
<tr>
<td><strong>San Jose State University</strong></td>
<td><strong>$46,631,939</strong></td>
<td><strong>$30,977,000</strong></td>
<td><strong>$82,976,130</strong></td>
<td><strong>$160,585,069</strong></td>
</tr>
<tr>
<td>Sonoma State University</td>
<td>$13,980,795</td>
<td>$9,153,000</td>
<td>$24,732,994</td>
<td>$47,866,789</td>
</tr>
<tr>
<td>CSU System-Wide Totals</td>
<td>$853,833,277</td>
<td>$535,535,000</td>
<td>$1,507,325,177</td>
<td>$2,896,693,454</td>
</tr>
</tbody>
</table>

**Vulnerability Assessment Conclusions**

Before the COVID-19 pandemic, populations at all CSU campuses and CSU-affiliated facilities were substantial. Collectively, as of Fall 2019, CSU campuses had 480,541 students and 53,763 faculty and staff. All were at risk from the communicable disease events, with 534,304 people being directly vulnerable. The COVID-19 pandemic has caused campus population numbers to plummet to a small fraction of full capacity.

At some point in the future, campus population numbers will return to their pre-pandemic levels, and students, faculty, and staff will again be vulnerable to the communicable
disease hazard. If just 10% of the total CSU population were to become ill with a highly infective communicable disease like influenza or another strain of SARS, this would mean that approximately 53,430 people would be sick at the same time. This scenario would likely overwhelm available on-campus medical services could even overwhelm portions of the larger community’s medical resources – especially if there were large numbers of infected people with immune system compromises or other underlying health problems.

See Table 22-13 below for the “10% outbreak scenario” projections for the SJSU campus and for the entire CSU system.

Table 22-12: Scenario of Communicable Disease Hazard Affecting 10% of the CSU Population

<table>
<thead>
<tr>
<th>CSU Campus</th>
<th>Approximate Enrollment Population (Fall 2019)</th>
<th>Approximate Total FT/PT Faculty/Staff Population (Fall 2019)</th>
<th>Total Combined Approximate Student and Faculty/Staff Population</th>
<th>10% Outbreak Scenario (Students and Faculty/Staff Combined)</th>
</tr>
</thead>
<tbody>
<tr>
<td>CSU Bakersfield</td>
<td>11,199</td>
<td>1,277</td>
<td>12,476</td>
<td>1,248</td>
</tr>
<tr>
<td>CSU Channel Islands</td>
<td>7,093</td>
<td>994</td>
<td>8,087</td>
<td>809</td>
</tr>
<tr>
<td>Chico State</td>
<td>17,019</td>
<td>1,969</td>
<td>18,988</td>
<td>1,899</td>
</tr>
<tr>
<td>CSU Dominguez Hills</td>
<td>17,027</td>
<td>1,761</td>
<td>18,788</td>
<td>1,879</td>
</tr>
<tr>
<td>Cal State East Bay</td>
<td>14,705</td>
<td>1,764</td>
<td>16,469</td>
<td>1,647</td>
</tr>
<tr>
<td>Fresno State</td>
<td>24,139</td>
<td>2,534</td>
<td>26,673</td>
<td>2,667</td>
</tr>
<tr>
<td>Cal State Fullerton</td>
<td>39,868</td>
<td>3,736</td>
<td>43,604</td>
<td>4,360</td>
</tr>
<tr>
<td>Humboldt State</td>
<td>6,983</td>
<td>1,171</td>
<td>8,154</td>
<td>815</td>
</tr>
<tr>
<td>Cal State Long Beach</td>
<td>38,074</td>
<td>4,004</td>
<td>42,078</td>
<td>4,208</td>
</tr>
<tr>
<td>Cal State LA</td>
<td>26,361</td>
<td>2,821</td>
<td>29,182</td>
<td>2,918</td>
</tr>
<tr>
<td>Cal Maritime</td>
<td>911</td>
<td>329</td>
<td>1,240</td>
<td>124</td>
</tr>
<tr>
<td>CSU Monterey Bay</td>
<td>7,123</td>
<td>1,059</td>
<td>8,182</td>
<td>818</td>
</tr>
</tbody>
</table>


<table>
<thead>
<tr>
<th>Institution</th>
<th>Enrollment</th>
<th>International Programs</th>
<th>Total Enrollment</th>
<th>CSU System-Wide</th>
</tr>
</thead>
<tbody>
<tr>
<td>CSUN (Northridge)</td>
<td>38,391</td>
<td>3,832</td>
<td>42,223</td>
<td>4,222</td>
</tr>
<tr>
<td>Cal Poly Pomona</td>
<td>27,914</td>
<td>2,650</td>
<td>30,564</td>
<td>3,056</td>
</tr>
<tr>
<td>Sacramento State</td>
<td>31,156</td>
<td>3,228</td>
<td>34,384</td>
<td>3,438</td>
</tr>
<tr>
<td>Cal State San Bernardino</td>
<td>20,311</td>
<td>2,118</td>
<td>22,429</td>
<td>2,243</td>
</tr>
<tr>
<td>San Diego State</td>
<td>35,081</td>
<td>3,702</td>
<td>38,783</td>
<td>3,878</td>
</tr>
<tr>
<td>San Francisco State</td>
<td>28,880</td>
<td>3,401</td>
<td>32,281</td>
<td>3,228</td>
</tr>
<tr>
<td>San José State</td>
<td>33,282</td>
<td>3,568</td>
<td>36,850</td>
<td>3,685</td>
</tr>
<tr>
<td>Cal Poly San Luis Obispo</td>
<td>21,242</td>
<td>2,871</td>
<td>24,113</td>
<td>2,411</td>
</tr>
<tr>
<td>CSU San Marcos</td>
<td>14,519</td>
<td>1,687</td>
<td>16,206</td>
<td>1,621</td>
</tr>
<tr>
<td>Sonoma State</td>
<td>8,649</td>
<td>1,338</td>
<td>9,987</td>
<td>999</td>
</tr>
<tr>
<td>Stanislaus State</td>
<td>10,614</td>
<td>1,276</td>
<td>11,890</td>
<td>1,189</td>
</tr>
<tr>
<td>Office of the Chancellor</td>
<td>0</td>
<td>673</td>
<td>673</td>
<td>67</td>
</tr>
<tr>
<td><strong>CSU System-Wide</strong></td>
<td><strong>480,541</strong></td>
<td><strong>53,763</strong></td>
<td><strong>534,304</strong></td>
<td><strong>53,430</strong></td>
</tr>
</tbody>
</table>

Note: Enrollment figures do not include non-specific CSU campus International Programs (455 students) or CALStateTEACH Program (933 students).

While the case numbers of COVID-19 have been significantly lower (about 1% of the total CSU population) than those in the 10% scenario, the degree of virulence and resultant morbidity and mortality caused by COVID-19 have led to widespread campus shutdowns, educational disruption, and economic harm to the CSU system (including SJSU). In short, the real-time COVID-19 communicable disease outbreak scenario has proven far more devastating than the 10% simulated scenario.

**Identified Data Limitations**

There is a wealth of technical information available for communicable disease. However, there is also limited non-COVID-19 communicable disease data available regarding risk or vulnerability of specific populations throughout the CSU. Much of the data that does exist is protected by privacy policies, and therefore cannot be obtained for more specific populations. As a result, performing a detailed quantitative assessment for this hazard is difficult.

Data that could be collected prior to the next update in order to improve this methodology includes:

- Data regarding infection rates at the campus level and for specific populations;
- Data regarding communicable disease case numbers and outcomes, by CSU campus;
- Data regarding projected population changes;
- Data regarding absenteeism; and
- Data regarding increased operating costs as a result of absenteeism (i.e., temporary shifting of duties resulting in business interruption).
**Dam and Levee Failure**

Description of the Hazard

A dam failure represents the structural collapse of a dam that stores water in a reservoir behind the dam. These failures are typically the result of structural age, damage to the structure caused by earthquake or flooding, inadequate discharge or spillway capacity, inadequate maintenance, improper construction materials, or extreme inflow of water into the reservoir. Prolonged precipitation may result in overtopping of the dam resulting in structural compromise. The tremendous energy generated by a sudden breach of the dam will have significant downstream effects. Flood damage resulting from dam failures potentially will result in economic losses, environmental damage, destruction of agriculture, and human casualties. This type of incident is extremely dangerous as it can occur rapidly, with no warning resulting in an inability to effectively evacuate threatened communities.

A levee failure is similar to dam failures as the result will be a breach causing flooding on the dry side of the levee. Levees are embankments whose primary purpose is to furnish flood protection from seasonal high water or divert the flow of water. Most levees in California are intended to withstand peak water levels generated by heavy precipitation or rapid snowmelt in a watershed. Other levees are designed to withstand fluctuating water levels on a continuous basis such as those in the California Delta exposed to tidal influences. Levees routinely extend for lengthy distances immediately protecting communities. Levees can be found throughout the state but are most prominent in the Sacramento and San Joaquin Valleys.

Levee failures can vary from overtoppings to small uncontrolled discharge to catastrophic failure. Areas downstream of the failure will be subject to inundation dependent on the volume of water released. These levee failures are also typically the result of structural age, damage to the structure caused by earthquake or flooding, slumping, seepage underneath the levee, high velocity flows eroding the levee, inadequate capacity, inadequate maintenance, improper construction materials, or extreme inflow of water into the system. Flood damage resulting from levee failures potentially will result in economic losses, environmental damage, destruction of agriculture, and human casualties.

A Dam or levee failure flooding will vary depending on a number of factors including the extent of the collapse or breach, the volume of water behind the structure, and the nature of the exposed downstream features. This unpredictable flooding presents a threat to life and property in addition to critical infrastructure. Lifelines and supply routes will likely be damaged or made impassible by flood erosion or standing water. Water quality and health concerns would likely be cascading effects of dam or levee failures.

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Location of the Hazard

Santa Clara County is home to a variety of flood control facilities and levee systems. The dam facilities are mostly along the base of the various mountains and hills throughout the county. Levees have been constructed along the San Francisco Bay and flood control channels providing community protection. The San Jose State University campus is in proximity to multiple small dams upstream to the south and east of the city. The campus is in proximity to rivers or flood control channels lined with levees.

Figure 22-2: Dams and Levees located near San Jose State University

There are a number of dam facilities in the Santa Cruz Mountains and Diablo Range. The larger facilities include the Leroy Anderson Dam and Coyote Dam located in Santa Clara County on the Coyote Creek. Anderson Lake is a reservoir with the potential holding capacity of 89,073-acre feet of water when full. The San Jose State University campus lies within the dam inundation zones for the Anderson Dam facility in addition to major transportation routes south of the campus are included. The James J Lenihan Dam inundation zone and the Calero Dam inundation zone extend in proximity to the campus.
reaching downtown San Jose but stay west of the campus. The Coyote Dam inundation zone extends along the Coyote Creek east of the campus. All of the above inundation zones affect transportation routes and other critical infrastructure in San Jose affecting access and support services to the campus.

Figure 22-3: Leroy Anderson Dam Breach Inundation Map

29 California Department of Water Resources, Dam Breach Inundation Map Publisher, https://fmds.water.ca.gov/webgis/?appid=dam_prototype_v2
Figure 22-4: James J Lenihan Dam Breach Inundation Map

California Department of Water Resources, Dam Breach Inundation Map Publisher, https://fmds.water.ca.gov/webgis/?appid=dam_prototype_v2
The Coyote Creek drains Anderson Lake and portions of the Diablo Range north towards the San Francisco Bay. A number of creeks and flood control systems feed into Coyote Creek throughout San Jose. The length of Coyote Creek from Anderson Lake to the outlet into the San Francisco Bay is a natural creek channel. The channel is located almost ½ mile east of the San Jose State University campus, is separated from the campus by a densely populated residential neighborhood.

The Guadalupe River is a natural creek channel ¾ mile west of the campus that drains much of the northern face of the Santa Cruz Mountains. The channel feeds into the San Francisco Bay after extending along the west side of downtown San Jose and the San Jose International Airport. The San Jose State University campus is separated from the Guadalupe River by downtown San Jose and the densely developed urban core. The river is not lined with levees and the campus is not within a levee protected zone.

31 California Department of Water Resources, Dam Breach Inundation Map Publisher, https://fmds.water.ca.gov/webgis/?appid=dam_prototype_v2
Dams are classified according to the hazard that they pose to life and property in the event of failure, rather than the likelihood of that failure.

- **High hazard potential dams** may result in loss of human life, and will likely result in economic, environmental, or lifeline losses.
- **Significant hazard potential dams** are not expected to result in loss of life, but are expected to cause economic, environmental, and lifeline losses.
- **Low hazard potential dams** are not expected to result in loss of life, and there is a low expectation of economic, environmental, or lifeline losses. What losses do occur are generally limited to the dam owner.

Dams classified as high hazard are required to have Emergency Action Plans (EAP). EAPS are formal documents that identify potential emergency conditions at the dam and specify preplanned actions to be followed in case of failure. An EAP is required for all high hazard dams and is recommended for all significant hazard dams.

Table 22-13: Santa Clara County Dams in Proximity to San Jose State University

<table>
<thead>
<tr>
<th>River</th>
<th>Dam</th>
<th>Storage</th>
<th>Hazard Severity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alamitos</td>
<td>Almaden</td>
<td>2,000af</td>
<td>High Hazard</td>
</tr>
<tr>
<td>Calero</td>
<td>Calero</td>
<td>9,850af</td>
<td>High Hazard</td>
</tr>
<tr>
<td>Penitencia</td>
<td>Cherry Flat</td>
<td>500af</td>
<td>High Hazard</td>
</tr>
<tr>
<td>Coyote</td>
<td>Coyote</td>
<td>23,666af</td>
<td>High Hazard</td>
</tr>
<tr>
<td>Guadalupe</td>
<td>Guadalupe</td>
<td>3,460af</td>
<td>High Hazard</td>
</tr>
<tr>
<td>Los Gatos</td>
<td>James J Lenihan</td>
<td>21,430af</td>
<td>High Hazard</td>
</tr>
<tr>
<td>Coyote</td>
<td>Leroy Anderson</td>
<td>89,073af</td>
<td>High Hazard</td>
</tr>
</tbody>
</table>

The San Jose State University campus lies within the dam inundation zone for the Anderson Dam facility, the largest in the area. In the event of a catastrophic failure of the Anderson dam, the San Jose State University campus is expected to be inundated. In addition, the campus lies fairly close the inundation zones for the Lenihan and Calero dams. The inundation areas are expected to spread water in areas to the west and south from the campus. Additionally, there are multiple transportation corridors that lie within the dam inundation zones that could compromise access, evacuation, and supply routes. Based on the factors above, even though high hazard dams in the area undergo regulated inspections, monitoring and maintenance, the planning committee ranks the extent of the hazard as **Moderate**.

**Extent – Levee Failure**

Levees are used along numerous rivers, irrigation channels, and other waterways throughout Santa Clara County primarily along waterways in the eastern part of the County. The SJSU campus does not lie within a levee flood protected area, although the campus is in proximity to rivers or flood control channels lined with levees. Potentially, the campus community will be affected, as a breach in other areas of San Jose or Santa Clara County may cause flooding and damages to the homes of students, faculty, and

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staff or to access/supply routes, utilities, or other critical services. Based on these conditions, the planning committee ranks the extent of the levee failure hazard on campus as Low.

History of the Hazard

There are no records of dam or levee failures in areas that present a threat to the San Jose State University campus. Santa Clara County has no record of dam failures:

Table 22-14: Santa Clara County Dam Failures

<table>
<thead>
<tr>
<th>Date</th>
<th>Dam</th>
<th>Release</th>
<th>Damage</th>
</tr>
</thead>
<tbody>
<tr>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
</tr>
</tbody>
</table>

Potential Impacts of the Hazard

Dam Failure Impacts - Water that is released due to a dam that has failed generates tremendous energy and force causing a flood that will be catastrophic to life and property. Water levels from the failed dam could be significantly higher than those experienced in worst case scenario flood events. Areas closer to the failed dam will be more likely to experience complete devastation while other areas within the inundation zone will see varying levels of flood waters. The extent of the impacts of a failed dam would vary based on a number of factors such as the volume of water released, the base flow of the river, the time of the failure, the amount of warning provided, and the distance from the dam. Impacts resulting from a dam failure include:

- Loss of life
- Property destruction or damage
- Loss of property contents
- Infrastructure damage
- Flooded or destroyed lifelines/supply routes
- Damaged or destroyed utilities
- Loss of community economic base
- Employment losses
- Agricultural (crops and livestock) damages or destruction
- Environmental damage

33 Santa Clara Operational Area Hazard Mitigation Plan, September 2017
- Floods generating threats to public health
- Flood generated debris

**Levee Failure Impacts**

A levee failure may result in substantial amounts of water to enter into developed areas protected by the levee. The force and volume of water that is generated by a levee failure may cause extensive structural damage in close proximity to the breach and effects of flooding spreading well beyond the point of the failure. The extent of the impacts would vary based on a number of factors such as the volume of water released, the time of the failure, the amount of warning provided, the location of the breach, elevation, and distance from the breach. Potential impacts resulting from a levee failure include:

- Loss of life
- Property destruction or damage
- Loss of property contents
- Infrastructure damage
- Public health hazards resulting from mold, mildew, and disease due to flood water
- Flooded or destroyed lifelines/supply routes
- Damaged or destroyed utilities
- Loss of community economic base
- Employment losses
- Agricultural (crops and livestock) damages or destruction
- Environmental damage
- Prolonged periods of necessary dewatering
- Disruptions to education delivery to community

**Probability of Future Occurrence of the Hazard**

Santa Clara County remains at risk from dam and levee failure. The location of the San Jose State University campus downstream from the Anderson Dam and within a flood protected area demonstrates that the potential exists for future dam issues. The entire San Jose State University campus is located within the Anderson Dam inundation zone. Though as a high hazard dam, the Anderson facility undergoes consistent regulated inspections, monitoring and maintenance. There are no identified levees in proximity to the campus and thus the campus is outside of any levee protected zone. There are no official recurrence intervals that have been calculated for dam or levee failures. Based on historical experience and occurrences, the likelihood of this hazard is low.

The probability of future occurrence for both dam and levee failures is *Unlikely.*
Vulnerability to the Hazard

Given high priority inspections, monitoring and maintenance practices in place, a catastrophic dam or levee failure is highly unlikely even though the campus lies within the Anderson dam inundation zone. As such, the campus is not considered to be subject to a high degree of vulnerability on a daily basis. However, in the unlikely event of a catastrophic failure of the Anderson dam, the effects of flooding to the campus would extreme. With regard to the two other inundation zones in close proximity, the campus effects would most likely be limited to indirect or secondary effects in terms of disruption to regional transportation networks and services, and the amount of time to respond to the needs of the campus community prior to inundation will be limited.

Any breach along a levee is impossible to predict where a failure may occur. It is likely that response action will not be fully implemented until the incident situational intelligence provides adequate information as to compromised locations. These variables place all those working and living within the dam inundation and flood protection zones in vulnerable locations in the event of a low probability, catastrophic event.

Vulnerability to a dam or levee failure on the San Jose State University campus will vary depending on the degree of breach or structural failure and when the failure was to occur. The risk to the campus population will be lessened during periods when classes are not in session or during periods of breaks. Conversely, during the days and hours that classes are in session and staff are at their workplaces, the human vulnerability increases. However, in region-wide events this vulnerability may be shared with the homes and workplaces of members of the campus community and their families.

Certain campus populations will experience greater challenges to a post-flood / failure environment. Vulnerable populations will likely need to navigate through flood generated debris, face extreme health safety issues from flood waters, experience extreme stresses of a disaster, an inability to communicate to or gain access to support networks, and find difficulty in accessing equipment or supplies to aid in a specific need.

Estimate of Potential Losses

Estimates of potential losses will be influenced by a variety of factors. The volume and force of the water will determine the scale of damages affecting campus infrastructure, equipment, and other impacted features. The proximity to the failure and elevation above flood waters will affect the level of damage and individuals exposed. The time of the academic year, the day of week, and hour in which the failure was to occur will influence the number of people on campus and potential casualties. Losses will be generated by the physical damages, the loss of revenue, loss of academic research, loss of building contents, and community wide economic reductions.
Based on estimate replacement costs of facilities and structures on campus, the total replacement costs due to dam and levee failure are $1,129,789,581. However, it is unlikely for a dam or levee failure event to cause catastrophic destruction at San Jose State.

Vulnerability Assessment Conclusions

While the occurrence of dam and levee failures have not been historically relevant near the San Jose State campus, the potential for hazards related to the region’s levees and dams still exist. However, the presence of earthquake faults in proximity to the existing dam and levee structures presents a valid danger to downstream locations in the event of an earthquake. In the unlikely event of Anderson or another dam’s total failure, the consequences would be catastrophic to downstream communities. The potential for dam or levee failure further generates the added potential for a number of cascading effects such as disruptions to the local economy, utility failures, disruptions to providing for the needs of the community, and development of public health hazards. These effects would be exacerbated by effects of seasonal flooding, ongoing heavy precipitation, or excessive run-off from the watershed contributing to the river system. The potential for widespread flooding and damage of structures due to the force of water has exponentially powerful impacts on particular populations among the campus community including those with access or functional needs, international students, the homeless, and students residing in the residence halls.

Identified Data Limitations

Data limitations include missing campus structural replacement costs, and an incomplete inventory of both building construction features and mitigation efforts to lessen the impact due to flood inundation.
Drought

Description of the Hazard

Drought is defined as a condition where moisture levels fall significantly below normal for an extended period of time over a large area that adversely affects plants, animal life, and humans. Drought is a gradual phenomenon. Although droughts are sometimes characterized as emergencies, they differ from typical emergency events. Most natural disasters, such as floods or forest fires, occur relatively rapidly and afford little time for preparing for disaster response. Droughts occur slowly, over a multi-year period, and it is often not obvious or easy to quantify when a drought begins and ends.

Throughout California, one dry year does not normally constitute a drought. California’s extensive system of water supply infrastructure (reservoirs, groundwater basins, and conveyance assets) mitigates the effect of short-term dry periods for most water users. Defining when a drought begins is a function of drought impacts to water users. Drought in one location may not constitute a drought for all water users, as some users in relative proximity may have a different water supply. For example, individual water suppliers may use a combination of sources such as rainfall/runoff, water in storage, or expected supply from a water wholesaler to define their water supply conditions.

Drought can be characterized as one or more of the four following types:

- **Meteorological drought** is defined on the basis of the degree of dryness (in comparison to some “normal” or average amount) and the duration of the dry period. A meteorological drought must be considered as region-specific since the atmospheric conditions that result in deficiencies of precipitation are highly variable from region to region.

- **Hydrological drought** is associated with the effects of periods of precipitation (including snowfall) shortfalls on surface or subsurface water supply (e.g., streamflow, reservoir and lake levels, ground water). The frequency and severity of hydrological drought is often defined on a watershed or river basin scale. Although all droughts originate with a deficiency of precipitation, hydrologists are more concerned with how this deficiency plays out through the hydrologic system. Hydrological droughts are usually out of phase with or lag the occurrence of meteorological and agricultural droughts. It takes longer for precipitation deficiencies to show up in components of the hydrological system such as soil moisture, streamflow, and ground water and reservoir levels. As a result, these impacts are out of phase with impacts in other economic sectors.

- **Agricultural drought** focus is on soil moisture deficiencies, differences between actual and potential evaporation, reduced ground water or reservoir levels, and so forth. Plant water demand depends on prevailing weather conditions, biological characteristics of the specific plant, its stage of growth, and the physical and biological properties of the soil.
- **Socioeconomic drought** refers to when physical water shortage begins to affect health, well-being, and quality of life of people, or when the drought starts to affect the supply and demand of an economic product that relies on water.

The drought issue in California is further compounded by water rights. The central challenge is how to prioritize water usage among a broad variety of contexts. It is for this reason that water is a commodity possessed and utilized under a variety of legal doctrines. As such, many competing sets of interests create a dynamic prioritization process between, for example, farming and federally protected fish habitats and water supply for municipal/public use (including usage for San Jose State University (SJSU) versus water usage for wildfire abatement or natural resource protection.

**Location of the Hazard**

Drought conditions have been identified throughout Santa Clara County and the City of San Jose where the SJSU campus is located. Drought is not a location-specific hazard and affects the entire planning area equally. Drought location is not isolated to each campus footprint but occurs as a geographic sub-set of drought conditions occurring at larger scales. From 2000-2020, drought conditions existed continuously in the state, with 80-100% of the state impacted for 12 of the last 20 years.  

**Extent of the Hazard**

Given the historical occurrence of drought throughout the county and city surrounding the planning area, and the potential future impact exacerbated by climate change, the CSU Planning Committee recognizes that drought will continue to pose a high degree of risk statewide, potentially impacting crops, livestock, water resources, the natural environment at large, buildings and infrastructure (from land subsidence), and local economies. In addition, although drought affects the entire CSU system-wide planning area equally, the extent is variable and specific to each campus/jurisdiction, depending on contextual factors such as the degree of assets and activities, historically impacted by drought within each jurisdiction. That said, the extent of the hazard on campus is reported to be Low.

In addition, drought related land subsidence has occurred statewide and will continue in areas where the groundwater basin has been subject to overdraft and long-term recharge is inadequate to maintain the water table elevation, leaving underground voids. Subsidence levels have been measured up to 30-feet in California with subsidence bowls covering hundreds of square miles. As such, drought-related subsidence may result in serious structural damage to buildings, roads, irrigation ditches, underground utilities, and pipelines. Though such effects have not been reported on campus, they remain issues of concern for the campus over the long term.

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Although the campus planning team identifies the extent of the hazard as Low (qualitatively) which corresponds to D0 – D1 on the Extent scale (below), Santa Clara County has experienced more severe drought conditions, including D4 levels during the statewide event from 2012-2017. As such, the campus planning team recognizes that while historic impacts shaping the extent of drought on campus have been minimal, the potential impacts are tied to trends across larger geographic areas, and, therefore, the committee recognizes that the extent of drought on campus has the potential to increase in the future.

The U.S. Drought Monitor developed tables of impacts reported during past droughts in California in order to depict the extent of drought risk for each level of drought on the U.S. These possible extent conditions for California complement the general impacts column of the U.S. Drought Monitor Classification Scheme.

Table 22-15: Impacts of Drought Levels as Determined by US Drought Monitor

<table>
<thead>
<tr>
<th>Category</th>
<th>Impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>D0</td>
<td>Soil is dry; irrigation delivery begins early</td>
</tr>
<tr>
<td></td>
<td>Dryland crop germination is stunted</td>
</tr>
<tr>
<td></td>
<td>Active fire season begins</td>
</tr>
<tr>
<td></td>
<td>Winter resort visitation is low; snowpack is minimal</td>
</tr>
<tr>
<td>D1</td>
<td>Dryland pasture growth is stunted; producers give supplemental feed to</td>
</tr>
<tr>
<td></td>
<td>cattle</td>
</tr>
<tr>
<td></td>
<td>Landscaping and gardens need irrigation earlier; wildlife patterns begin</td>
</tr>
<tr>
<td></td>
<td>to change</td>
</tr>
<tr>
<td></td>
<td>Stock ponds and creeks are lower than usual</td>
</tr>
<tr>
<td>D2</td>
<td>Grazing land is inadequate</td>
</tr>
<tr>
<td></td>
<td>Producers increase water efficiency methods and drought-resistant crops</td>
</tr>
<tr>
<td></td>
<td>Fire season is longer, with high burn intensity, dry fuels, and large</td>
</tr>
<tr>
<td></td>
<td>fire spatial extent; more fire crews are on staff</td>
</tr>
<tr>
<td></td>
<td>Wine country tourism increases; lake- and river-based tourism declines;</td>
</tr>
<tr>
<td></td>
<td>boat ramps close</td>
</tr>
<tr>
<td></td>
<td>Trees are stressed; plants increase reproductive mechanisms; wildlife</td>
</tr>
<tr>
<td></td>
<td>diseases increase</td>
</tr>
<tr>
<td></td>
<td>Water temperature increases; programs to divert water to protect fish</td>
</tr>
<tr>
<td></td>
<td>begin</td>
</tr>
<tr>
<td></td>
<td>River flows decrease; reservoir levels are low and banks are exposed</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>D3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Livestock need expensive supplemental feed, cattle and horses are sold; little pasture remains, producers find it difficult to maintain organic meat requirements</td>
</tr>
<tr>
<td>Fruit trees bud early; producers begin irrigating in the winter</td>
</tr>
<tr>
<td>Federal water is not adequate to meet irrigation contracts; extracting supplemental groundwater is expensive</td>
</tr>
<tr>
<td>Dairy operations close</td>
</tr>
<tr>
<td>Marijuana growers illegally tap water out of rivers</td>
</tr>
<tr>
<td>Fire season lasts year-round; fires occur in typically wet parts of state; burn bans are implemented</td>
</tr>
<tr>
<td>Ski and rafting business is low, mountain communities suffer</td>
</tr>
<tr>
<td>Orchard removal and well drilling company business increase; panning for gold increases</td>
</tr>
<tr>
<td>Low river levels impede fish migration and cause lower survival rates</td>
</tr>
<tr>
<td>Wildlife encroach on developed areas; little native food and water is available for bears, which hibernate less</td>
</tr>
<tr>
<td>Water sanitation is a concern, reservoir levels drop significantly, surface water is nearly dry, flows are very low; water theft occurs</td>
</tr>
<tr>
<td>Wells and aquifer levels decrease; homeowners drill new wells</td>
</tr>
<tr>
<td>Water conservation rebate programs increase; water use restrictions are implemented; water transfers increase</td>
</tr>
<tr>
<td>Water is inadequate for agriculture, wildlife, and urban needs; reservoirs are extremely low; hydropower is restricted</td>
</tr>
<tr>
<td>Fields are left fallow; orchards are removed; vegetable yields are low; honey harvest is small</td>
</tr>
<tr>
<td>Fire season is very costly; number of fires and area burned are extensive</td>
</tr>
<tr>
<td>Many recreational activities are affected</td>
</tr>
<tr>
<td>Fish rescue and relocation begins; pine beetle infestation occurs; forest mortality is high; wetlands dry up; survival of native plants and animals is low; fewer wildflowers bloom; wildlife death is widespread; algae blooms appear</td>
</tr>
<tr>
<td>Policy change; agriculture unemployment is high, food aid is needed</td>
</tr>
<tr>
<td>Poor air quality affects health; greenhouse gas emissions increase as hydropower production decreases; West Nile Virus outbreaks rise</td>
</tr>
<tr>
<td>Water shortages are widespread; surface water is depleted; federal irrigation water deliveries are extremely low; junior water rights are</td>
</tr>
</tbody>
</table>
curtailed; water prices are extremely high; wells are dry, more and deeper wells are drilled; water quality is poor;

History of the Hazard

Historically, drought has been so prevalent in California that its presence is almost continuous. Although no occurrences are reported on campus, according to the US Drought Monitor Time Series data, Santa Clara County (which encompasses the SJSU footprint), has experienced six periods of drought covering 11 years from 2000 – 2021, including the severe statewide event from 2012-2017.

Figure 22-7: Periods of Drought in Santa Clara County, CA, 2001 – 2021

According to the National Drought Mitigation Center, over 3,500 reports and publications covering 370 drought-related events took place across the state (many of which were statewide events) between 2000-2020. In addition, the National Center for Environmental Information (NCEI) reports more than 500 events statewide during this same time period. These events produced a comprehensive range of impacts to water supply, regulations and allocations to businesses and municipalities, budgets and resources for firefighting, water law and policy, and physical impacts to built and natural environments. As such, data records of previous occurrences can be viewed as separate time and event demarcations for a hazard almost continuously in effect across the state with cascading impact potential.

According to the Department of Water Resources, droughts exceeding three years are relatively common in Southern California, but relatively rare in Northern California - the region is the geographic source of much of the state’s developed water supply. The 1929-

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34 drought established the criteria commonly used in designing storage capacity and yield of large Northern California reservoirs. 37

According to the US Drought Monitor’s time series data, from 2000-2021 (with the exception of a 2–3-month period in 2000 and 2011), some degree of drought conditions have been continuously in effect somewhere in California. In fact, 80% - 100% of the state has been subjected to drought conditions for 12 of the last 20 years, with the most severe drought being the 100% state-wide event from 2012-2017.

Figure 22-8: Periods of Drought in State of California, 2001 – 202138

Given the extent of the drought risk in California, the following drought event was selected as an exemplar due to its broad and significant impacts on the state and on the SJSU campus planning area:

2012 – 2017 – Drought produced severe impacts to water wells throughout the state of California, with a high number of wells running dry. Land subsidence due to increased groundwater pumping also occurred in numerous areas of the state such as the San Joaquin and Central Valleys. Crop damage was widespread as well. Water allotments were drastically reduced in many towns and water agencies, with extremely high costs for procuring water. In addition, job loss occurred with many families requiring food supply assistance, and water supply assistance provided to home-owners with dry wells. According to a report released by UC Davis Center for Watershed Sciences, the 2012-2017 period of the California drought cost the state’s agriculture industry about $1 billion in lost revenue, with a total statewide economic cost of the drought calculated to be $2.2 billion. The report says, ‘it is responsible for the greatest water loss ever seen in California agriculture - about one third less than normal”. The report calls the


groundwater situation in California "a slow-moving train wreck." Spring snowpack at
Donner Summit reached record low levels in 2014, exceeded in 2015 by a remarkable
April 1 snow-water-equivalent value of only 5% of average. Decreased precipitation since
contributed to near-record low levels in the Shasta Reservoir. The ongoing drought has
contributed to declines in crop values across the state. For example, crops including
cotton, corn silage and barley (the field crop category) fell by 42 percent. 39

Potential Impacts of the Hazard

Drought impacts are wide-reaching and may be economic, environmental, and/or
societal. This assessment of its impact recognizes that historic occurrences of drought
throughout the county surrounding the planning area are often a sub-set of larger and
inter-connected regional droughts, and that the (related) historic local/county impacts
provide a sound basis for understanding potential (future) impacts on campus.

The most significant potential impact associated with drought across the SJSU campus
planning area is a reduction in water availability for the municipal area tied to the
campus. Other impacts include crop loss and damage to trees and other natural
resources (See Tree Mortality below). The footprint of SJSU to some extent includes
these vulnerable resources based on the campus landscape (trees) and the presence (and
footprint size) of any agricultural research crops and/or field stations.

As a secondary impact of drought, wildfire is directly attributable to dry atmospheric
conditions. Wildfires almost always coincide with drought in California, though not
limited to such. 40 However, the wildfire hazard is analyzed separately in this plan.

In reviewing the occurrences of drought for Santa Clara County (which encompasses
CSJSU), the US Drought Monitor and the National Drought Mitigation Center report that
tens of millions of trees died during the (2012-2017) state-wide drought disaster. Though
data sources do not provide data for tree mortality specific to CSJSU, the broad
geographic extent of the impact makes it likely that tree mortality occurred to some
degree on the campuses. Due to the lasting and ongoing effects of drought on the
landscape, trees will continue to be impacted within the municipalities, counties and
regions wherein lies the CSU campus system as long as drought conditions continue.

Given the absence of data, in order for the CSU Committee to assess the impact of tree
mortality, it is useful to view it as a risk sub-set to the probability, location, extent,
severity and duration of the drought hazard within each campus-located municipality,
county and region. Regarding potential impacts, standing dead trees could fall, posing a
risk to people, buildings, power lines, roads and other infrastructure. In addition, drought-
impacted trees become susceptible to diseases and insect infestations (bark beetle)

39 National Oceanic and Atmospheric Administration National Centers for Environmental Information. State
Climate Summaries: California. Retrieved 05.04.2021 from: https://statesummaries.ncics.org/chapter/ca/

40 CAL FIRE Fire and Resource Assessment Program (FRAP). 2017 Assessment. Print. Retrieved 05.05.2021
from: https://frap.fire.ca.gov/assessment/
further adding to the risk of tree mortality and related potential impacts. No data is currently available for tree mortality on campus, however, the CSU Planning Team will pursue data on this issue in the future.

As a potential tertiary impact, prolonged and repeated drought conditions over time can produce land subsidence and the risk of damage to building foundations and infrastructure on campus resulting from ground instability and collapse. Land subsidence is defined as the vertical sinking of the land over manmade or natural underground voids. Subsidence is often the direct result of groundwater over-extraction in response to drought conditions, as well as oil and gas extraction. Weight can accelerate the process of subsidence resulting from surface development and infrastructure such as roads and buildings, vibrations from construction blasting and heavy truck or train traffic. For example, the State Water Project’s 444-mile-long California Aqueduct has required repairs such as the raising of canal linings, bridges, and water control structures on the Aqueduct – in the Central Valley a five-mile reach of the Eastside Bypass was impacted by subsidence, and the Department of Water Resources estimated that it may cost in the range of $250 million to acquire flowage easements and levee improvements to restore the design capacity of the subsided area.  

At present, drought related damage to campus buildings and infrastructure at SJSU has not been reported, but the potential for such impacts is possible. With regard to overall potential impact, water supply/availability for SJSU is ultimately tied to broader inter-dependent, and more intensive modes of water use at local and regional scales such as agriculture and ranching, wildfire protection, larger metropolitan/municipal usage, manufacturing and commerce, tourism, recreation, and wildlife preservation. During drought periods, the State of California’s regulated water allocations are modified and often reduced, which can result in reduced water availability for all usage contexts, including SJSU. A reduction of electric power generation and water quality deterioration are also potential impact factors.

Table 22-16: Summary of Drought Impacts on Water Resources

<table>
<thead>
<tr>
<th>Resource</th>
<th>Type of Impact</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sea Level</td>
<td>Direct</td>
<td>Sea level is rising and will likely impact coastal areas</td>
</tr>
</tbody>
</table>


<table>
<thead>
<tr>
<th>Soil Moisture</th>
<th>Direct/Indirect</th>
<th>Prolonged dry seasons can lead to decreases in soil moisture; drier vegetation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vegetation</td>
<td>Indirect</td>
<td>Longer and more intense fire season with increased extent of area burned</td>
</tr>
<tr>
<td>Stream Conditions</td>
<td>Direct</td>
<td>Increases in water temperature; potential effects on fish</td>
</tr>
<tr>
<td>Snowpack</td>
<td>Indirect</td>
<td>Increases in temperature will lead to decreases in snowpack</td>
</tr>
<tr>
<td>Runoff</td>
<td>Direct</td>
<td>Warmer temperatures are likely to lead to a shift in peak runoff from spring to winter and a likely decrease in summer base flow</td>
</tr>
<tr>
<td>Hydropower</td>
<td>Indirect</td>
<td>Decreased summer flows resulting from earlier snowmelt and a shift in peak runoff could affect hydropower generation during summer months</td>
</tr>
<tr>
<td>Precipitation</td>
<td>Direct</td>
<td>Warmer winter temperatures will result in a greater percentage of precipitation falling as rain rather than as snow</td>
</tr>
<tr>
<td>Groundwater</td>
<td>Indirect</td>
<td>Reduction in snowpack and extended periods of drought are likely to increase dependency on groundwater</td>
</tr>
</tbody>
</table>

**Probability of Future Occurrence of the Hazard**

**Highly Likely** — The US Drought Monitor’s time series data (2000-2020) indicates that some degree of drought has nearly a 100% probability of occurrence somewhere in the state in any given year. Given that SJSU lies within a drought impacted region, it is prudent to extend the Highly Likely probability of occurrence to the planning area even though past occurrences and impacts on campus have been minimal.

**Vulnerability to the Hazard**

In California, rising temperatures are projected to increase the average lowest elevation at which snow falls, reducing water storage in the snowpack, particularly at those lower mountain elevations which are now on the margins of reliable snowpack accumulation. Higher spring temperatures will also result in earlier melting of the snowpack. The shift in snow melt to earlier in the season is critical for California’s water supply because flood control rules require that water be allowed to flow downstream and that water cannot be stored in reservoirs for use in the dry season. As such, state-level drought risk factors that have led to drought’s state-wide severity and extent, and potential impacts also create drought vulnerabilities at the level of the SJSU campus.
Moreover, climate change will likely adversely impact the vulnerability of watersheds and ecosystems in their ability to deliver important ecosystem services. These changes may limit the natural capacity of healthy forests to capture water and regulate stream flows. Sierra Nevada mountain winters and springs are warming, and on average, precipitation as snowfall relative to rain is decreasing. A warming climate with reduced snowpack will result in earlier snowmelt and will subsequently reduce downstream water availability during summer and early fall.

As such, the state and the SJSU planning area stakeholders potentially have less capacity to address future drought risks due to projected temperature increases and shortages in water; ground-water withdrawals have been occurring at a deficit rate of 1 – 2-million-acre feet per year, where the impacts of drought include decreased availability of water for agriculture and environmental uses. 43 In forested and other vegetated areas, prolonged drought decreases the moisture content of forest fuels and increases the risk of high severity wildfires.

It should be pointed out that California is the single most productive agricultural state and its agricultural industry relies heavily on reservoir water supplied by snowmelt and rainfall runoff. Yearly variations in snowpack depths have implications for water availability as snowmelt from the winter snowpack feeds a network of reservoirs. Spring snowpack at Donner Summit reached record low levels in 2014, exceeded in 2015 by a remarkable April 1 snow-water-equivalent value of only 5% of average. Decreased precipitation since 2011 has contributed to near-record low levels in the Shasta Reservoir. 44

Vulnerability of Populations

Drought vulnerabilities for California’s population include agricultural sector job loss, secondary economic losses to local businesses and public recreational resources, increased cost to local and state government for large-scale water acquisition and delivery, and water rationing and water wells running dry for individuals and families. As drought is often accompanied by prolonged periods of extreme heat, negative health impacts such as dehydration can also occur, where children and elderly are most susceptible. Air quality often declines in times of drought which can affect those with respiratory ailments. These same vulnerabilities apply to the students, faculty and staff of the SJSU campus.

Property Vulnerability

Drought vulnerabilities include crop loss, injury and death of livestock and pets, and damage to infrastructure, homes and other buildings resulting from the secondary


drought impact of land subsidence. The related drought impacts of tree mortality and land subsidence pose risks to vulnerable critical infrastructure and property. These same vulnerability measures apply to the properties of the SJSU campus.

Natural Environment Vulnerability

Drought vulnerabilities for the natural environment on campus are primarily flora and landscaping. Statewide, vulnerabilities are widespread throughout public and private lands within the state, including tree mortality, impacts to all flora and fauna, and destabilization (subsidence) of land along streams and rivers, and within watersheds.

The core issue shaping drought vulnerabilities on campus and throughout California is water supply and demand. Several factors play into the issue including groundwater basins, surface water run-off, public and agricultural demand, and surface water storage water sheds. A USGS led analysis was first conducted in 2010 through the Forest and Rangeland Assessment and ongoing through the USGS Forest and Rangeland Ecosystem Science Center to identify threats and assets where water supply would benefit from environmental management designed to protect or enhance water resources, the key effort which, in part, both defines and mitigates the severity of drought risk and vulnerabilities.

With regard to overall threat and asset findings shaping the potential severity of drought, the watersheds in the Sierra region contribute most greatly to the state’s water supply, but are under threat from climate change, wildfire and development. In addition, groundwater basins in the San Joaquin Valley and Sacramento Valley bioregions are an abundant resource that is heavily threatened by over pumping.

Critical Facilities Vulnerabilities

Drought vulnerabilities for SJSU’s critical facilities include water shortfalls for facility operations and critical functions, and potential structural destabilization and damage resulting from land subsidence.

Estimate of Potential Losses

An estimate of potential losses from drought has not been calculated for the campus or the CSU system. However, drought related losses to the City of San Jose and Santa Clara county, and the surrounding region such as crop loss and cost increases for water resources have re-occurred over time. Please consult city and county level government, and/or state agricultural agencies for data on the financial impacts from drought.

Vulnerability Conclusions

The CSU Planning Committee understands that the high degree of vulnerability posed by drought will be exacerbated by greater climate variation in the future and therefore greater variation and uncertainty regarding the availability of water supplies which are already under tremendous stress. In response to such vulnerability, state legislation passed in 2014 requires local governments to regulate pumping and recharge to better
manage groundwater supplies, and groundwater-dependent regions are required to halt overdraft and bring basins into sustainable levels of pumping and recharge by the early 2040s. That said, the Committee will continue to work with local, regional and state partners and stakeholders to explore solutions for mitigating the drought hazard on its campuses by accessing the best available data and resources on climate change and its relationship to drought.

Identified Data Limitations

Data is limited concerning campus-related agricultural assets as well as data on campus tree mortality.
Earthquake

Description of the Hazard

An earthquake is a sudden motion or shaking caused by the release of pressure accumulated along the edge of tectonic plates covering the earth. These huge plates are constantly moving and move ever so slowly under, over, or by passing one another. This movement is gradual however the plates may lock together accumulating enormous amounts of energy. When this energy builds, stress develops, and the adjoining plates will eventually break free and result in ground shaking – an earthquake.

Large earthquakes may result in fissuring, ground settlement, and/or vertical or horizontal displacement. Earthquakes occur without warning and can result in extensive damages and human casualties. Damages associated to earthquake generated ground shaking is normally confined to a narrow area along fault trend from the earthquake epicenter. However, seismic waves may generate ground shaking resulting in damages in areas outside of the fault trend.

Fault Rupture – The rupture of faults is the differential movement of the two sides of the earth’s plates at the point of the fault. Horizontal or vertical displacement may be significant and occur over great distances. The movement and energy that occurs along a fault is released in waves resulting in ground shaking. The intensity of ground shaking varies based on the magnitude of the earthquake, the proximity to the earthquake epicenter, the composition of the ground sediment or rock the waves travel through, and the depth of the earthquake.

Liquefaction – In addition to the primary fault rupture that occurs right along a fault during an earthquake, the ground many miles away can also fail during intense shaking. As seismic waves travel through saturated granular soil; the soil begins to liquefy and act as a fluid. Soil strength and stability is lost causing the effects of ground shaking to intensify and for ground deformation to occur. These water saturated soils when shaken quickly lose the ability to support buildings, bridges, utilities, and other structures. Areas susceptible to liquefaction include places where sandy sediments have been deposited by rivers along their course or by wave action along beaches. The greater the magnitude of an earthquake and longer duration of strong ground shaking will result in an enhanced potential for liquefaction to occur. Settlement can cause damage when the amount settlement varies significantly across the length of a structure. Lateral spreading occurs when liquefaction occurs on gently sloping ground and the liquefied material at depth allows the area to slide, often toward a vertical discontinuity or “free face” such as a creek or stream channel. Liquefaction can occur in susceptible soils below bodies of water, and settlement and lateral spreading can damage structures built on or adjacent to these areas. Transportation bridges across water bodies, wharves, piers and other structures at ports and harbors, and underwater utility lines can be severely damaged by this hidden hazard.

Subsidence - Changes in the local environment that cause subsidence or sinkholes are called triggering mechanisms. Water is the primary factor that affects the local
environment and causes subsidence. Water level decline, changes in groundwater flow, increased loading, and deterioration (such as abandoned mines) are all triggering mechanisms. Water level decline may occur naturally, or it may be the result of human action. Factors that lead to water decline are pumping (from wells), localized drainage (for construction activities), dewatering, or drought. Changes in groundwater flow can result from an increase in the velocity of groundwater movement, and increase in the frequency of water table fluctuations, and changes in discharge (either increase or decrease). Increased loading can cause pressure in the soil, leading to the failure of underground cavities and space, such as caves. Vibrations from earthquakes, heavy machinery, and blasting may result in structural collapse, followed by surface resettlement.

Location of the Hazard

The State of California is particularly vulnerable to earthquake activity due to California’s location residing between two large tectonic plates. San Jose State University is located in the South Bay area of the San Francisco Bay region. In general, fault systems surround and traverse throughout the Bay Area and Santa Clara County including the area of San Jose State University. Throughout the populated areas of San Jose and surrounding cities, the ground is saturated with sediment eroded from the hills by means of multiple stream channels. Liquefaction zones rated at moderate susceptibility exist in the majority of San Jose including all of downtown.

The Pacific Plate and the North American Plate come together at the San Andreas Fault 12-14 miles west of the San Jose State University campus. In addition to the San Andreas Fault, Santa Clara County is home to or near additional fault systems with the potential to generate strong ground shaking. The campus is additionally in close proximity to a number of powerful fault systems. The Hayward Fault traverses south to north along the western base of the Hayward and Oakland Hills 5 miles east of the San Jose State University campus. The Calaveras Fault extends south to north 120 miles in length from San Benito County to Contra Costa County 7 miles east of the CSU East Bay campus. The 17-mile-long Mission Fault connects the Calaveras Fault with the Hayward Fault 10 miles north of the campus. The Monte Vista Fault extends through the peninsula towards San Francisco 8 miles west of the campus. The Silver Creek Fault is one mile east of the campus traversing through urban portions of San Jose. The entire San Francisco Bay Area is saturated with numerous additional faults mostly paralleling the San Andreas Fault to the northwest. These fault systems are located on each side of the campus.
The entire San Jose State University campus resides on areas designated to be liquefaction zones. All campus facilities are located within the liquefaction zone. The liquefaction zones appear throughout downtown following the valley floor towards the bay. Liquefaction zones additionally appear throughout portions of the neighboring communities of San Jose.

Figure 22-10: Liquefaction Zones in Proximity to San Jose State University

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Extent of the Hazard

The extent or severity of earthquake damage is expressed in terms of magnitude, intensity, and duration. The amount of energy released during an earthquake is normally conveyed as a magnitude measured from a seismogram. Magnitude is expressed in numbers and decimals representing the physical size of the earthquake. The strength and effect of the shaking on the surface of the earth is classified as the intensity. Intensity is further defined from the effects the earthquake has on people, structures, and the natural environment. The intensity of an earthquake in terms of measuring magnitude and evaluating its effects is generally expressed using the Modified Mercalli (MM) Intensity Scale. Duration is the length of time the earthquake’s energy is released.

The Richter magnitude scale was developed in 1935 by Charles F. Richter of the California Institute of Technology as a mathematical device to compare the size of earthquakes. The Richter Scale is the best-known scale for measuring the magnitude of earthquakes. The magnitude value is proportional to the logarithm of the amplitude of the strongest wave during an earthquake. A recording of 7, for example, indicates a disturbance with ground
motion 10 times as large as a recording of 6. The energy released by an earthquake increases by a factor of 31 for every unit increase in the Richter scale.

Table 22-17: Earthquake Intensity and Frequency Comparisons

<table>
<thead>
<tr>
<th>Magnitude</th>
<th>Mercalli Intensity</th>
<th>Potential Damage</th>
<th>Global Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 2.0</td>
<td>I</td>
<td>None</td>
<td>Continually</td>
</tr>
<tr>
<td>2.0 - 2.9</td>
<td>I to II</td>
<td></td>
<td>&gt; 1M per year</td>
</tr>
<tr>
<td>3.0 - 3.9</td>
<td>II to IV</td>
<td></td>
<td>&gt; 100,000 per year</td>
</tr>
<tr>
<td>4.0 - 4.9</td>
<td>IV to VII</td>
<td>Light</td>
<td>10K to 15 K per year</td>
</tr>
<tr>
<td>5.0 - 5.9</td>
<td>VI to VII</td>
<td>Moderate</td>
<td>1K to 1,500 per year</td>
</tr>
<tr>
<td>6.0 - 6.9</td>
<td>VII to X</td>
<td>Heavy</td>
<td>100 to 150 per year</td>
</tr>
<tr>
<td>7.0 - 7.9</td>
<td>VII &lt;</td>
<td>Very Heavy</td>
<td>10 - 20 per year</td>
</tr>
<tr>
<td>8.0 - 8.9</td>
<td>VII &lt;</td>
<td></td>
<td>1 per year</td>
</tr>
<tr>
<td>&gt; 9.0</td>
<td>VII &lt;</td>
<td></td>
<td>1 per 10-50 years</td>
</tr>
</tbody>
</table>

The Modified Mercalli Intensity Scale provides descriptive values of earthquake intensity that may provide greater meaning to the broader population as the description of intensity refers to the effects actually experienced. This scale uses an arbitrary ranking based on observed earthquake effects. The scale is composed of increasing levels of intensity ranging from shaking that is not recognizable to intense shaking resulting in catastrophic damages and casualties. The Modified Mercalli Intensity Scale is demonstrated below:

Table 22-18: Modified Mercalli Intensity Scale

<table>
<thead>
<tr>
<th>Intensity</th>
<th>Shaking</th>
<th>Description / Damage</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Not felt</td>
<td>Not felt except by a very few under especially favorable conditions.</td>
</tr>
<tr>
<td>II</td>
<td>Weak</td>
<td>Felt only by a few persons at rest, especially on upper floors of buildings.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Magnitude</th>
<th>Description</th>
<th>Intensity</th>
</tr>
</thead>
<tbody>
<tr>
<td>III</td>
<td>Weak</td>
<td>Felt quite noticeably by persons indoors, especially on upper floors of buildings. Many people do not recognize it as an earthquake. Standing motor cars may rock slightly. Vibrations similar to the passing of a truck. Duration estimated.</td>
</tr>
<tr>
<td>IV</td>
<td>Light</td>
<td>Felt indoors by many, outdoors by few during the day. At night, some awakened. Dishes, windows, doors disturbed; walls make cracking sound. Sensation like heavy truck striking building. Standing motor cars rocked noticeably.</td>
</tr>
<tr>
<td>V</td>
<td>Moderate</td>
<td>Felt by nearly everyone; many awakened. Some dishes, windows broken. Unstable objects overturned. Pendulum clocks may stop.</td>
</tr>
<tr>
<td>VI</td>
<td>Strong</td>
<td>Felt by all, many frightened. Some heavy furniture moved; a few instances of fallen plaster. Damage slight.</td>
</tr>
<tr>
<td>VII</td>
<td>Very strong</td>
<td>Damage negligible in buildings of good design and construction; slight to moderate in well-built ordinary structures; considerable damage in poorly built or badly designed structures; some chimneys broken.</td>
</tr>
<tr>
<td>VIII</td>
<td>Severe</td>
<td>Damage slight in specially designed structures; considerable damage in ordinary substantial buildings with partial collapse. Damage great in poorly built structures. Fall of chimneys, factory stacks, columns, monuments, walls. Heavy furniture overturned.</td>
</tr>
<tr>
<td>IX</td>
<td>Violent</td>
<td>Damage considerable in specially designed structures; well-designed frame structures thrown out of plumb. Damage great in substantial buildings, with partial collapse. Buildings shifted off foundations.</td>
</tr>
<tr>
<td>X</td>
<td>Extreme</td>
<td>Some well-built wooden structures destroyed; most masonry and frame structures destroyed with foundations. Rails bent.</td>
</tr>
</tbody>
</table>

The graph below (Figure 22-11) illustrates the increasing intensity of energy that is released and as the measured magnitude increases. While each whole number increases
in magnitude represents a tenfold increase in the measured amplitude, it represents an increasing rate of 32 times more energy released in the same increase in magnitude. As the magnitude of an earthquake is measured higher, the intensity of the earthquake worsens progressively from one category to the next.

Figure 22-11: Graph Depicting Earthquake Magnitude and Equivalent Energy Release

The entire San Jose State University campus resides on areas designated to be liquefaction zones. All campus facilities are located within the liquefaction zone. In addition, powerful fault systems traverse and surround the campus, and the area has experienced numerous powerful and damaging events. The impacts of a major earthquake would be felt beyond the campus and have long reaching effects. The risk of casualties and damages would likely extend to the homes and workplaces of members of the campus community including students, staff, and faculty. As such, the planning committee ranks the extent of the hazard as **High**.

**History of the Hazard**

The State of California has a long history of chronic and destructive earthquakes throughout the state. On average, earthquakes strong enough to result in structural

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damages occur three to four times a year in California, while earthquakes Magnitude 6.0 to 6.9 occur once every two to three years. Likewise, Santa Clara County also has a long history of earthquake activity. The entire area of Santa Clara County is at risk to seismic activity and has a history of significant earthquakes resulting in damages.

Table 22-19: Historic Earthquakes Near San Jose, CA$^{48}$

<table>
<thead>
<tr>
<th>Date</th>
<th>Location</th>
<th>Magnitude</th>
<th>Damages</th>
</tr>
</thead>
<tbody>
<tr>
<td>10/21/1868</td>
<td>Hayward</td>
<td>6.8</td>
<td>Extensive destruction; 20-mile rupture</td>
</tr>
<tr>
<td>4/18/1906</td>
<td>San Francisco</td>
<td>7.9</td>
<td>Extensive destruction; 3000 fatalities</td>
</tr>
<tr>
<td>3/22/1957</td>
<td>Daly City</td>
<td>5.3</td>
<td>$1 million, 1 fatality</td>
</tr>
<tr>
<td>8/6/1979</td>
<td>Gilroy</td>
<td>5.7</td>
<td>Minor</td>
</tr>
<tr>
<td>4/24/1984</td>
<td>Morgan Hill</td>
<td>6.2</td>
<td>$8 million</td>
</tr>
<tr>
<td>10/17/1989</td>
<td>Loma Prieta</td>
<td>6.9</td>
<td>$5.9 billion, 63 fatalities</td>
</tr>
<tr>
<td>9/3/2000</td>
<td>Yountville</td>
<td>5.0</td>
<td>Minor</td>
</tr>
<tr>
<td>10/30/2007</td>
<td>Alum Rock</td>
<td>5.6</td>
<td>Minor</td>
</tr>
<tr>
<td>8/24/2014</td>
<td>American Canyon</td>
<td>6.0</td>
<td>$400 million</td>
</tr>
</tbody>
</table>

The April 18, 1906 San Francisco Earthquake became one of the most well-known earthquakes in California history. The earthquake caused extensive damage to buildings, bridges, water systems, and critical facilities. Damage was experienced well beyond San Francisco including areas such as Monterey and Santa Cruz. 3,000 people were killed and thousands more injured. The San Francisco Earthquake was found to shift the course of northern California rivers. The shaking was felt from Oregon to Los Angeles.

The October 17, 1989 Loma Prieta Earthquake shook a large part of northern California, especially the San Francisco Bay Area. The earthquake caused $5.9 billion in damages, most extensively in San Francisco, the East Bay, and South Bay areas. The earthquake resulted in extensive infrastructure damages, 12,000 displaced, 3,757 injuries, and 63 fatalities. The earthquake was provided a federal disaster declaration (DR-845).

Potential Impacts of the Hazard

The shaking of the ground from earthquakes can result in building collapse, bridge failure, utility disruptions and other structural collapse. Large earthquakes can additionally cause natural gas lines to break resulting in structure fires. The proximity to the unstable soils surrounding the campus presents a potential for liquefaction creating greater ground instability during seismic events. A major earthquake in the Bay Area would likely result in region-wide social disruptions in addition to structural damages. The region-wide structural damages may disrupt lifelines and supply chain routes limiting the campus from effective evacuation routes and receiving necessary supplies or equipment.

$^{48}$ Santa Clara County Operational Area Hazard Mitigation Plan, September 2017
Most injuries resulting from earthquakes are from collapsing walls, flying glass, or other objects moved by ground shaking. The lack of warning allows individuals minimal time to react and find areas of safety. A moderate earthquake occurring near San Jose could cause injuries or fatalities to members of the campus community or support networks the campus relies on. These earthquake effects might be aggravated by collateral incidents such as fire, flooding, hazardous material spills, dam/levee compromises, and other cascading events. A catastrophic earthquake near San Jose could result in extensive casualties, expansive structural damages, panic, widespread utility outages, communication failures, and secondary emergencies such as fire. A catastrophic earthquake would certainly affect the broader San Francisco Bay Area region limiting immediate assistance that the campus may normally expect.

Local impacts to the San Jose State University campus caused by an earthquake could include:

- Injuries and damage related casualties
- Ground rupture
- Potential hazardous material releases on and off campus
- Infrastructure damage to freeway and roadway system
- Landslides blocking primary access routes including US 101 and CA SR 17
- Damage to rail lines transiting through San Jose
- Structural damage to bridges over waterways and flood control channels
- Damage to power grid and widespread power outages
- Disruption in water services
- Potential isolation of campus from community
- Potential isolation among on-campus residents
- Structural damage to flood control facilities
- Structural damage to campus academic and support buildings
- Damage or loss of academic research, documents, electronic storage, art, and literature.
- Structural damage to residence halls resulting in displaced student populations
- Structural damage to nearby residences
- Community members arriving on campus for refuge from damaged homes
- Damaged university communications, computer systems, and networks
- Gaps in service delivery to vulnerable populations
- Considerable stress and fear among community
- Spontaneous creation of tent cities or outdoor camping on personal property
- Closure or reduction of service to campus operations
- Reduction of campus revenue

**Probability of Future Occurrence of the Hazard**

The Working Group on California Earthquake Probabilities (WGCEP), a collaboration between the United States Geological Survey (USGS), the Southern California Earthquake Center (SCEC), and the California Geological Survey (CGS) develops Uniform California Earthquake Forecasts (UCERFs) using the best currently available science and technology. The UCERF version 3 provides a three-dimensional view of the likelihood a region in California will experience a Magnitude 6.7 or greater earthquake in the next 30 years. The likelihood for the Santa Clara County fault systems surrounding the Santa Clara Valley is included in the following table.

Table 22-20: Major Potentially Active Faults in Proximity to San Jose State University

<table>
<thead>
<tr>
<th>Fault Zone</th>
<th>Recurrence</th>
<th>Maximum Magnitude</th>
<th>UCERF3 Likelihood</th>
</tr>
</thead>
<tbody>
<tr>
<td>Calaveras</td>
<td>Varies: 125-850 years</td>
<td>6.2 to 7.2</td>
<td>14-17%</td>
</tr>
<tr>
<td>Greenville</td>
<td>Historic: Unknown</td>
<td>6.5</td>
<td>4-6%</td>
</tr>
<tr>
<td>Hayward</td>
<td>Varies: 20-300 years</td>
<td>6.8 to 7.0</td>
<td>14-21%</td>
</tr>
<tr>
<td>Mission</td>
<td>Historic: Unknown</td>
<td>6.0 to 6.5</td>
<td>1-2%</td>
</tr>
<tr>
<td>Monte Vista-Shannon</td>
<td>Historic: Unknown</td>
<td>6.0 to 6.5</td>
<td>1%</td>
</tr>
<tr>
<td>Reliz</td>
<td>Unknown</td>
<td>6.2 to 7.0</td>
<td>&lt;1%</td>
</tr>
<tr>
<td>San Andreas</td>
<td>Varies: 20-300 years</td>
<td>6.8 to 8.0</td>
<td>15-22%</td>
</tr>
<tr>
<td>San Gregorio</td>
<td>Historic: 400-1000 years</td>
<td>6.5 to 7.2</td>
<td>2-4%</td>
</tr>
<tr>
<td>Sargent</td>
<td>Historic: 350-1500 years</td>
<td>6.2 to 7.2</td>
<td>1%</td>
</tr>
</tbody>
</table>

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40 Santa Clara County Operational Area Hazard Mitigation Plan, September 2017


The Santa Clara County Operational Area Hazard Mitigation Plan identifies that the region experiences small earthquakes every year. The Plan further estimates the probability for the faults within the San Francisco Bay Area to produce a Magnitude 6.7 or greater earthquake in the next 30 years is 72%.

Based on the earthquake shaking potential in the San Francisco Bay area, the proximity to the above listed fault systems, and the moderate liquefaction potential that exists throughout the campus, the probability of seismic ground shaking generating damage is considered Possible.

Vulnerability to the Hazard

A considerable challenge regarding earthquakes is they generally occur without warning. The fault systems surrounding the region all cross major transportation routes potentially reducing the availability of access and the supply chain. The geographic location of San Jose State University places the campus in an urban downtown community near residential, commercial, and industrial areas that is densely populated. Earthquake effects experienced in the neighboring local community will likely spill over onto the campus.

The known fault systems generating the threat to the Santa Clara Valley and San Francisco Bay region generally surround the area and some cross near the San Jose State University campus. The campus resides in a region that is exposed to fault systems on all sides. The proximity and potential for large earthquake development from these surrounding systems expose significant vulnerabilities. The potential for earthquake damaged structures being left uninhabitable including campus residence halls will result in numerous displaced individuals and households. The lack of earthquake insurance will cause extreme financial burdens on those affected. Campus buildings and equipment would be vulnerable to damages from building, seismic shaking, secondary fires, and secondary building floods from broken pipes.

Elements of the vulnerability to a major earthquake on the San Jose State University campus will vary depending on when the earthquake were to strike. The primary basis of vulnerability is based on the population affected and the built environment exposed. In general, newer construction will be more earthquake resistant than older buildings as building codes and construction technology have improved. A locally centered earthquake, even from moderate events, would have the potential for more damaging results when associated with the moderate liquefaction zones of the city. This would particularly be seen with greater damages to unreinforced masonry buildings.

The risk to the campus population will be lessened during periods when classes are not in session or during periods of breaks. Conversely, during the days and hours that classes are in session and staff are at their workplaces, the human vulnerability increases. Generally, people are safer when at home in wood frame structures as earthquakes tend
to generate less structural damage to wood construction than in commercial or industrial facilities. The greater number of people on campus at the time of an earthquake will result in more people being exposed to effects from damaged campus facilities or equipment and require greater evacuation assistance. However, in region-wide events this vulnerability may simply shift to the homes and workplaces of members of the campus community and their families.

The aftermath of a major earthquake will likely result in widespread search and rescue operations for trapped and injured individuals. The demand on emergency services will be great, potentially requiring the campus community to be prepared for these scenarios and initiate response actions as needed. There will be needs for emergency medical care, shelter, water, and food for individuals who have been displaced by the earthquake. In earthquakes causing significant damages, there may be a necessity to provide assistance with identification and support to local agencies in mass fatality management.

There may be a need to evacuate members of the campus community from the campus and to other locations that are deemed to be safer locations. This may be heightened in the southwestern portions of the campus as this area has been identified as being within a liquefaction zone. As the San Jose State University campus is downstream from dam facilities, the decision to evacuate will need to take into account whether flood control facilities are filled with water and the actual threat to the dam or levees.

The San Francisco Bay Area and San Jose in particular is densely populated and attract numerous commuter employees to the urban core. The road and freeway network becomes easily congested in normal situations. A major earthquake has the potential for rendering these critical lifelines and supply routes inoperable and forcing the campus community to be self-reliant for a period of time.

Certain campus populations will experience greater challenges to a post-earthquake environment. Vulnerable populations including those that rely on specific services, require electrical power, homeless students, experience disabilities, non-English speakers, those whose age make evacuating difficult, and others will be most affected. These individuals will likely need to navigate through earthquake generated debris, extreme stresses of a disaster, an inability to communicate to or gain access to support networks, and find difficulty in accessing equipment or supplies to aid in a specific need.

Estimate of Potential Losses

Estimates of potential losses will be influenced by a variety of factors. The intensity of the earthquake will determine what scale of damages affecting campus infrastructure, equipment, and other impacted features. Losses will be generated by the physical damages, the loss of revenue, loss of academic research, loss of building contents, and community wide economic reductions.

Based on estimate replacement costs of facilities and structures on campus, the maximum total replacement costs due to earthquake are $1,129,789,581.

Table 22-21: HAZUS Peak Ground Acceleration Zone (PGA) Estimated Losses
The table above includes 3 facilities located at the Moss Landing based San Jose State University, Moss Landing Marine Laboratories. The provided cost estimates for the Moss Landing Marine Laboratories are unknown.

Vulnerability Assessment Conclusions

It is difficult to predict the severity of casualties, property, and cascading impacts generated by future seismic events affecting the greater San Francisco Bay region, the Santa Clara Valley, and the San Jose State University campus. Each of the earthquake generated effects will vary widely based on the intensity of the earthquake, location of the epicenter, proximity to people and development, time of day and year, the soil composition under the impacted structures, building construction, among others. In any case, the potential for a major earthquake exists affecting the campus and causing extensive challenges to the San Jose State University campus and community.

In the event that a major earthquake was to strike along the many fault systems surrounding San Jose, the effects could be significant to the campus community and campus operations. The widespread impacts generated by a major earthquake would extend the effects of casualties, damages, and other impacts to the broader San Francisco Bay region creating large-scale regionwide needs for critical assistance and a heavy demand on limited emergency resources. The threat and impacts presented to the campus will be shared with the campus community from their homes and places of work. The campus will likely be required to address critical needs independently during early phases of the disaster.

Vulnerabilities will be seen in the physical infrastructure on the campus and the human population of the campus community. Campus infrastructure is vulnerable to severe shaking particularly in areas where the ground is loose or susceptible to liquefaction. Specifically older buildings, masonry constructed buildings, and other structures susceptible to shaking related damage are the most vulnerable. Communication systems,
computer networks, and other electronic systems may be vulnerable when overwhelmed by increased demand during emergencies or by shaking related damages. The people of the campus community are vulnerable to effects of intense shaking in the form of injuries from falling debris, exposure to secondary floods or fires, loss of employment, extreme disaster induced stress, and loss of access to critical services or social contacts.

The campus population are additionally vulnerable to the effects of major ground shaking that are far reaching. The psychological and social impacts a major earthquake will give rise to will potentially harm individuals and cause tremendous fear. The willingness to return indoors may be hampered especially as after-shocks continue. These effects are magnified for populations having specific vulnerabilities or access limitations. Populations having various limitations or specific needs may be vulnerable to reduced or eliminated access to essential services that have been rendered incapable to respond.

**Identified Data Limitations**

Data limitations include missing campus structural replacement costs, and lack of a complete inventory of building construction types to include status of earthquake retrofitting. HAZUS generated analysis is focused on the broader community level versus fine-tuning the analysis to the micro-level for facilities such as a university campus.

**Erosion**

**Description of the Hazard**

The US Geological Survey (USGS) defines erosion as “the process whereby materials of the earth’s crust are loosened, dissolved, or worn away and simultaneously moved from one place to another”\(^5\) Erosion may occur in areas of streams and rivers, along bluffs, around immovable objects (such as buildings or bridge abutments), or as a cascading result of other natural hazards, such as earthquakes or wildfires. When erosion occurs along bodies of water, the removal of material causes the shore to move further landward.

Forces such as sea level rise and changes in sediment supply impact erosion gradually and can be difficult to recognize. In contrast, the impacts of short-term events, such as storms and flooding, can be severe and are immediately recognizable.

**Location of the Hazard**

Erosion is a relatively non-spatial hazard that can occur in any location with conducive soil structure and a source of movement such as water or wind. An area’s potential for erosion is determined by several factors, including rainfall, topography, soil characteristics, and vegetative cover. Streambank and bluff erosion can occur near any

riverine area. For the purpose of this campus-level analysis, the erosion hazard poses a consistent risk across those areas of the campus with erosion-prone characteristics. That said, an effort to identify such locations on campus has not been conducted up to this point.

Extent of the Hazard
There is no published scale of severity or extent for this geologic hazard. If conditions are favorable, erosion is likely to occur to some degree over the long term. Given no history of occurrence on the campus and no known locations at risk to erosion, the planning committee ranks the extent of the hazard on the campus as Low.

History of the Hazard
There have been no recorded incidences of erosion on the San Jose State University (SJSU) campus.

Potential Impacts of the Hazard
Erosion causes instability in soil. During high-intensity rain events, for example, eroded areas will continue to erode, resulting in additional loss of soil and ground stability in the area. This removal of sediment can result in damage to infrastructure, public health, and safety. On campus, areas of erosion can create pedestrian and transportation hazards, and structures may become unsafe if erosion is not controlled.

Probability of Future Occurrence of the Hazard
Erosion is an on-going and dynamic process that occurs regularly. As climate change induces more frequent and intense weather events, such as wildfires and flooding, erosion may generally become more widespread or severe. These events can cause erosion or exacerbate areas already experiencing erosion. However, in consideration of the potential extent of erosion, and the unlikely probability of erosion occurring somewhere on campus in the future, the probability is Low over the long term.

Vulnerability to the Hazard
Topography, soil structure, land use, and precipitation are all factors of erosion. SJSU does not have infrastructure and buildings located on steep slopes and does not have recorded instances of erosion.

In the wider San Jose community, erosion vulnerabilities include agricultural sector job loss, degradation of riverine ecosystems, and loss of water quality.

Estimate of Potential Losses
The historic and potential impacts of erosion on property statewide include reduced agricultural productivity, lower surface water quality, and damaged drainage networks.

Current modeling is not precise enough to allow for an assessment of potential losses to buildings and infrastructure on campus.
Vulnerability Assessment Conclusions

While the ability to predict future erosion on the SJSU campus is limited, the core issues shaping erosion vulnerability on campus are flora and landscaping. If left unchecked, erosion can cause significant damage to campus infrastructure and the surrounding environment.

Identified Data Limitations

The complex interactions between soil erosion factors make predictive modeling, determination of hazard areas, and quantification of loss difficult. Localized data on this hazard is also limited, resulting in more generalized findings.
**Extreme Temperatures (Includes Extreme Cold and Extreme Heat)**

**Heat**

**Description of the Hazard**

What is considered an excessively hot temperature varies according to the normal climate for that region. However, when temperatures are extremely high, people are at higher risk for heat-related illnesses, such as dehydration, heat exhaustion, heat stroke, and in severe cases, death.\(^{53}\)

Hazards from extreme heat are made worse when high temperatures are accompanied by high levels of humidity, which is defined as the amount of moisture in the air.\(^{54}\) As the temperature climbs, the air is able to hold more moisture. High humidity prevents the human body from cooling down naturally, which leads people to perceive that the temperatures “feel” hotter. The combination of temperature and humidity is known as the heat index.\(^{55}\)

Heat stroke, the most serious heat-related illness, occurs when the body is unable to control its temperature. Body temperature rises rapidly, the sweating mechanism fails, and the body cannot cool down.\(^{56}\) In extreme cases, heat stroke can cause confusion and unconsciousness, so the victim is unable to seek treatment without assistance.

There are several groups of people who are uniquely vulnerable to the effects of extreme heat, such as infants and children, older adults aged 65 and up, athletes and outdoor workers, low-income households, and individuals with certain chronic medical conditions.\(^{57}\)

**Location of the Hazard**

Extreme heat events are a non-spatial hazard and may occur throughout the San Jose State University campus.

**Extent of the Hazard**


\(^{55}\) Ibid.


Extreme heat has a wide range of extent and severity markers and characteristics. Monthly average maximum temperatures in June through October remain fairly steady in the low 80s in San Jose. According to data from the National Climatic Data Center (NCDC), the highest daily temperature recorded in San Jose was 119° F on June 14, 2000. Based on 2 extreme heat events, and the probable increase in the number of such events due to climate change, the planning committee ranks the extent of the hazard as Moderate.

The National Weather Service issues a Heat Advisory when the heat index value is expected to reach 100° – 104° F within the next 12 to 24 hours. Excessive Heat Warnings are issued when there is an anticipated heat index of 105° F or greater that will last for two (2) or more hours. Excessive Heat Warnings are issued by the county when any location in the county is expected to meet the criteria. In anticipation of an Excessive Heat Warning, an Excessive Heat Watch may be issued 1 to 2 days in advance, when the Heat Warning criteria is 50 – 79% likely to occur.

Figure 22-12 (following) depicts the National Weather Service’s methodology for determining the heat index, using the % humidity and the actual temperature.

Figure 22-12: Methodology for Determining Heat Index

As the heat index rises, so does the potential danger to people and animals. Table 22-23 (following) shows the health hazards associated with extreme heat.

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Table 22-22: Health Risks Associated with Heat Index 59

<table>
<thead>
<tr>
<th>Category</th>
<th>Heat Index</th>
<th>Health Hazards</th>
</tr>
</thead>
<tbody>
<tr>
<td>Extreme Danger</td>
<td>130° F or higher</td>
<td>Heat stroke / sunstroke is likely with continued exposure.</td>
</tr>
<tr>
<td>Danger</td>
<td>105° – 129° F</td>
<td>Sunstroke, heat cramps, and/or heat exhaustion is likely with prolonged exposure and/or physical activity.</td>
</tr>
<tr>
<td>Extreme Caution</td>
<td>90° – 104° F</td>
<td>Sunstroke, heat cramps, and/or heat exhaustion is possible with prolonged exposure and/or physical activity.</td>
</tr>
<tr>
<td>Caution</td>
<td>80° – 89° F</td>
<td>Fatigue is possible with prolonged exposure and/or physical activity.</td>
</tr>
</tbody>
</table>

History of the Hazard

Based on data gathered from the National Centers for Environmental Information (NCEI) Storm Events Database, there has been only two excessive heat events recorded since 1950 and five other heat events.

**June 10, 2019:** This heat event occurred during one of the hottest heat waves ever to hit the Bay Area, with temperatures 20-30 degrees above normal. The temperature in San Jose hit 100° F. There was one death attributable to this excessive heat event.

**June 14, 2000:** According to data from the National Climatic Data Center (NCDC), the highest daily temperature recorded in San Jose was 119° F.

Potential Impacts of the Hazard

During an excessive heat event, San Jose State may experience impacts from extreme heat due to cancelled classes or postponed outdoor events in order to protect students, faculty, and staff from the weather.

In addition to the threat extreme heat poses to humans, high temperatures also pose a threat to utility production, which in turn threaten facilities and operations that rely on utilities. As temperatures rise, more people stay indoors, increasing the demand for air conditioning, fans, and other electronics. This puts a strain on the electrical grid, which can cause temporary outages. These outages can impact operations throughout campus, resulting in interruptions and delays in service. Outages may also negatively impact

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research efforts on campus, as the inability to maintain a steady, constant temperature may impact research specimens and experimental results.

**Probability of Future Occurrence of the Hazard**

The City of San Jose (and Santa Clara County) experienced an excessive heat event in 2000 and 2019. The Santa Clara County Hazard Mitigation Plan considers extreme heat to be a threat to people, pets, and livestock, particularly due to climate change and the increasing number of extremely hot days that Santa Clara County experiences per year.60

According to the scale provided, it is **Possible** that this hazard will occur annually in the future.

**Vulnerability to the Hazard**

When dealing with an extreme heat event, the most common impacts are those generally felt by the people living in the targeted area. For people in particular, heat can kill when the body is pushed beyond its limits. Most heat disorders occur because the victim has been overexposed to heat. As discussed, the major human risks associated with extreme heat include dehydration, sunburn, fatigue, heat exhaustion, heat stroke, and in severe cases, death.

Some portions of the population are more at risk to the effects of extreme heat. The very young, the elderly, and certain groups with chronic medical conditions (such as asthma or other pulmonary illnesses, heart disease, poor blood circulation, neurological illnesses, and obesity) are generally more vulnerable to the effects of extreme heat, and are more likely to suffer illness or death as a result.61 This is especially true if exposure is extended for a period of time and preventative measures are not taken immediately.

San Jose State does not directly address the hazard of extreme heat. The risks of heat illness among campus staff and workers are addressed by the campus’s Office of Environmental Health and Safety. During their orientation, campus staff take a brief course on Heat Illness Prevention.

However, the City of San Jose has a specific Heat Wave Annex as part of its Emergency Operations Plan. The city has contingency plans to open cooling centers, post heat

60 Santa Clara County Operational Area Hazard Mitigation Plan. Projected Number of Extreme Heat Days by Year for OA. Print. Retrieved 01.29.21 from: https://emergencymanagement.sccgov.org/partners

emergency information on the City’s website, notify the public of the hazard, and provide public education materials.\textsuperscript{62}

As this may be a hazard that the campus will experience with increasing regularity, the campus may want to take additional measures in order to properly handle the risks and vulnerabilities.

**Estimate of Potential Losses**

Based on the previous historical occurrences, annualized losses are considered to be negligible. In an extreme heat event, loss of human life or health impacts are a greater concern than is property damage.

**Vulnerability Assessment Conclusions**

While the ability to predict future heat events at the San Jose State campus is limited, the effects of climate change may provide some information. According to the Environmental Protection Agency (EPA), Central California has warmed about two degrees on average over the last century, with less rainfall. This may lead to stronger and more frequent heat events, drought, and an increased risk of wildfires.\textsuperscript{63}

If such changes take place, it will produce a variety of inter-connected vulnerabilities and impacts stemming from each hazard.

**Extreme Cold**

**Description of the Hazard**

What is considered an excessively cold temperature varies according to the normal climate for that region. However, when temperatures are far below normal, with higher wind speeds, heat leaves the human body more rapidly, which increases the possibility of negative effects from these extreme temperatures.\textsuperscript{64}

The greatest danger from extreme cold is to people, as prolonged exposure can cause frostbite or hypothermia, and can become life threatening. When someone is suffering from hypothermia, body temperatures can become so low that they affect the brain, making it difficult for the victim to think clearly or move well. In the case of frostbite, the


\textsuperscript{64} National Weather Service. *Stay Safe in the Extreme Cold.* Retrieved 01.29.21 from: https://www.weather.gov/dlh/extremecold
frozen tissue becomes numb and the victim may be unaware that anything is wrong until someone else notices.65 This makes hazards from extreme cold particularly dangerous, as people may not understand what is happening to them or what to do about it.

The primary hazards from extreme cold are frostbite and hypothermia. Frostbite is caused by freezing of the skin and underlying tissue. It causes a loss of feeling and color in the affected areas of the body, and most often affects the nose, chin, fingers, or toes.66 It can be permanently damaging if not treated promptly and can lead to infection, nerve damage, or amputation in severe cases.67 The risk of frostbite is increased in people with preexisting conditions, the elderly, people with reduced blood circulation, and people who are not dressed warmly enough for the conditions.

Hypothermia occurs when the body loses heat faster than it can produce heat, causing a dangerously low body temperature. A normal body temperature is around 98.6°F. Hypothermia occurs when your body temperature falls below 95°F.68 As this happens, the heart and other essential organs cannot work properly. If hypothermia is not treated, it can lead to heart failure, respiratory failure, and eventually to death.

Excessive or extreme cold can accompany severe winter weather, or it can occur without severe weather. For this reason, extreme cold is a separate hazard from severe winter storms.

Location of the Hazard

Extreme cold events are a non-spatial hazard and may occur throughout the San Jose State campus.

Extent of the Hazard

Extreme cold has a wide range of extent and severity markers and characteristics. Average nighttime winter temperatures in the City of San Jose are typically in the low 40s to mid-40s. According to data from the National Climatic Data Center (NCDC), the lowest daily temperature recorded in the City of San Jose was 19°F on December 22, 1990. Based on no record of extreme cold events and only three frost/freeze events, the planning committee ranks the extent of the hazard on campus as Low.


67 Ibid.

The National Weather Service issues Extreme Cold Warnings when the temperature feels like it is -30° F or colder across a wide area for a period of at least several hours. When possible, these advisories are issued a day or two in advance of the conditions.69

The most common extent/severity marker for extreme cold is the Wind Chill scale. Figure xx (following) depicts the National Weather Service’s methodology for determining the wind chill, using wind speed and actual temperature. Although wind chill is not necessarily related to extreme cold as a single cause, the advisory system that the NWS currently uses relies on wind chill to relay warning and advisory information to the public. Extreme cold severity is a function of wind chill and other factors, such as precipitation amount (rain, sleet, ice, and/or snow).

In 2011, the National Weather Service introduced an experimental program that issued warnings for extreme cold events, independent of other severe weather warnings. The test areas included North and South Dakota and Minnesota. However, in 2012, after a single season of use, the program was abandoned, based on reports of confusion among test audiences.\textsuperscript{70}

**History of the Hazard**

Based on data gathered from the National Centers for Environmental Information (NCEI) Storm Events Database, Santa Clara County has had three frost/freeze events, but no extreme cold hazards. \textit{[Records for this hazard were first recorded in 1996].}

**Potential Impacts of the Hazard**

Should an extreme cold event occur, San Jose State might experience impacts due to cancelled classes.

In addition to the threat posed to humans, extreme cold weather poses a significant threat to utility production, which in turn threatens facilities and operations that rely on utilities, specifically climate stabilization. As temperatures drop and stay low, increased demand for heating places a strain on the electrical grid, which can lead to temporary outages. These outages can impact operations throughout the campus, which can result in interruptions and delays in services. These outages may also negatively impact research efforts throughout the campus, as the inability to maintain a steady, constant temperature may result in unintended effects on research specimens.

Probability of Future Occurrence of the Hazard

The City of San Jose has experienced frost/freeze events, but has never experienced an extreme cold event. Due to the campus’s location in a fairly temperate climate, it is **Unlikely** that this hazard will occur annually.

Vulnerability to the Hazard

When dealing with an extreme cold event, the most common impacts are those generally felt by the people living in the targeted area. For people in particular, extreme cold can kill when the body is pushed beyond its limits. Most danger due to the cold is because the victim has been overexposed to low temperatures. As discussed, the major human risks associated with extreme cold include frostbite, hypothermia, and in severe cases, death.

Some portions of the population are more at risk to the effects of extreme cold. The elderly, those with certain preexisting conditions (hypothyroidism, diabetes, and high blood pressure, just to name a few), those with poor blood circulation, and people who are not dressed warmly enough for the cold are generally more vulnerable and are more likely to suffer illness or death as a result.71 This is especially true if exposure is extended for a period of time and preventative measures are not taken immediately.

San Jose State does not have any specific contingency or emergency plans in case of an extreme cold event. Likewise, excessive/extreme cold is not a profiled hazard in either the City of San Jose Hazard Mitigation Plan/Emergency Operations Plan or in the Santa Clara County Hazard Mitigation Plan. In fact, the Santa Clara County Hazard Mitigation Plan notes that, “Extreme cold weather has not been profiled for the Santa Clara County OA has [sic] its frequency and severity do not warrant assessment (the California State Hazard Mitigation Plan also omitted extreme cold weather as an identified hazard of concern).”72 In an extreme cold or frost/freeze event, power outages can also be a


72 Santa Clara County Operational Area Hazard Mitigation Plan. *Severe Weather, General Background*. Retrieved 03.28.21 from https://emergencymanagement.sccgov.org/partners
concern. However, San Jose State has its own gas-powered power plant that provides 80% of its electrical needs and is not subject to public safety power shut-offs (PSPS) or brown-outs. In a severe power outage, the campus projects that the power plant could provide power to most campus buildings for a period of at least a few days.

Estimate of Potential Losses

Based on the previous historical occurrences of extreme heat events, annualized losses are considered to be negligible. In an extreme heat event, loss of human life or health impacts are a greater concern than is property damage.

Vulnerability Assessment Conclusions

While the ability to predict future extreme cold events at the San Jose State campus is limited, the effects of climate change may provide some information. According to the Environmental Protection Agency (EPA), Central California has warmed approximately two degrees on average over the last century, with less rainfall. This may lead to fewer frost/freeze events in the future.73

Identified Data Limitations

Numerous public and private actors conduct research, acquire data and disseminate meteorological information and forecasting to the general public, including the CSU university system. Currently, it is assumed that, apart from regular access to climate change models on changes to temperature extremes over time, the CSU community maintains sufficient access to the data needed to plan for, respond to, and mitigate the effects of extreme heat and cold.

Flood

Description of the Hazard

The incredible geographic diversity in California presents tremendous challenges for flood planning and response. The state is home to extensive mountain ranges such as the Sierra Nevada, Cascades, Klamath, Coastal Ranges, and the Southern California Transverse Range all creating tremendous watersheds. Large river systems drain the mountains traveling through populated communities including the Sacramento and San Joaquin Rivers draining into the California Delta. The state has a complex system of reservoirs, dams, and levees providing water storage and flood protection. Finally, California’s 840-mile coastline exposes the coastal regions to tidal influences.

Floods are characterized by the rising and overflowing of excess water from a water source such as a stream, river, lake, canal, or coastal body onto an area of normally dry floodplain. A floodplain is a lowland area downstream and/or adjacent to water bodies that are subject to flood events. Flooding is a naturally occurring event that become hazardous when populations and property are affected.

Flooding can result from excessive precipitation from weather systems generating prolonged rainfall, excessive snowmelt from watersheds upstream from the floodplain, infrastructure failure, exceeding the capacity of dams or levees, tidal influences, or a combination from any of the previous factors.

Floods represent one of the costliest and most frequent natural disasters that influences human suffering and economic impact in the United States. Flooding will likely result in significant damage to structures, infrastructure, utilities, landscapes, and the environment. Erosion of stream banks, roadways, other feature may result from the movement of flood waters. The saturated ground resulting from standing flood waters may cause ground instability, collapse, erosion, or other damages. Further, floods will often generate substantial debris that will accumulate and be deposited throughout the flooded areas.

Floods can be either slow-rise or rapid onset floods. With slow rise floods, there is often warning preceding water rise by hours or days before dangerous conditions present themselves. Slow rise floods that are expected to enter into populated areas generally allow for some time to initiate evacuation and sand bagging efforts. Flooding that occurs rapidly conversely are water events that present with extremely limited warning times and a limited ability to take response actions until flooding has already begun to occur.

Flooding may take on different forms:

- **Flash Flooding** – Flash flooding is typically characterized by a rapid rise, short duration, and large volume of water in a localized area. Heavy rainfall in areas that have limited drainage capacities often contribute to flash flooding conditions. These flooding events frequently occur with limited notice requiring immediate evacuation or rapid response efforts such as sand bagging. Flash flooding may arrive with fast moving water creating added hazardous conditions.

- **Riverine Flooding** – Riverine flooding is usually caused by prolonged rainfall or rainfall combined with heavy snowmelt. When soils are already saturated, the ability for the ground to absorb water is minimized. In a riverine flood, the water way exceeds channel capacity and extends into areas outside of the channel, often in developed communities. In California, riverine flooding is most likely to occur from November through April. The duration of riverine floods may vary from a period of hours to weeks.

- **Localized Flooding** – Localized flooding is commonly the result of stormwater drainage systems being overwhelmed by unusually heavy rainfall. These flooding events frequently occur in areas that are urbanized or developed with greater
amounts of impervious surfaces not allowing ground absorption. This generates added runoff into the drainage systems and onto roadways creating backups.

- **Infrastructure Failure** – Failures of dams or levees presents a serious flooding concern for areas downstream from the compromised structure. This situation may result in a catastrophic flood with limited warning time and widespread areas affected.

- **Coastal Flooding** – Coastal flooding can occur in multiple areas along the California coastline. Flooding may result from intense storms coming from the Pacific Ocean that generate elevated water levels or storm surge. The size, duration, winds generated, and intensity of the storm will influence the effect the waves will have on the shoreline. Periods of high tide can aggravate the conditions allowing greater wave impingement into coastal areas.
Atmospheric Rivers

California, including the location of this campus, is subject to the effects of a phenomenon referred to as atmospheric rivers. These weather events consist of long, narrow regions in the atmosphere transporting tremendous amounts of water vapor from the tropics. These weather regions behave like rivers in the sky. They can carry heavy volumes of water vapor compared to the amount of water flow at the mouth of the Mississippi River. As these atmospheric rivers arrive into California, they tend to generate significant rain and snow.

Atmospheric rivers can arrive in many different shapes and sizes. The larger events are able to generate extreme rainfall amounts resulting in flooding. They can stall over watersheds vulnerable to flooding, often saturated with heavy snow amounts. The atmospheric rivers known as a “Pineapple Express” coming from the tropics and arriving with warmer air may produce heavy rains that will melt ground snow adding to the water volume that will be added in the flood runoff.

These events can produce heavy amounts of precipitation creating extensive damages. However, these events may present as weaker systems that produce precipitation that is enough to be beneficial for the local water supply. At the higher elevations in the California mountains, these events have the potential to generate a tremendous snowpack providing a source of water during the dry summer months.
Location of the Hazard

San Jose is located in Santa Clara County on the southern end of the San Francisco Bay. Santa Clara County can experience flooding from overflowing streams and heavy precipitation events in low lying areas such as San Jose, Santa Clara, and Sunnyvale. These areas often experience shallow flooding impacting roadways and other areas where drainage is inadequate. The northern side of Santa Clara County is a coastal plain adjacent to the San Francisco Bay that gradually rises to the south toward the Santa Cruz Mountains and the Diablo Range. The communities in San Jose are densely populated with extensive residential neighborhoods. Adjacent to the campus is downtown San Jose with heavy commercial land uses including high rise buildings. Within a mile east and west of the campus are industrial zones containing a variety of land uses including chemical facilities and distribution centers shipping different materials.

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74 National Oceanic and Atmospheric Administration, “What are atmospheric rivers?”, https://www.noaa.gov/stories/what-are-atmospheric-rivers
The San Jose State University campus is located in the low-lying plain that surrounds the San Francisco Bay. The campus is situated in a densely populated downtown area that is ½ mile away from the Coyote Creek to the east and ¾ mile from the Guadalupe River to the west. Both of these waterways drain reservoirs upstream that capture runoff from the hills and mountains that line the Santa Clara Valley.

The San Jose State University campus is entirely located in a designated Zone D: An Area of Undetermined but Possible Flood Threats. The access routes into and out of the campus servicing locations to the north and south are found in designated Zone D: An Area of Undetermined but Possible Flood Threats. Access routes to the west are found in areas designated as Zone X: 0.2% Annual Chance Flood Hazard and Zone AO: 1% Annual Chance Flood Hazard. Access routes to east are found in areas designated as Zone AE: 1% Annual Chance Flood Hazard and Zone D: An Area of Undetermined but Possible Flood Threats.

The San Jose State University, Moss Landing Marine Laboratories campus is entirely located in a designated Zone X: 0.2% Annual Chance Flood Hazard. The access routes into
and out of the campus are found in designated Zone X: 0.2% Annual Chance Flood Hazard and Zone A: 1% Annual Chance Flood Hazard.

Extent of the Hazard

The San Jose State University campus lies within an Undetermined Flood Hazard Areas but outside of levee flood protected areas. Levees protect areas at the base of the foothills and lining flood control channels. Surrounding transportation routes are located in Zones D, X, AE and AO. As such, potential for disruption to campus access exists. That said, the planning committee ranks the extent of the hazard on campus as Low. In support of the NFIP, FEMA identifies those areas that are more vulnerable to flooding by producing Flood Hazard Boundary Maps (FHBM), Flood Insurance Rate Maps (FIRM), and Flood Boundary and Floodway Maps (FBFM). Several areas of flood hazards are commonly identified on these maps, including the 1% annual chance flood zone. Flood zones are further delineated by risk and are assigned a letter signifier. The flood zone designations are defined and described in the following table.

Table 22-23: Flood Zone Designations and Descriptions

<table>
<thead>
<tr>
<th>Zone Designation</th>
<th>Percent Annual Chance of Flood</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Zone V</td>
<td>1%</td>
<td>Areas along coasts subject to inundation by the 1% annual chance of flooding with additional hazards associated with storm-induced waves. Because hydraulic analyses have not been performed, no BFEs or flood depths are shown.</td>
</tr>
<tr>
<td>Zones VE and V1-30</td>
<td>1%</td>
<td>Areas along coasts subject to inundation by the 1% annual chance of flooding with additional hazards associated with storm-induced waves. BFEs derived from detailed hydraulic analyses are shown within these zones. (Zone VE is used on new and revised map in place of Zones V1-30.)</td>
</tr>
<tr>
<td>Zone A</td>
<td>1%</td>
<td>Areas with a 1% annual chance of flooding and a 26% chance of flooding over the life of a 30-year mortgage. Because detailed analyses are not performed for such areas, no depths or base flood elevations are shown within these areas.</td>
</tr>
<tr>
<td>Zone</td>
<td>Percentage</td>
<td></td>
</tr>
<tr>
<td>--------</td>
<td>------------</td>
<td></td>
</tr>
<tr>
<td>Zone AE</td>
<td>1%</td>
<td></td>
</tr>
<tr>
<td>Zone AH</td>
<td>1%</td>
<td></td>
</tr>
<tr>
<td>Zone AO</td>
<td>1%</td>
<td></td>
</tr>
<tr>
<td>Zone X (shaded)</td>
<td>0.2%</td>
<td></td>
</tr>
<tr>
<td>Zone X (unshaded)</td>
<td>Undetermined</td>
<td></td>
</tr>
</tbody>
</table>

Areas with a 1% annual chance of flooding and a 26% chance of flooding over the life of a 30-year mortgage. In most instances, BFEs derived from detailed analyses are shown at selected intervals within these zones.

Areas with a 1% annual chance of flooding where shallow flooding (usually areas of ponding) can occur with average depths between 1 – 3 feet.

Areas with a 1% annual chance of flooding, where shallow flooding average depths are between 1 – 3 feet.

Represents areas between the limits of the 1% annual chance flooding and 0.2% chance flooding.

Areas outside of the 1% annual chance floodplain and 0.2% annual chance floodplain, areas of 1% annual chance sheet flow flooding where average depths are less than one (1) foot, areas of 1% annual chance stream flooding where the contributing drainage area is less than one (1) square mile, or areas protected from the 1% annual chance flood by levees. No BFEs or depths are shown within this zone.

History of the Hazard

Flooding in San Jose and the broader San Francisco Bay Area have typically occurred during the winter months when Pacific storms are more common. The occurrences of significant flooding typically have been the result of successive intense storms with heavy precipitation. The region has experienced flood events that have caused tens of millions of dollars in damages and casualties. The following provides insight into information of past flooding events that are significant to the San Jose State University campus. Data on the impact of these events on campus is not available, but, in general, flooding on campus is confines to localized or isolated ponding in low lying areas during heavy rainfall events.
Table 22-24: Historic Flooding Events in Santa Clara County\textsuperscript{75}

<table>
<thead>
<tr>
<th>Date</th>
<th>Event</th>
<th>Declaration</th>
<th>Damage</th>
</tr>
</thead>
<tbody>
<tr>
<td>January 2017</td>
<td>Flood; Winter Storms</td>
<td>DR-4301-CA</td>
<td>Countywide, Coyote Creek</td>
</tr>
<tr>
<td>December 2014</td>
<td>Flood; Debris Flows</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td>February 2014</td>
<td>Flood; Heavy Rains</td>
<td>NA</td>
<td>Urban flooding</td>
</tr>
<tr>
<td>January 2010</td>
<td>Flood; Heavy Rains</td>
<td>NA</td>
<td>Localized urban flood</td>
</tr>
<tr>
<td>February 2000</td>
<td>Flash Flood; Heavy Rains</td>
<td>NA</td>
<td>Coyote Creek flooding</td>
</tr>
<tr>
<td>February 1998</td>
<td>Flood; Winter Storms</td>
<td>DR-1203-CA</td>
<td>$550 million; 17 fatalities</td>
</tr>
<tr>
<td>January 1997</td>
<td>Flood; Winter Storms</td>
<td>DR-1155-CA</td>
<td>$1.8 billion</td>
</tr>
<tr>
<td>March 1995</td>
<td>Flash Flood; Heavy Rains</td>
<td>DR-1046-CA</td>
<td>$1.1 billion</td>
</tr>
<tr>
<td>January 1995</td>
<td>Flash Flood; Heavy Rains</td>
<td>DR-1044-CA</td>
<td>$741 million; 11 fatalities</td>
</tr>
<tr>
<td>January 1993</td>
<td>Flood; Winter Storms</td>
<td>DR-979-CA</td>
<td>&lt;$1 million</td>
</tr>
<tr>
<td>February 1992</td>
<td>Flood; Winter Storms</td>
<td>DR-935-CA</td>
<td>&lt;$1 million</td>
</tr>
<tr>
<td>February 1986</td>
<td>Flood; Winter Storms</td>
<td>DR-758-CA</td>
<td>$407 million</td>
</tr>
<tr>
<td>February 1983</td>
<td>Flood; Debris Flows</td>
<td>DR-677-CA</td>
<td>$523 million</td>
</tr>
<tr>
<td>January 1982</td>
<td>Flood; Winter Storms</td>
<td>DR-651-CA</td>
<td>$273 million</td>
</tr>
</tbody>
</table>

Potential Impacts of the Hazard

A flood will potentially result in extensive amounts of water entering onto developed areas. The force and volume of water that is generated by a flood may cause extensive structural damage in areas subject to standing or moving water. The effects of flooding may spread over significant distances covering large areas of land. The extent of the impacts would vary based on a number of factors such as the volume of water flooding, the time of the flood event, the amount of warning provided, the location and extent of the flood boundary, facility elevation, and distance from the flood source. Potential impacts resulting from flooding include:

- Injuries or loss of life
- Property destruction or damage
- Loss of property contents
- Infrastructure damage including roadways, bridges, other transportation means
- Public health hazards resulting from mold, mildew, and disease due to flood water
- Flooded or destroyed lifelines/supply routes
- Damaged or destroyed utilities,

\textsuperscript{75} Santa Clara County Operational Area Hazard Mitigation Plan, September 2017
- Loss of community economic base
- Employment losses
- Agricultural (crops and livestock) damages or destruction
- Environmental damage
- Prolonged periods of necessary dewatering
- Flooding erosion may alter natural drainage channels
- Residence halls requiring evacuation and sheltering of occupants
- Threat, inundation, or damage to on campus childcare facilities and occupants
- Societal and community impacts
- Psychological impacts of impacted populations
- Disruptions to education delivery to community

Additionally, individuals who were unable to evacuate in time or refused to leave will likely need assistance or rescue from the flooded area. Remaining in or being trapped by flood waters places individuals in significant risk of injury or death. The impacts extend beyond the danger placed upon the affected individual and places greater resource demands on agencies and organizations making efforts to rescue trapped individuals.

Probability of Future Occurrence of the Hazard

Santa Clara County is determined to have considerable portions of the county at high risk from flooding. The repeated historic occurrences have shown that the region is subject to flooding in any given year. Floods can occur at any time but are most common in the San Francisco Bay Area with winter storms that are saturated with subtropical moisture. The area surrounding the San Jose State University campus is an urban downtown environment. Flood waters are more likely to occur due to isolated heavy precipitation resulting street flooding. However, the campus is located in an area classified as Zone D (An Area of Undetermined but Possible Flood Threats). A half mile to the northeast is the Coyote Creek zoned as Zone AE Special Flood Hazard Area (Area Inundated by 1% Annual Chance of Flooding) and has a history of flood events. A half mile to the southwest is the Guadalupe Creek and is buffered by Zone X (0.2% of Annual Chance of Flood Hazard). Access in and out of the campus may become compromised in flooding events on or off campus. There are specific buildings and areas of the campus that have a greater risk for isolated flooding. However, the area is subject to isolated urban or street flood events providing a demonstration of potential flood activity.

The probability of future occurrence for flooding on campus is Possible.

Vulnerability to the Hazard
The San Jose State University campus is subject to the effects of localized or isolated flooding resulting primarily from excessive precipitation and isolated strong storms. Flooding also may result from creek overflow from either the Coyote Creek or Guadalupe River. There is a more remote potential for flooding and damage on campus and surrounding residential and commercial areas of San Jose due to overflow or damage to upstream flood control systems. The flood control channels and drainage systems that are upstream from the campus have limited storage or volume capacities. The campus and the campus community are vulnerable to the effects generated by flooding from these systems.

Vulnerability to flooding on the San Jose State University campus will vary depending on when the flood were to occur. The risk to the campus population will be lessened during periods when classes are not in session or during periods of breaks. Conversely, during the days and hours that classes are in session and staff are at their workplaces, the human vulnerability increases. During severe floods, members of the campus community may become trapped on campus depending on the level and locations of isolated flooding occurring on surface streets. However, in rare region-wide events this vulnerability may be extended to the homes and workplaces of members of the campus community and their families.

San Jose State University is in proximity to a variety of industrial and commercial facilities in the surrounding communities. When these facilities are inundated with flood water, the potential for chemical or other hazardous materials release exists presenting possible exposures to individuals from the campus community. These facilities additionally line many of the primary access routes in and out of the campus.

During low probability, severe flood events, some campus buildings and infrastructure might be vulnerable to large-scale flooding if it reaches the university. Campus utilities and communication capabilities might be impacted by flood waters rendering them disabled. A flood covering a large portion of the city might affect communication capabilities well beyond the boundaries of the campus. Remaining flood waters will leave behind molds and other health concerns in affected campus buildings and facilities likely requiring extensive restoration or demolishing. The residents of the on-campus residence halls may have transportation limitations requiring evacuation and alternative housing procedures to be implemented if populated. Flood waters may result in damage to campus equipment, communication systems, protected documents, artwork, academic materials, computer systems, research, and other critical activities on lower levels of buildings.

Certain campus populations will experience greater challenges to a post-flood / failure environment. Vulnerable populations will likely need to navigate through flood generated debris, face extreme health safety issues from flood waters, experience extreme stresses of a disaster, an inability to communicate to or gain access to support networks, and find difficulty in accessing equipment or supplies to aid in a specific need. Students remaining on campus such as those residing in the residence halls would be particularly vulnerable especially those without access to adequate transportation.
Estimate of Potential Losses

Estimates of potential losses will be influenced by a variety of factors. The volume and force of the water will determine the scale of damages affecting campus infrastructure, equipment, and other impacted features. The location and elevation above flood waters will affect the level of damage and individuals exposed. The time of the academic year, the day of week, and hour in which the flooding was to occur will influence the number of people on campus and potential casualties. The severity of the storms producing precipitation, the speed of the storms moving across the area, the level of snowpack in the higher elevations, and amount of resulting snowmelt will produce varying effects on damages produced and costs incurred. Losses will be generated by the physical damages, the loss of revenue, loss of academic research, loss of building contents, and community wide economic reductions.

Based on estimate replacement costs of facilities and structures on campus, the maximum total replacement costs due to flood are $1,129,789,581. However, it is unlikely for flood to cause destructive losses to the entire campus.

Table 22-25: Special Flood Hazard Area (SFHA) Estimated Losses

<table>
<thead>
<tr>
<th>Zone Designation</th>
<th>No of Buildings</th>
<th>Maximum Replacement Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Zone V</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Zone VE &amp; V 1-30</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Zone A</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Zone AE</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Zone AH</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Zone AO</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Zone D</td>
<td>62</td>
<td>$1,129,789,581</td>
</tr>
<tr>
<td>Zone X .2%</td>
<td>3</td>
<td>Unknown</td>
</tr>
<tr>
<td>Zone X Minimal Risk</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Not in a SFHA</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>No Building Value Data Provided*</td>
<td>17</td>
<td>Unknown</td>
</tr>
</tbody>
</table>

*Buildings with no value defined are also included in the respective Zones they are found in.

The table above includes 3 facilities located at the Moss Landing based San Jose State University, Moss Landing Marine Laboratories. The 3 facilities included are located in the Zone X (0.2% of Annual Chance of Flood Hazard). The provided cost estimates for the Moss Landing Marine Laboratories are unknown.

Vulnerability Assessment Conclusions

While the campus is located in areas of minimal flooding, the primary vulnerabilities to flood on campus are people and assets exposed to mostly localized flooding from overflow of campus creeks or isolated or large-scale storms that produce heavy amounts of precipitation directly over the campus and surrounding neighborhoods. The proximity
to the Coyote Creek and Guadalupe River presents an additional flood hazard for the campus.

The potential for highly unlikely, but severe flooding on the campus and surrounding area generates the potential for a number of cascading effects such as disruptions to the local economy, utility failures, disruptions to providing for the needs of the campus and the surrounding community, and development of public health hazards. These effects would be exacerbated by effects of seasonal flooding, ongoing heavy precipitation, or excessive run-off from the watershed contributing to the river system. The potential for widespread flooding and damage of structures due to the force of water, while unlikely, has exponentially powerful impacts on particular segments of the campus community including those with access or functional needs, international students, the homeless, and students residing in the residence halls.

Identified Data Limitations

Data limitations include missing campus structural replacement costs, and an incomplete inventory of both building construction features and mitigation efforts to lessen the impact due to flood inundation. HAZUS generated analysis is focused on the broader community level versus fine-tuning the analysis to the micro-level for facilities such as a university campus.

**Hazardous Materials**

Description of the Hazard

A hazardous material is defined in California’s State Hazardous Materials Incident Contingency Plan (1991) as “a substance or combination of substances which, because of quantity, concentration, physical, chemical, or infectious characteristics may: cause, or significantly contribute to an increase in deaths or serious illnesses; and/or pose a substantial present or potential hazard to humans or the environment.” Hazardous materials are one or more of the following: flammable, corrosive or an irritant, oxidizing, explosive, toxic (poisonous or infectious), thermally unstable or reactive, or radioactive. Hazardous materials are ubiquitous in modern society and may be found at all stages of production, consumption, and disposal.

Federal and state laws permit the intentional release of some hazardous materials into the environment such that the risk to human health and the environment is thought to be acceptable. However, sometimes releases are unintentional, resulting from leaks, accidents, or natural hazards. This section focuses on such accidental releases and fall into the following key categories:

**Fixed Hazardous Materials Incident:** A fixed hazardous materials incident is the accidental release of chemical substances or mixtures during production or handling at a fixed facility.

**Transportation Hazardous Materials Incident:** A transportation hazardous materials incident is the accidental release of chemical substances or mixtures during highway, waterway or air transport. Populations, built and natural environments are potentially impacted.

**Pipeline Incident:** A pipeline transportation incident occurs when a break in a pipeline creates the potential for an explosion or leak of a dangerous substance (oil, gas, etc.) possibly requiring evacuation. An underground pipeline incident can be caused by environmental disruption, accidental damage, or sabotage. Incidents can range from a small, slow leak to a large rupture where an explosion is possible. Inspection and maintenance of the pipeline system along with marked gas line locations and an early warning and response procedure can lessen the risk to those near the pipelines.

Hazardous materials can also be classified according to worker safety and health. Information provided by California Division of Safety and Health includes guidelines related to:

- **Safety hazards:** fire and fire byproducts, electricity, flammable gases, unstable structures, demolition, sharp or flying objects, excavations)
- **Health hazards:** carbon monoxide ash, soot and dust; asbestos; hazardous liquids; other hazardous substances; heat illness)

**Natural-Technological Incidents (Natechs):** During the past two decades, increasing attention has been given to hazardous materials releases resulting from Natechs or a natural disaster event that triggers a technological hazard event. Natechs are of particular concern for the following reasons:

- They can produce a simultaneous effect on many industrial facilities
- Can overwhelm response capacity
- Containment systems may fail
- May produce cascading disasters

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Response may be hindered by a disaster’s impact on the physical environment.\(^8\)

Location of the Hazard

Hazardous materials and infrastructure such as fuel tanks, rail lines, chemicals, hazardous waste sites and gas pipelines to varying degrees are located within the CSU system and/or within its surrounding communities. The planning committee indicates that chemicals are located in science labs on campus, and the campus stores chlorine for disinfecting its swimming pools. Mapping indicates that numerous hazardous waste sites are very close to the campus, a gas pipeline runs through the middle of campus, and rail lines lie approximately one mile to the south, east and west of campus. At larger scales (beyond the campus planning area) hazardous materials and infrastructure are located throughout the city of San Jose and Santa Clara County, and reflect different types, configurations and scales dispersed across these geographic areas.

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Extent of the Hazard

There is no comprehensive statewide vulnerability assessment available at this time. As such, the true extent of the hazardous materials risk in California and its communities is not known, meaning no overarching conclusions have been reached which have been able to integrate all qualitative and quantitative risk factors to produce a comprehensive measure of the extent of the hazard.

For the SJSU planning committee, chemicals are managed in campus science labs, and chlorine is stored in pool areas. A few small-scale chemical spills have taken place in science labs. Based on these factors, along with the close proximity of hazardous waste sites and the gas pipeline on campus, the extent of the hazard for the SJSU campus is Moderate. That said, it is prudent to consider worst case scenarios as the main driver of policy in order to fully mitigate all possible hazardous materials event outcomes.

For example, according to the 2018 CA State Hazard Mitigation Plan, 400 hazardous materials problems are tied to 32 past earthquakes, including over 150 problems from the Loma Prieta Earthquake alone. That said, the plan indicates that it is likely that many such hazardous materials releases have received little attention in the past because public authorities, the media, and the public have overlooked them in the rush to address and recover from immediate disaster threats, and that responsible parties may have an incentive to understate the extent of releases or not to report them at all.

History of the Hazard

According to the CA Governor’s Office of Emergency Services’ Hazardous Materials Spill Report, the state experiences from 10 to 30 spill events daily. As of April 20th, 2021 already 2096 spill events had occurred. Such events have occurred in all the cities and/or counties where CSU campuses are located.

According to the 2018 CA State Hazard Mitigation Plan, with regard to natural-technological hazard events (Natechs), 400 hazardous materials events are tied to 32 past earthquakes, including over 150 Natech events from the Loma Prieta Earthquake alone.

According to the campus planning committee, a few chemical spills have taken place at science labs but were confined to a small area and did not require evacuation.

Potential Impacts of the Hazard

A large hazardous materials release could affect an entire community or city under certain conditions related to direction of air flow (air-based chemical release) and population density or the contamination of a community’s main water supply. Either type...


of release could necessitate large scale evacuation. By contrast, in the rural unincorporated areas where population densities are low, even in the event of a large release, the number of homes that may need to be evacuated would be significantly lower than in an urban environment. The occurrence of a hazmat incident can also result in the shut-down of transportation corridors which can last for hours at a time while the impacted area is stabilized.

The release of some toxic gases may cause immediate death, disablement, or sickness if absorbed through the skin, injected, ingested, or inhaled. Contaminated water resources become unsafe and unusable, depending on the amount of contaminant. Some chemicals cause painful and damaging burns if they come in direct contact with skin. Prolonged and concentrated exposure to such chemicals can produce severe long-term impacts to respiratory, endocrine and nervous systems, heart and brain health.

The potential impacts of chemicals and toxic gases discussed here also to some degree apply to the students, staff and environment on the SJSU campus.

With regard to the natural environment overall, contamination of air, ground, or water may result in harm to fish, wildlife, livestock, and crops. The release of hazardous materials into the environment may cause debilitation, disease, or birth defects over a long period of time. Loss of livestock and crops may lead to economic hardships within the community.

Recent California examples include the 2016 Aliso Canyon methane gas leak\(^3\), which caused evacuation of nearby residents, many of whom experienced temporary health problems such as difficulty breathing and eye irritation; and the 2016 Fruitland metal recycle plant fire in Maywood, which released heavy metals such as lead, magnesium, copper, aluminum, antimony, calcium, iron, sulfur, tin, potassium, and zinc which pose severe risks to public health.\(^4\) Health effects from exposure to these metals included short-term symptoms such as irritation to the eyes, nose, throat, and lungs.

**Potential Impact of the Hazard (Natechs)**

Natural disasters, including earthquake, flood, and fire also pose risks to public health and the environment. For example, following the Northridge Earthquake, California State University (CSU) Northridge laboratories and chemical storage rooms experienced multiple chemical spills. Such incidents, triggered by a natural disaster, pose a significant risk to students, faculty, staff, and first responders. At a minimum, all CSU campuses with a science lab (including CSU – San Jose) is at risk of potential impact from a natural-technological (combined impact) event.

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In a severe flood event, floodwaters are often contaminated with hazardous materials posing a threat to public and animal health, groundwater, and other parts of the environment. These hazardous materials may be released from damaged or flooded underground tank sites (e.g., gas stations or chemical storage facilities), propane tanks, manure or human waste handling facilities, fertilizer and pesticide storage, agricultural sites, and household hazardous waste.

In a fire event, (such as the October 2017 Northern California firestorms which destroyed approximately 6,000 residences) entire neighborhoods can be burned to the ground. Hazardous material release creates public health concerns which can delay the initial steps of fire recovery, including reopening burned areas to residents and initiating debris removal activities. The post-fire “toxic sweep” poses a risk of coming into contact with toxic substances due to the presence of synthetic and hazardous materials.

Probability of Future Occurrence of the Hazard

The probability of occurrence for a hazmat event on the SJSU campus can be viewed in two different ways: the history of occurrence serves as a sound predictor of future probability assuming current risk and vulnerability factors remain somewhat constant. For the purposes of the current estimate, no current data clearly indicates otherwise. As such, the probability of occurrence is Moderate - the campus has experienced a few small-scale chemical spills in science labs in recent years. In addition, hazardous materials and a gas pipeline are in close proximity which may increase vulnerability and the probability of a campus-related event. Moreover, hazmat occurrences are largely based on human error, and any changes in risk and vulnerability factors such as a decreased vigilance in materials oversight and handling practices or changes in the amount of material or exposure will likely increase the probability on campus.

Vulnerability to the Hazard

Hazardous materials pose a risk to the SJSU campus. As identified by the campus planning committee and on the hazmat map, the following vulnerabilities are present on campus: chemicals are located in science labs and the campus stores chlorine for disinfecting its swimming pools; numerous hazardous waste sites closely surround the campus, a gas pipeline runs through the middle of campus, and two rail lines lie approximately one mile to the east and west of campus. Due to their close proximity, gases and chemicals or hazardous waste, if spilled or released, could severely impact human health and campus operations.

Although it is quite difficult to produce a quantitative measure of vulnerability because (unlike natural hazards) the probability of occurrence is dependent on human error, which itself is variable based upon a fluctuating set of interrelated factors, some of which lack prediction or control, given the complexity of how all natural and built environments and hazmat risks factors interrelate at the local or campus level, it is prudent to assume for planning purposes that the campus’ vulnerability is a sub-set of the larger community’s vulnerability. As such, the SJSU leadership maintains vigilance to mitigate the campus’ vulnerabilities identified above at a minimum.
Estimate of Potential Losses

As discussed previously, it is difficult if not impossible to produce an accurate quantitative measure of vulnerability because of the variable nature of a hazardous materials spill. For example, the release of a toxic airborne chemical in a populated area has severe impact potential, whereas the impact potential of a small chemical spill in a remote or rural area is most likely limited to remediation of soil. And, in both cases, the probability of occurrence is dependent on human error, which itself is variable based upon a fluctuating set of interrelated factors, some of which lack prediction or control. In all cases, different types and amounts of hazardous materials interact with fluctuating combinations of human error to produce different event outcomes with variable impact costs.

Vulnerability Assessment Conclusions

It is well understood that with regards to hazmat vulnerability, each campus and its surrounding community (including SJSU) operates through a complex and dynamic interaction between industrial and commercial inputs and outputs and the natural and built environment. Such activity produces hazardous materials that move through the environment along both convergent and divergent routes and across all levels of land-use from site to campus to city and county and beyond. It is also clear from a review of the Santa Clara County hazard mitigation plan and Cal OES’ records of hazardous material spills, that such events occur with great frequency and varying degrees of severity across jurisdictions statewide. As such, in assessing the vulnerability of the SJSU campus, campus-level risks and vulnerabilities are not discreet or isolated but can become exacerbated or augmented through connections to broader community-level hazmat risks and vulnerabilities.

Finally, in order to draw conclusions on vulnerability, it should be noted that any identified vulnerabilities at the campus level and/or community level are circumscribed and potentially reduced by targeted policy and program interventions. Numerous policies and programs have been established in recent years in response to California’s widespread and complex and integrated hazardous materials risks - California established the Unified Program which consolidates and integrates the administrative requirements, permits, inspections, and enforcement activities of the following environmental and emergency response programs: the Aboveground Petroleum Storage Act (APSA) Program, Area Plans for Hazardous Materials Emergencies, the California Accidental Release Prevention (CalARP) Program, the Hazardous Materials Release Response Plans and Inventories (Business Plans), Hazardous Material Management Plan (HMMP) and Hazardous Material Inventory Statement (HMIS) requirements (California Fire Code), the Hazardous Waste Generator and Onsite Hazardous Waste Treatment (tiered permitting) Programs, and the Underground Storage Tank Program.
Identified Data Limitations

The SJSU planning committee has provided information on campus-level hazmat materials and risks. Data limitations pertain to a comprehensive understanding of human activity and error related to materials control over the long term.

**Landslide**

Description of the Hazard

A landslide is a down-slope movement of soil, rock, or other debris, and can also be referred to as a mass movement or slope failure. These geological hazards can range in size from a few feet to over a mile in length and width and, when heavy and rapidly moving, can cause serious damage and loss of life.

Landslides are classified based on the type of material and type of movement involved. They can range from slow-moving earth flows to fast-moving debris flows, though many large slope failures involve more than one type of movement. The primary natural triggers of slope failures are water, seismic activity, and volcanic activity. Slope saturation by water can occur from intense rainfall, snowmelt, changes in ground-water levels, and surface-water level changes along coastlines. In winter months, El Nino storms or other high rainfall events may saturate soils and trigger slope failure.

**Deep-Seated Landslides**

Deep-seated landslides, ranging in depth from ten to several hundred feet, occur as a result of geologic and hydraulic changes, such as earthquakes or increased levels of groundwater. These landslides can move slowly or quickly and can cause extensive property damage, but rarely result in loss of life.

**Debris Flows Related to Shallow Landslides**

Shallow landslides may mobilize into rapidly moving debris flows and typically occur after sudden saturation of the ground. These types of debris flows are typically more dangerous because they move rapidly, causing both property damage and loss of life.

Debris flows may also occur as a result of post-fire conditions, where wildfires have left barren ground exposed to heavy rainfall. Intense rainfall, generally greater than .5 inch per hour, has the potential to trigger a post-fire debris flow. These landslides may impact lives and properties within its deposition zone, and can result in downstream

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flooding. These post-fire debris flows often occur during the fall and winter following major summer fires.

Location of the Hazard

The susceptibility of an area to landslides depends on several variables, including magnitude of slope gradients, water content, ground cover, presence of erosion, and slope material and structure. However, landslides are most prevalent in terrain with weak material and steep slopes, and the highest risk is found in areas with high rainfall or high earthquake potential. Slope failures are also most likely to occur in areas where they have occurred in the past. In California, the most landslide-prone areas are found along the coast and in the northern Franciscan Formation.

General landslide vulnerability can be estimated from the distribution of weak rocks and steep slopes as seen in Figure 22-10. Based on Figure 22-10 (below), the SJSU campus is located in an area with a very low degree of susceptibility to landslide.
Extent of the Hazard

In Santa Clara, landslides risk is limited to the steep slopes outside of the metropolitan area. However, the indirect impacts of landslides in the region may cover a larger geographical extent. Additionally, the indirect impacts of landslides in the region may cover a larger geographical extent. Based on the SJSU campus’ location in a low-risk landslide hazard zone, and no history of impacts on or near the campus, the planning committee ranks the extent of the landslide hazard for the campus as **Low**.

History of the Hazard

Landslides have occurred in conjunction with earthquakes and heavy rains in Santa Clara County. NOAA has recorded 23 debris flow events in Santa Clara from 2006 to 2019, almost all of which occurred in the foothills to the south and southwest of Santa Clara.

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FEMA has declared six major disasters since 1982 that involved landslides, mudslides, or mud flows, all of which were a result of storms or flooding. Earthquake-induced landslides in 1989 disrupted traffic along Highway 17 for a month. No landslides have occurred on or immediately adjacent to the campus.

**Potential Impacts of the Hazard**

San Jose State University (SJSU) may be impacted by the disruption of services as a result of landslides in the region. Landslides can result in physical damage to buildings and property and have the potential to significantly effect infrastructure. As a landslide moves, it distresses structural foundations by settlement, cracking, and tilting. Fast-moving flows can remove entire structures in one instance, while other types of flows can cause damage gradually.

Transportation and utility infrastructure are particularly vulnerable to landslides, since the failure of any component can disrupt service over a large area. The loss of power and communication and disruption of transportation can have cascading effects throughout an area, including impaired disposal of sewage, contamination of water supplies, and the release of flammable fuels. Transportation routes are also often expensive to clean up, and prolonged obstruction can disrupt the movement of people and goods for long periods of time.

**Probability of Future Occurrence of the Hazard**

Slope failures are often triggered by other natural hazards such as heavy rainfall and earthquakes, so landslide frequency is often related to the frequency of these other hazards. As climate change impacts the frequency and intensity of triggers such as rain events, fires, and coastal erosion, landslides may generally occur more often. Historically, landslides have occurred frequently in Santa Clara County and therefore are likely to occur in the future. Historically, landslides have occurred infrequently in the City of San Jose and, therefore, are not likely to occur in the future. Given the location of the SJSU campus in a low-risk landslide zone, and the infrequent occurrence of landslides in San Jose, the planning committee ranks the probability of the landslide hazard for the campus as *Unlikely*.

**Vulnerability to the Hazard**

The vulnerability of the built environment to landslides depends on exposure and is more likely to incur damage as a result of proximity, rather than inferior structural design. The structures most vulnerable to landslides are buildings and utility/transportation lifelines, which can be impacted by either impact or ground deformation. Utilities and transportation infrastructure are particularly vulnerable, due to their geographic extent and susceptibility to physical distress. The SJSU campus exhibits very few, if any building and infrastructure vulnerabilities due to its location. See the landslide location map in relation to the campus along with landslide severity zones identified. Any population proximal to a landslide when it occurs is vulnerable to its impacts.
Estimate of Potential Losses

There are no current models for estimating potential losses from a landslide directly impacting the campus.

Although the economic impact of landslide damage can exceed that of the direct repair costs, there are currently no applicable methods for estimating indirect costs related to CSU San Jose.

Vulnerability Assessment Conclusions

Landslides are not likely to impact the campus, though indirect impacts to campus transportation and utilities are possible. Utility outages can impact health, particularly for vulnerable populations, and can cause interruptions in operations. Interruptions may impact student and employee’s ability to travel to campus and the delivery of classes and events.

Identified Data Limitations

The ability to predict future landslides at the SJSU campus is limited. However, the USGS estimates that climate change-induced shifts in weather will increase the frequency of post-wildfire landslides, which are expected to occur almost every year in California.\textsuperscript{13}

Power Outage

Description of the Hazard

San Jose, California is considered the center of the Silicon Valley. It is the third most populous city in California

Most aspects of modern life, and almost all aspects of urban life, rely on the availability of reliable utilities, such as electricity, water, and natural gas. An interruption in the supply or distribution of these commodities can leave highly populated areas like San Jose without basic services, such as electricity or sanitation. These interruptions can be cascading effects from other hazard events, such as windstorms, floods, wildfires and earthquakes, or they can be caused by intentional disruptions of transmission lines.

A power outage event can interrupt day-to-day operations of the SJSU campus, like in-person classes, impede or limit digital, telephonic or radio communications, create traffic jams around the busy avenues and boulevards surrounding the campus, close the student health center, and close restaurants around campus and outside the campus. Additionally, thousands of SJSU student residents in on-campus housing would also be affected by a power outage on campus and in the area.

Additionally, a severe outage to San Jose would also directly affect the campus and the community.
Electric power disruptions and outages fall into two categories: intentional and unintentional.

The four types of intentional disruptions are:

- Planned: Some disruptions are intentional and can be scheduled based on maintenance or upgrading needs.
- Unscheduled: Some intentional disruptions must be done "on the spot" in response to an emergency.
- Demand-Side Management: Some customers (i.e., on the demand side) have entered into an agreement with their utility provider to curtail their demand for electricity during periods of peak system loads.
- Load Shedding: When the power system is under extreme stress due to heavy demand and/or failure of critical components, it is sometimes necessary to intentionally interrupt the service to selected customers to prevent the entire system from collapsing. These intentional interruptions result in rolling blackouts.

Unintentional or unplanned disruptions are outages that come with essentially no advance notice or warning. This type of disruption is the most problematic. The following are categories of unplanned disruptions:

- Accident by the utility, utility contractor, or others.
- Malfunction or equipment failure.
- Equipment overload (utility company or customer).
- Reduced capability (equipment that cannot operate within its design criteria).
- Tree contact other than from storms.
- Vandalism or intentional damage.
- Weather, including lightning, wind, earthquake, flood, and broken tree limbs taking down power lines.
- Wildfire that damages transmission lines.

Location of the Hazard

Although power outages can take place within a certain area, as a hazard, it has the potential to occur and affect the entire planning area equally.

Extent of the Hazard

In order to anticipate outage conditions and reduce impacts, campus facility managers and others keep track of conditions and data provided by the media, municipal utilities and the California Independent System Operator (CAISO). CAISO is tasked with managing
the power distribution grid that supplies most of California, except in areas served by municipal utilities, and is thus the entity that coordinates statewide flow of electrical supply. CAISO uses a series of stage alerts to the media based on system conditions. The alerts are:

- Stage 1 - reserve margin falls below 7 percent.
- Stage 2 - reserve margin falls below 5 percent.
- Stage 3 - reserve margin falls below 1.5 percent.

Rotating blackouts become a possibility when Stage 3 is reached.

A power outage could affect the entire area of the campus, including the SJSU athletic fields, classrooms residence halls, administrative offices, virtual, telephonic and radio communications, leading to loss of lighting in campus parking structures, and creating a cascading hazard for commuters as they depart from or arrive to campus in the evening. Additionally, the university is located within proximity of highly utilized thoroughfares for the transportation of goods to throughout California, within one of the busiest areas of the Silicon Valley.

Given the prevalence of rolling blackouts and other power outages in California, the campus maintains safety precautions, situational awareness, access to emergency power generators and other protocols for managing campus power outages. However, given that recorded outages have taken place on campus, the planning committee ranks the extent of the power outage hazard as **Moderate**.

**History of the Hazard**

San Jose State reported experiencing power outages and brown outs in recent years. Although the threat is low, the university has gas powered generators to ensure continuity in power. The power outages required generator support to campus facilities, including residence halls and sorority houses near campus. Generators were successful in running over 24 hours during the power outage. The majority of students at San Jose State are commuters (30,000 students). The on-campus power plant provides power to most of the buildings on campus.

**Potential Impacts of the Hazard**

Instructors, campus residents, staff, and administration rely on electricity for basic survival and operations.

During a widespread power failure, it may take days to restore operations. Electrical power may be the only cooling source for many individuals around the campus and its community, and long-term outages can potentially put people’s health and life at risk. Disruptions in the supply of heating fuel may put people and property at risk during extremely cold weather if it relies on electric generation or heating mechanisms instead of gas. Additionally, many medical devices, communications devices, and security rely on power to maintain their functions.
Climate Change and Energy Shortage

Climate change is expected to bring more frequent and intense natural disasters. These changes have created a variability at a rate that makes historical data a poor predictor of future climate. For example, the warmest years on record in California occurred in 2014, 2015, and 2016. The 2016-2017 year broke the record as the wettest ever recorded in the northern Sierra Nevada Mountains.

Changes in temperatures, precipitation patterns, extreme events, and sea-level rise have the potential to decrease the efficiency of thermal power plants and substations, decrease the capacity of transmission lines, render hydropower less reliable, spur an increase in electricity demand, and put energy infrastructure at risk of flooding.

With climate warming, higher costs from increased demand for cooling in the summer are expected to outweigh the decreases in heating costs in the cooler seasons. Hotter temperatures in California will mean more energy (typically measured in “cooling-degree days”) needed to cool homes and businesses both during heat waves and on a daily basis, during the daytime peak of the diurnal temperature cycle. During future heat waves, historically cooler coastal cities (e.g., San Francisco and San Jose) are projected to experience greater relative increases in temperature, such that areas that never before relied on air conditioning will experience new cooling demands.

Secondary impacts of energy shortages are most often felt by vulnerable populations. For example, those who rely on electric power for life-saving medical equipment, such as respirators, are extremely vulnerable to power outages. Also, during periods of extreme heat emergencies, the elderly and the very young are more vulnerable to the loss of cooling systems requiring power sources.

Probability of Future Occurrence of the Hazard

The probability of California experiencing a power outage can be difficult to quantify but is a hazard that occurs annually during the same seasonal periods of temperature variance throughout the calendar year. The City of San Jose and Santa Clara County experience such outages. As such, the probability ranking for the San Jose area is Likely. Since the San Jose State University campus has also recorded power outage events, it is prudent to assign this same ranking for the campus.

Climate models suggest summer global temperatures are likely to increase while changes between temperature extremes would be more pronounced. As such, it is expected that power outages will occur more frequently in the future.

Vulnerability to the Hazard

Based on the data available, and in consideration of the increasing effects of climate change, the campus remains vulnerable to power outages in terms of impacts to people, power infrastructure and campus operations. Nonetheless, as discussed campus leadership works to reduce vulnerabilities through consistent use of safety and operational protocols and emergency power sources to ensure it is able to mitigate an interruption to electrical power.
Estimate of Potential Losses

The data provided by San Jose State does not report any value for potential losses due to power outage.

Vulnerability Assessment Conclusions

Elevators, entry ways, air filtration systems and lighting provide the campus community with the necessary infrastructure and systems to function and navigate through the campus and to maintain a safe campus environment and visibility during nighttime hours. The primary concern for campus leadership is that a loss of power can lead to potential hazards to students, faculty, and staff at SJSU. Vulnerable populations (especially students with physical disabilities) may be the most heavily affected by loss of power, as they rely on elevators, entry ways with automatic doors, and locks and lights; a power outage would impede a disabled student’s ability to travel and utilize the campus and its structures safely.

The use of communication devices, billing, records, and electrical tools may also become unusable due to a loss of electricity. Many records and billing items may have to revert to “by-hand” procedures and paper copies may have to be kept continuing operations. Additionally, classrooms may not be usable if lighting equipment is not functioning impacting a semester or quarter’s progress for the academic year.

Identified Data Limitations

San Jose State did not report any monetary or life losses due to a power outage. Also, the campus did not report any incidents involving a power outage directly affecting the campus community and operations.
Volcano (Associated Air Quality)

Description of the Hazard

The US Geological Service defines volcanoes as “openings or vents where lava, tephra (small rocks), and steam erupt on to the Earth’s surface. Through a series of cracks within and beneath the volcano, the vent connects to one or more linked storage areas of molten or partially molten rock (magma). This connection to fresh magma allows the volcano to erupt over and over again in the same location.”

A volcanic eruption occurs when magma, lighter than surrounding rock, is driven upwards by its buoyancy and by pressure from the dissolved gases contained within it. Gases are released from magma as it reaches the surface and pressure decreases. Magma can be erupted in several ways and violent eruptions typically cause tiny pieces of tephra (ash) to be carried away by the wind. This ash is hard, does not dissolve in water, is extremely abrasive and mildly corrosive, and conducts electricity when wet. The gases released in an eruption include carbon dioxide, sulfur dioxide, hydrogen sulfide, and hydrogen halides. Depending on their concentration, these are potentially hazardous to people, animals, agriculture, and property.

Location of the Hazard

There are eight volcanic areas located throughout California. Seven of these - Medicine Lake Volcano, Mount Shasta, Lassen Volcanic Center, Clear Lake Volcanic Field, Long Valley Volcanic Region, Coso Volcanic Field, and Salton Buttes – are considered active volcanoes. No portion of San Jose State University (SJSU) or Santa Clara County is located within a volcano hazard zone.

Extent of the Hazard

Volcanic hazards are most severe within a few miles of the volcano vent and the severity generally decreases with distance. Ash impact zones can range from tens to hundreds of miles from the vent source. The US Geological Survey has estimated zones surrounding active volcanoes wherein 2 inches or more of ashfall following an eruption is possible. While SJSU does not fall within an estimated ashfall zone, lighter dustings of ash outside of those areas may directly or indirectly impact the campus. As such, the planning committee ranks the extent of the hazard for the campus as Low.

History of the Hazard


No historical eruption events in California have affected the campus. Over the last 1,000 years, there have been at least 12 eruptions in California.\textsuperscript{11} The most recent volcanic eruption in California occurred at Lassen Peak about 100 years ago, when a major explosion delivered windborne ash over 275 miles away.\textsuperscript{12}

Potential Impacts of the Hazard

The specific impacts vary widely and depend on which type of volcano erupts, the style of explosion, the volume of lava, the eruption duration, and the local water conditions. As SJSU is not proximal to an active volcano, only the potential impacts of ashfall and gases have been detailed. While both these hazards can be widespread, their most severe impacts are generally seen closer to the volcanic source.

Although ashfall is typically a nonlethal volcanic hazard, it is the most widespread and disruptive. Falling ash can damage crops, electronics, and machinery. It can also impact human health by irritating the respiratory tract, eyes, and skin. The particles may enter drinking water and structures and may cause structure failure if it is thick and heavy enough. Even a fine layer of ash can disrupt utilities. A portion of California’s major electric transmission lines, aerial telecommunication lifelines, transportation corridors, and water storage and conveyance lie within the state’s volcano hazard zones. Impacts to any of these can impact operations at CSU San Jose.

The potential impacts of gases released during volcanic eruptions are as follows:

- Carbon dioxide typically becomes diluted very quickly and is not life threatening. However, it can become trapped in higher concentrations in low-lying areas and has the potential to be fatal.
- Sulfur dioxide can cause acid rain and air pollution downwind of a volcano.
- Hydrogen sulfide can cause irritation of the upper respiratory tract. At high concentrations it can cause unconsciousness and death.
- Hydrogen halides can coat ash particles and, once deposited, poison drinking water, agricultural crops, and grazing land.

Probability of Future Occurrence of the Hazard

The US Geological Survey, based on the record of volcanic activity in California, estimates that the probability of another small- to moderate-sized eruption in the next thirty years is about 16 percent. As such, the annual probability of future occurrence for the campus is ranked by the committee as **Unlikely**.

Vulnerability to the Hazard

Populations living near volcanoes are the most vulnerable to eruptions and lava flows. However, volcanic ash can travel and affect populations miles away. The location and thickness of ash in any given area is a function of the severity of the eruption and wind speed and direction. For SJSU, there is low vulnerability to the immediate impacts of
volcanic eruptions due to the limited area affected and remote potential of an eruption. In the event of a widespread ashfall event, the elderly, infants, and populations with existing respiratory disease will be at higher risk.

**Estimate of Potential Losses**

Impacts to critical infrastructure, agriculture, and property from ashfall have the potential to cause widespread disruption, damage, and economic loss throughout the state. In the event of a widespread ashfall event, impacts will be immediate.

Current modeling is not precise enough to allow for an assessment of potential losses from ashfall to structures or infrastructure on or surrounding the SJSU campus.

**Identified Data Limitations**

Not all active volcanoes in California have been zoned for hazards by the US Geological Survey. This, together with the infrequent occurrence of volcanic explosions and number of factors determining type and extent of impacts, make the quantification of potential loss difficult.

**Wildfire**

**Description of the Hazard**

While wildfires are a natural part of California’s ecosystem, wildfires in California represent a hazard that presents one of the greatest probabilities of destruction along with a demonstrated history of catastrophic fire events in recent years. The destructive fire seasons of 2017 to 2020 illustrated the destructive forces fire presents to communities across the state. Wildfires may result in the structural loss, infrastructure loss, dangerous air quality, environmental damages, economic impacts, injuries, and loss of life. In many communities throughout California, wildfire presents greatest risk to human life and property.

Wildfires have been defined as any free burning vegetation fire that initiates from an unplanned ignition, whether natural or human caused demanding fire suppression actions to contain. These fires are prone to become uncontrolled, spreading through vegetative fuels rapidly exposing people and structures to harm. Wildfires present a significant risk to communities across the state, as evidenced by increasing trends of structural losses from wildland fires. This risk is elevated in areas where development and community growth has intersected, also known as the wildland-urban interface (WUI). In the interface setting, development itself can provide additional fuel for large fires. Recent fires have also demonstrated the ability of fire to consume populated areas in extreme conditions.

California’s Mediterranean climate in combination with its geography and vast population create a combination of factors that promotes an optimal environment for large fire

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90 *State of California Hazard Mitigation Plan*, September 2018
growth and consequences. As there is great diversity of geographic characteristics across the state, the risks and potential consequences of wildfire must be assessed locally. The physical location, weather patterns, local fuel types and volume, extent of the WUI, topography, and additional factors will factor differently from part of the state to another.

The behavior of wildfires in California is significantly influenced by three distinct geographic factors. These factors will help shape the size, direction of spread, rate of combustion, fire intensity, and ability to pre-heat fuels. The physical factors contributing to wildfire behavior include:

- **Topography** – The rate at which wildfires spread increases with greater slopes in topography. The greater the slope will result in more pre-heating of fuel above the advancing fire. The direction that a slope faces will also influence fire behavior as south facing slopes receive greater solar radiation and thus drier vegetation that is more susceptible to combustion. Ridgetops often denote the end of fire spread as fire has greater difficulty spreading downhill.

- **Weather** – Weather factors substantially in influencing the behavior of wildfires. Wind, temperature, humidity, lightning, and lack of precipitation all contribute to a fire’s ability or inability to spread and intensify. California routinely experiences conditions in which these factors are in alignment to contribute to extreme fire behavior during the summer and fall seasons. High winds, low humidity, and high temperatures provide an environment promoting extreme fire activity.

- **Fuels** – Certain types of vegetation are increasingly prone to igniting and promote more intense burning. Areas with greater “fuel loading” (amount of fuel present in terms of weight of fuel per unit of area) increases the amount of fuel to fuel a fire. Greater volumes of dead or dry vegetation compared to live plants is a critical factor. Vegetation during drought conditions will experience decrease in moisture content increasing the conditions for combustion. Fuels close proximity to one another allows for rapid spread through contact or radiant exposures.

A risk assessment for wildfires should be implemented within a geospatial context focusing on the specific location features and incorporates the three components of the wildfire risk triangle – likelihood, intensity, and susceptibility.

**Location of the Hazard**

Substantial portions of the State of California are exceptionally vulnerable to wildfire activity or reside in a wildland-urban interface (WUI) area due to the vast open spaces, rangelands, forests and other lands with high susceptibility to fire occurring throughout the state. San Jose State University and Santa Clara County are located in a densely populated area of the Bay Area. This area near the university is dominated by downtown urban with limited direct exposures to wildland fire. San Jose State University has extensive residential neighborhoods to the east and south of the campus. The western side of the campus is downtown urban commercial development including high-rise structures.
The San Jose State University campus is located in the central portion of the City of San Jose. The campus is 8 miles north of the Santa Cruz Mountains and 7 miles west of the Diablo Range, the closest areas designated as having a high fire hazard where there are large areas of hillsides with moderate to heavy vegetative fuels. The campus is not located next to areas with a fire hazard potential making direct impacts by fire on the campus unlikely.

However, the San Jose State University campus is in a region surrounded by mountains and extensive areas of fire hazards further away. Surrounding the Bay Area are large mountain ranges and hills including the Santa Cruz Mountains, the Diablo Range, Oakland Hills, Hayward Hills and the mountains of the North Bay Counties. These mountain ranges host forests with extensive history of large fire development. The fires that burn in these areas have the potential to develop vast quantities of smoke that can fill the Bay Area in the right wind conditions. The geography of the San Francisco Bay, Santa Clara Valley, and surrounding valleys creates a topography that can capture and direct air pollutants including smoke through the movement of offshore winds. The San Jose State University campus is located in a region in which wildfire smoke can saturate the air around the campus.

Figure 22-17: Fire Hazard Severity Zones around San Jose, CA\textsuperscript{91}

Extent of the Hazard

The area immediately surrounding the San Jose State University (SJSU) campus is not in proximity to fire hazard zones designated as a High Fire Hazard Severity Zones, and the campus does not have a history of wildfire activity occurring within proximity to the campus. Although the campus is not surrounded by High fire severity zones, it is surrounded by mountain ranges containing forests with an extensive history of large wildfire development and smoke generation. As a result, the planning committee ranks the extent of the wildfire hazard for the SJSU campus as **Moderate**.

The National Fire Danger Rating System (NFDRS) is the current system in use for rating and classifying the potential danger of fire. The NFDRS tracks the effects of previous weather events on both dead and live fuel loads and adjusts accordingly based on future or predicted weather conditions. These complex relationships and equations are computed, and the outputs are expressed in terms that users can quickly and easily understand. The current NFDRS is used by all federal and most state agencies to assess fire danger conditions.
The following table depicts the NFDRS, from the US Forest Service’s Wildland Fire Assessment System.

Table 22-26: National Fire Danger Rating System

<table>
<thead>
<tr>
<th>Rating</th>
<th>Basic Description</th>
<th>Detailed Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>CLASS 1: Low Danger (L) COLOR CODE: Green</td>
<td>Fires not easily started</td>
<td>Fuels do not ignite readily from small firebrands. Fires in open or cured grassland may burn freely a few hours after rain, but wood fires spread slowly by creeping or smoldering and burn in irregular fingers. There is little danger of spotting.</td>
</tr>
<tr>
<td>CLASS 2: Moderate Danger (M) COLOR CODE: Blue</td>
<td>Fires start easily and spread at a moderate rate</td>
<td>Fires can start from most accidental causes. Fires in open cured grassland will burn briskly and spread rapidly on windy days. Woods fires spread slowly to moderately fast. The average fire is of moderate intensity, although heavy concentrations of fuel – especially draped fuel -- may burn hot. Short-distance spotting may occur but is not persistent. Fires are not likely to become serious and control is relatively easy.</td>
</tr>
<tr>
<td>CLASS 3: High Danger (H) COLOR CODE: Yellow</td>
<td>Fires start easily and spread at a rapid rate</td>
<td>All fine dead fuels ignite readily, and fires start easily from most causes. Unattended brush and campfires are likely to escape. Fires spread rapidly and short-distance spotting is common. High intensity burning may develop on slopes or in concentrations of fine fuel. Fires may become serious and their control difficult, unless they are hit hard and fast while small.</td>
</tr>
<tr>
<td>CLASS 4: Very High Danger (VH) COLOR CODE: Orange</td>
<td>Fires start very easily and spread at a very fast rate</td>
<td>Fires start easily from all causes and immediately after ignition, spread rapidly and increase quickly in intensity. Spot fires are a constant danger. Fires burning in light fuels may quickly develop high-intensity characteristics - such as long-distance spotting - and fire whirlwinds when they burn into heavier fuels. Direct attack at the head of such fires is rarely possible after they have been burning more than a few minutes.</td>
</tr>
</tbody>
</table>

Fire situation is explosive and can result in extensive property damage.

Fires under extreme conditions start quickly, spread furiously, and burn intensely. All fires are potentially serious. Development into high intensity burning will usually be faster and occur from smaller fires than in the Very High Danger class (4). Direct attack is rarely possible and may be dangerous, except immediately after ignition. Fires that develop headway in heavy slash or in conifer stands may be unmanageable while the extreme burning condition lasts. Under these conditions, the only effective and safe control action is on the flanks, until the weather changes or the fuel supply lessens.

Due to the impacts of wildfires on public health, agencies across the nation have adopted the use of the Air Quality Index (AQI) to communicate and provide a consistent approach to air quality measurements and categorization. The AQI primarily focuses on the health effects caused by pollutants in the air such as smoke. The goal of the AQI is to provide advisories to assist the public in determining when to reduce exposures to inhalation of air pollution as pollution levels rise.
History of the Hazard

The State of California has a long history of chronic and destructive wildfires throughout the state. On average, 8,300 wildfires have caused burnt 928,245 acres across the state over the 20-year period between 2000 and 2020. The San Francisco Bay Area also has a long history of wildfire activity primarily in the foothills and coastal mountains. Wildfires occurring in the Bay Area have resulted in thousands of acres burned and hundreds of millions of dollars in damages.

The area immediately surrounding the San Jose State University campus is not in proximity to fire hazard zones designated as a High Fire Hazard Severity Zones. The campus does not have a history of wildfire activity occurring within proximity to the campus. However, the County is surrounded by areas that are considered to be of high fire threat that would produce vast quantities of smoke and particulates into the air. The San Jose campus has experienced multiple days of poor air quality due to fires burning in throughout northern California. The 2017, 2018, and 2020 fire seasons in particular illustrated the increase in wildfire generated smoke saturating the air of communities throughout the state including San Jose. San Jose State University personnel reported the ongoing development of policies and procedures to address the response to poor air quality days.

94 California Department of Forestry and Fire Protection, Stats and Events, https://www.fire.ca.gov/stats-events/
Table 22-27: Historic Large-Scale Fires Near San Jose State University

<table>
<thead>
<tr>
<th>Date</th>
<th>Fire</th>
<th>Location</th>
<th>Declaration</th>
<th>Damages</th>
</tr>
</thead>
<tbody>
<tr>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
</tr>
</tbody>
</table>

Potential Impacts of the Hazard

The location of the San Jose State University campus surrounded by areas of urban development removed from areas with a fire hazard places a minimal direct threat from wildfire to the campus. The potential impacts to wildfire exist with members of the campus community who reside or work in these fire hazard zones.

Potential impacts to the campus community resulting from wildfires include:

- Injuries or loss of life
- Campus property destruction or damage
- Residential property destruction or damage
- Commercial property destruction or damage
- Loss of property contents
- Infrastructure damage
- Damaged or destroyed lifelines/supply routes
- Damaged or destroyed utilities
- Damaged or destroyed critical facilities supporting campus emergency support needs
- Loss of community economic base
- Employment losses
- Loss to ground supporting vegetation on hillsides resulting in erosion or landslides in future precipitation events
- Agricultural (crops and livestock) damages or destruction
- Environmental damage
- Societal and community impacts
- Damage to organizations and facilities providing support services to vulnerable populations

95 Santa Clara Operational Area Hazard Mitigation Plan, September 2017
- Greater evacuation challenges for those most vulnerable
- Psychological impacts of impacted populations
- Disruptions to education delivery to community

Potential impacts to the campus resulting from wildfire generated smoke include:
- Dangerous levels of air pollution
- Human Health Effects
  - Similar health impacts to pets
- Air conditioning systems overwhelmed
- Greater demands on air filtration systems
- Greater demands on healthcare systems
- Reduced outdoor work productivity
- Closures of academic sessions

Additionally, there remains a number of secondary impacts from wildfires that could affect the campus community. Utilities feeding areas of San Jose including the campus may be damaged resulting in power outages. Fire-related damage in the watersheds will likely cause future landslides, degradation to plants supporting hillsides, and impact the hydroelectric power capabilities. Fires may present threats to areas of recreation, scenic value, and wildlife that are a part of the culture of the campus community. Finally, the campus may experience effects of evacuated individuals arriving on campus from other areas as a location of refuge.

**Probability of Future Occurrence of the Hazard**

Based on the minimal wildfire threat potential in the area surrounding the San Jose State University campus, including the distance to Fire Hazard Severity Zones and density of residential and commercial development, the probability of wildfire related damage is considered **Unlikely**.

Based on the wildfire threat potential in the area surrounding Northern California and San Francisco Bay Area including the hills and mountains throughout the region, the volume of areas in elevated Fire Hazard Severity Zones throughout the southern portions of the state, and the historic occurrences of smoke, the probability of wildfire generated smoke impacts to air quality is considered **Possible**.

**Vulnerability to the Hazard**

The San Jose State University campus is not likely to be subject to direct impact from wildfire due to the campus location in an urban area of San Jose. The vulnerabilities to
the effects of wildfire would largely lie within the campus community who may reside or work in locations that are exposed to the Fire Hazard Severity Zones outside of downtown San Jose. Wildfires occurring in other areas of the region may result in the displacement of large numbers of people or the generation of smoke. These effects may spill onto the campus.

Fire directly threatening the campus would likely take the form of localized fires involving single structures or small areas. Smaller vegetation fires are remotely possible surrounding the campus in the urban forest or fields surrounding the city. These incidents would likely have little impact to the campus.

The primary basis of vulnerability is based on the population affected and the built environment exposed. In general, newer construction will be more fire resistant than older buildings as building and fire codes and construction technology have improved. Density of buildings and proximity of fuels to buildings or equipment at risk of combustion would additionally influence the fire’s ability to spread to structures.

Some areas of particular vulnerability on the campus includes:

- Students and staff engaging in outdoor activities when the air is determined to be unhealthy are vulnerable to adverse health effects.
- Buildings with ineffective HVAC or do not have HVAC will cause limitations in filtering of air during smoke filled days.
- Power outages or brownouts during days with high levels of smoke will limit shelter in place options during heat events in summer.

The greater concerns regarding vulnerabilities to wildfire on San Jose State University are related to the smoke that fires in the area would produce. The recent summer seasons have clearly demonstrated the reality of large wildfires producing enough smoke to fill the San Francisco Bay Area even from substantial distances away. These recent fires have displayed how the effects of this smoke impact the general population and especially vulnerable populations. San Jose State University students, faculty, and staff both on campus and off campus face these same vulnerabilities related to smoke filled air.

Smoke generated from large wildfires pose a threat in terms of diminished air quality that would be exposed to the population within the area of smoke distribution. Individuals with existing health problems such as respiratory or cardiac illnesses are increasingly vulnerable to wildfire generated smoke. Staff who work in roles requiring outdoor activity will be increasingly exposed during days where the air quality index is considered unhealthy or worse. Student athletes participating in outdoor sports and engaging in aerobic activities are increasingly vulnerable to the effects of wildfire.

The vulnerability to members of the campus community in which wildfire generated smoke on the San Jose State University campus will vary depending on when the air quality were to reach unhealthy levels. The risk to the campus population will be lessened during periods when classes are not in session or during periods of breaks. Conversely,
during the days and hours that classes are in session and staff are at their workplaces, the human vulnerability increases. However, in region-wide events this vulnerability may be shared with the homes and workplaces of members of the campus community and their families.

Vulnerable populations will likely face disproportionate health safety issues from smoke filled air, experience increased stresses, may require the need to remain away from the campus enclosed at home, and may find difficulty in accessing equipment or supplies to aid in a specific need.

Estimate of Potential Losses

Estimates of potential losses will be influenced by a variety of factors. Costs would also be likely to include mitigation or repairs of HVAC systems, sealing of doors and windows, and other methods of keeping smoke from entering buildings. Secondary costs would include lost academic days during campus closures, lost staff on campus productivity, and health and medical interventions for affected members of the campus community.

Based on estimate replacement costs of facilities and structures on campus, the maximum total replacement costs due to wildfire are $1,129,789,581. Due to the lack of a complete inventory of building and facility costs, the total replacement estimate is likely much higher. However, the location of the campus in an urban/suburban setting removed from hazard prone areas makes wildfire related damages unlikely.

Table 22-28: Wildfire Hazard Potential (WHP) Zone Estimated Losses

<table>
<thead>
<tr>
<th>WHP Zone</th>
<th>No of Buildings</th>
<th>Maximum Replacement Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Extreme</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Very High</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>High</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Moderate</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Low</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Very Low</td>
<td>6</td>
<td>$31,832,438</td>
</tr>
<tr>
<td>Non-Burnable</td>
<td>59</td>
<td>$1,097,957,143</td>
</tr>
</tbody>
</table>

No Building Value Data Provided* | 25 | Unknown

*Buildings with no value defined are also included in the respective Zones they are found in.

The table above includes 3 facilities located at the Moss Landing based San Jose State University, Moss Landing Marine Laboratories. The provided cost estimates for the Moss Landing Marine Laboratories are unknown.

Vulnerability Assessment Conclusions

The occurrence of wildfires has been a frequent event in Santa Clara County; however, wildfire incidents do not pose a direct risk to the San Jose State University campus. The urban location of the San Jose State University campus surrounded by densely
developed residential and commercial land uses mitigates any vulnerabilities of wildfire hazards to the campus community or facilities.

Communities located within or near the Wildland Urban Interface may be subject to damaging fires. These same communities may be home to members of the campus community. The students, faculty, and staff of San Jose State University who live or work in these hazard areas may experience vulnerabilities to the direct exposure to wildfire not likely at the campus. These effects may create tremendous challenges that could impact their ability to maintain engagement with university academic or professional activities. The potential for large-scale wildfires in the region further generates the added potential for a number of cascading effects such as disruptions to the local economy, utility failures, disruptions to providing for the needs of the community, and development of public health hazards.

Additionally, the topography and weather patterns of Northern California often creates conditions that allows for smoke filled air to linger in the valleys of the San Francisco Bay Area with the potential for unhealthy air quality depending on wind conditions. Fires in surrounding mountains and forests some distance away that generate tremendous quantities of smoke present tremendous health related vulnerabilities to members of the campus community. The campus community exposed to these unhealthy air conditions are vulnerable to a variety of potential health related effects.

**Identified Data Limitations**

Data limitations include missing campus structural replacement costs, and lack of both a complete inventory of building construction types and mitigation efforts to lessen the impact due to fire activity. HAZUS generated analysis is focused on the broader community level versus fine-tuning the analysis to the micro-level for facilities such as a university campus.

**Severe Weather (Wind, Tornado, Hail, and Lightning)**

**Description of the Hazard**

Severe weather can be described as a variety of weather or climate events that are beyond or near the ends of the range of observed weather patterns and behavior. These events can include high or extreme winds, storms, lightning, hail, tornadoes, heat waves, unusually cold temperatures, extreme rainfall, and flooding. According to the Intergovernmental Panel on Climate Change (IPCC), to be classified as severe (or extreme), the occurrence of each value of a climate or weather variable (e.g., wind, hail, 

lightning, tornado, etc.) must be “above (or below) a threshold value near the upper (or lower) ends of the range of observed values of the variable.”\textsuperscript{97}

Severe weather in California can be generated by local, regional, and/or global weather and climate influences. From the individual thunderstorm to the Santa Ana wind event to the strong El Niño, damaging weather elements that are produced by and accompany severe weather and climate phenomena (e.g., damaging winds, hail, lightning, and tornadoes) occur throughout California and the California State University (CSU) system.

**Global Scale Influences on Severe Weather in California: El Niño, La Niña, and ENSO**

The El Niño-Southern Oscillation (ENSO) is a recurring climate pattern involving changes in the temperature of waters in the central and eastern tropical Pacific Ocean. On periods ranging from about three (3) to seven (7) years, the surface waters across a large swath of the tropical Pacific Ocean warm or cool by anywhere from 1°C to 3°C, compared to normal. This oscillating warming and cooling pattern, referred to as the ENSO cycle, directly affects rainfall distribution in the tropics and can have a strong influence on weather across the United States and other parts of the world.

El Niño and La Niña are extreme phases of the ENSO cycle, with a third phase occurring between them called the Neutral phase.\textsuperscript{98} The El Niño phase is characterized by unusually warm ocean temperatures and weaker-than-normal east winds in the Equatorial Pacific, while the La Niña phase is characterized by unusually cold ocean temperatures and stronger-than-normal east winds in the Equatorial Pacific.\textsuperscript{99} Both extreme ENSO phases lead to significant differences from the average ocean temperatures, winds, surface pressure, and rainfall across parts of the tropical Pacific. The Neutral phase indicates that conditions are near their long-term average.\textsuperscript{100}

The extreme ENSO phases affect the frequency and intensity of weather events across the world, including in California.\textsuperscript{101} On average, areas across California experience


\textsuperscript{98} Retrieved on 07.18.2021 from https://www.weather.gov/mhx/ensowhat


\textsuperscript{100} Retrieved on 07.17.2021 from https://www.climate.gov/news-features/understanding-climate/el-ni%C3%B1o-and-la-ni%C3%B1a-frequently-asked-questions

\textsuperscript{101} Retrieved on 07.16.2021 from https://www.pmel.noaa.gov/elnino/what-is-el-nino
exceptionally stormy winters with increased precipitation under El Niño conditions, but experience less stormy and drier winters under La Niña conditions. This variability in storminess and precipitation brought on by El Niño and La Niña events affects the both the frequency and intensity of severe weather conditions experienced by all CSU campuses, including San José State University.

Regional Climate Influences on Severe Weather across California

Most of the weather in California is influenced by the wet-winter/ dry-summer Mediterranean climate pattern. In the summer months, Pacific storm tracks are deflected north due to the position of the Pacific High (i.e., a large-scale atmospheric circulation over the Northeast Pacific Ocean), preventing Pacific storms from reaching California. As a result, most summer storms are generated due to the incursion of moist air from the Gulf of Mexico or the Gulf of California, and occur as scattered, locally heavy showers in the desert and mountain regions of the state. In the winter months, the Pacific High decreases in intensity and moves south, permitting powerful Pacific storms to move into and across the state; these storms can produce extreme winds, heavy rains (including “atmospheric river” events), and widespread coastal and inland flooding. (Please see the Flood Hazard profile in this document for information on Floods.) As a result, storm events accompanied by precipitation in California are far more frequent in the winter months than they are in the summer months.

While the Mediterranean climate pattern influences the seasonal frequency, intensity, geographic spread, and type of some severe weather events CSU campuses experience (including San José State), other severe weather phenomena may occur in California at any time of the year. For example, near the coast and over the Central Valley, there appears to be no defined seasonality to thunderstorms, and these storms are usually light and infrequent. Thunderstorms are more intense and more frequent in the intermediate and higher elevations of the Sierra Nevada, and occur with greater frequency during the summer months.

Types of Storms in California

The 2018 California State Hazard Mitigation Plan (SHMP) defines a storm as a violent atmospheric disturbance occurring over land and/or water that is distinguished by its strength, characteristics, and the scale of the resulting damage. The SHMP also lists the

103 Retrieved on 07.17.2021 from https://wrcc.dri.edu/Climate/narrative_ca.php
104 Retrieved on 07.17.2021 from https://wrcc.dri.edu/Climate/narrative_ca.php
following types of storms that produce hazardous conditions and potential damage throughout the state of California.\textsuperscript{106} These storms affect (in varying degrees) all CSU campuses, including San José State.

- **Thunderstorm**: A rain-bearing cloud that also produces lightning. Thunderstorms can produce some of nature’s most destructive and deadly weather including tornadoes, hail, strong winds, lightning and flooding.\textsuperscript{107} Thunderstorms are caused by an atmospheric imbalance from warm unstable air rising rapidly into the atmosphere. Lightning, which occurs during all thunderstorms, can strike anywhere.\textsuperscript{108} Thunderstorms can produce some of nature’s most destructive and deadly weather including tornadoes, hail, strong winds, lightning and flooding.\textsuperscript{109} *Severe thunderstorms* are more intense, violent, and dangerous thunderstorms. The National Oceanic and Atmospheric Administration (NOAA) defines a severe thunderstorm as any storm that produces one or more of the following elements: Damaging winds or speeds of 58 mph (50 knots) or greater, hail 1 inch in diameter or larger, and/or a tornado.\textsuperscript{110} \textsuperscript{111}

- **Hailstorm**: a type of storm that precipitates round chunks of ice. Hailstorms usually occur during regular thunderstorms.\textsuperscript{112}

- **Wind storm**: marked by high wind with little or no precipitation.\textsuperscript{113}

- **Winter storm**: A storm that can produce a combination of freezing rain, sleet, heavy snow, and/or strong winds.\textsuperscript{114}

\textsuperscript{107} Retrieved on 07.14.2021 from https://www.weather.gov/phi/ThunderstormDefinition
\textsuperscript{110} Retrieved on 07.15.2021 from https://www.noaa.gov/explainers/severe-storms
\textsuperscript{111} Retrieved on 07.15.2021 from https://www.weather.gov/safety/thunderstorm
- **Coastal storm**: large wind-driven waves and/or storm surge that strike the coastal zone.\(^{115}\)

- **Ice storm**: Ice storms are one of the most dangerous forms of winter storms. When surface temperatures are below freezing, but a thick layer of above-freezing air remains aloft, rain can fall into the freezing layer and freeze upon impact into a glaze of ice. In general, 8 millimeters (0.31 inch) of accumulation is all that is required, especially in combination with breezy conditions, to start downing power lines as well as tree limbs. Ice storms also make unheated road surfaces too slick to drive on. Ice storms can vary in time range from hours to days and can cripple small towns and large urban centers alike.\(^{116}\)

- **Snowstorm**: A heavy fall of snow accumulating at a rate of more than 5 centimeters (2 inches) per hour that lasts several hours. Snowstorms, especially ones with a high liquid equivalent and breezy conditions, can down tree limbs, cut off power, and paralyze travel over a large region.\(^{117}\)

**Severe Weather Hazard Elements: Wind Hazards, Hail, and Lightning**

This hazard profile concentrates on the following types of severe weather hazards: wind hazards (including tornadoes), hail, and lightning. These hazards are produced by a variety of weather phenomena, including thunderstorms, coastal storms, winter storms, and topographically-enhanced downslope winds. While storm and downslope wind hazards are responsible for severe weather events across the CSU system, only the wind, tornado, hail, and lightning elements generated by these hazards are covered in this profile. (Storm-related hazards such as flooding and extreme temperatures are covered in other sections of this document.)

**Wind Hazards**

**Wind** is the horizontal movement of air past any given point. Wind begins with differences in air pressures; pressure that is higher at one point than another sets up a force, pushing the high towards the low pressure.\(^{118}\) Wind gusts are defined as “rapid...
fluctuations in the wind speed with a variation of 10 knots or more between peaks and lulls.”

Wind hazards in California take several forms: High Wind, Strong Winds, Thunderstorm Winds, Mountain-Valley (Downslope) Winds, and Tornadoes. These hazards are encountered across California, and have the potential to cause harm to or loss of life and/or property throughout California and the CSU system (including San José State).

**High Winds, Strong Winds, and Thunderstorm Winds**

The National Weather Service reports three (3) types of wind events that occur areas over land: High Winds, Strong Winds, and Thunderstorm Winds. Collectively, these reports are used to determine the frequency with which wind hazard events have affected areas across the U.S., including California.

**High Winds**

High winds are defined as sustained non-convective winds of 35 knots (40 mph) or greater lasting for 1 hour or longer, or gusts of 50 knots (58 mph) or greater for any duration (or otherwise locally/regionally defined). In some mountainous areas, the above numerical values are 43 knots (50 mph) and 65 knots (75 mph), respectively.

**Strong Winds**

Strong winds are defined as non-convective winds gusting less than 50 knots (58 mph), or sustained winds less than 35 knots (40 mph), resulting in a fatality, injury, or damage.

**Thunderstorm Winds**

Thunderstorm winds are winds that arise from thunderstorm convection (occurring within 30 minutes of lightning being observed or detected), with speeds of at least 50 knots (58 mph). They can also be winds of any speed (non-severe thunderstorm winds below 50 knots (58 mph)) producing a fatality, injury, or damage.

Please note: **Straight-line wind** is a term used to define any thunderstorm wind that is not associated with rotation. It is used mainly to differentiate from the rotational winds found in tornado-producing storms. However, it is not a term used in the NCEI Storm Events Database, and therefore cannot be used to determine severe weather history of or potential impacts to CSU campuses.

123 Retrieved on 07.15.2021 from https://www.nssl.noaa.gov/education/svrwx101/wind/types/
**Tornadoes**

A tornado is an extreme severe weather wind hazard. A tornado is a rapidly rotating column of air extending from a thunderstorm to the surface of the Earth.\(^{124}\) This column extends between cloud and the Earth’s surface. The damage from tornadoes comes from the strong winds they contain and the flying debris they create. It is generally believed that rotational wind speeds can be as high as 300 mph in the most violent tornadoes.\(^{125}\) On a local scale, tornadoes are the most violent and most destructive of all atmospheric phenomena.\(^{126}\)

**Mountain-Valley (Downslope) Wind Systems: Santa Ana, Diablo, and Sundowner Winds.**

**Santa Ana Winds.** A type of wind hazard that is peculiar to Southern California is called a *Santa Ana Wind*. Santa Ana winds are strong, topographically-enhanced, extremely dry downslope winds that originate inland and affect coastal southern California and northern Baja California (Mexico).\(^{127}\) They occur when air from a region of high pressure over the dry, desert region of the southwestern U.S. flows westward towards low pressure located off the California coast. This creates dry winds that flow east to west through the mountain passages in Southern California. These winds have a strong seasonal component; they are most common during the cooler months of the year, occurring from September through May. Santa Ana winds typically feel warm (or even hot) because as the cool desert air moves down the side of the mountain, it is compressed, which causes the temperature of the air to rise. If strong enough, Santa Ana winds can cause major property damage, and may present difficulties for airborne and seagoing transportation. They also may increase wildfire risk because of the dryness of the winds and the speed at which they can spread a flame across the landscape.\(^{128}\) (Note: The Wildfire hazard is profiled elsewhere in this document.)

Figure below illustrates the mechanisms involved in the generation of Santa Ana winds across Southern California.

\(^{124}\) Retrieved on 07.15.2021 from https://www.earthnetworks.com/tornado/

\(^{125}\) Retrieved on 07.15.2021 from https://www.nssl.noaa.gov/education/svrwx101/tornadoes/faq/

\(^{126}\) Retrieved on 07.15.2021 from https://www.weather.gov/bgm/severedefinitions


What Drives a Santa Ana Wind?

1. High surface pressure builds over the Great Basin region with lower pressure off Southern Cal Coast. (Fall-mid Spring)

2. Air remains relatively cold across the deserts. As the air extends through the mountain passes...it become compressed and warms. (See lower right map) Lower relative humidity also occurs helping to dry out vegetation and can fan any existing fires.

3. Wind speed increases as it squeezes through the mountain and valley canyons. Wind gusts can vary from 45 to 100 mph depending on the strength of the Santa Ana event.

4. Strong winds create turbulence for area flights and can make interstate travel difficult as well as choppy seas for mariners.

Cross Section over the Los Angeles and Ventura County Mountains to the Pacific Ocean

Source: National Weather Service

**Diablo Winds.** The Diablo wind is another type of topographically-enhanced downslope wind phenomenon that occurs in the North-Central areas of California. Diablo winds are offshore wind events that flow northeasterly over Northern California’s Coast Ranges, often creating high wind speeds downwind of major canyons and over ridges, and extreme fire danger for the San Francisco Bay Area. Diablo winds are driven by a surface pressure gradient that forms in response to an inverted pressure trough that develops over California.  

**Sundowner Winds.** Sundowner winds are significant and potentially damaging downslope wind and warming events that periodically occur along a short segment of the southern California coast in the vicinity of Santa Barbara, CA. The unique topography of this coastal region promotes the development of Sundowner wind events: over a length

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of about 100 km, the coastline is oriented approximately west–east, with the adjoining narrow coastal plain bounded by a steeply rising (to elevations greater than 1200 m) and coast-parallel mountain range. Called Sundowner winds because they often begin in the late afternoon or early evening, their onset is typically associated with a rapid rise in temperature and decrease in relative humidity, and the winds tend to blow from the north from the Santa Ynez Mountains to the coast of Santa Barbara County, California. During the more intense Sundowner wind events, wind speeds can be of gale force 39-54 miles per hour) or higher, and can even reach hurricane force (≥ 74 miles per hour) in the most extreme cases. Temperatures over the coastal plain, and even at the coast itself, can rise significantly above 37.8°C (100°F). Seasonally, Sundowner winds peak in March, April, and May, with a minimum during summer and a secondary peak in winter that often corresponds with Santa Ana winds. In addition to causing a dramatic change from the more typical marine-influenced local weather conditions, Sundowner wind episodes have produced significant wind-related property and agricultural damage, as well as conditions of extreme fire danger.\textsuperscript{131}  \textsuperscript{132}  \textsuperscript{133}

**Hail**

Hail is a form of precipitation consisting of solid ice that forms inside thunderstorm updrafts.\textsuperscript{134} It is roughly round in shape and at least 0.2' in diameter. Hail develops in the upper atmosphere as ice crystals that are bounced about by high velocity updraft winds; the ice crystals accumulate frozen droplets and fall after developing enough weight. The size of hailstones varies and is a direct consequence of the severity and size of the storm that produces them – the higher the temperatures at the Earth’s surface, the greater the strength of the updrafts and the amount of time hailstones are suspended, and therefore the greater the size of the hailstone.\textsuperscript{135}

**Lightning**

Lightning is an electrical discharge produced by a thunderstorm. Lightning rapidly heats the air in its immediate vicinity to about 50,000°F - about five times the temperature of the


surface of the sun. This compresses the surrounding air and creates a supersonic shock wave, which decays to an acoustic wave that is heard as thunder.\textsuperscript{136}

The discharge may occur within or between clouds, between the cloud and air, between a cloud and the ground, or between the ground and a cloud.\textsuperscript{137} Lightning that is produced from thunderstorms in which precipitation evaporates before reaching the ground is called “dry lightning.”

Location of the Hazard

Severe weather is a non-spatial hazard, and can occur anywhere in the CSU system, including either at the San Jose State main campus or at satellite campus facilities owned by the school. No one area of the campus – or of the surrounding community – is subject to experiencing severe weather more than any other area.

There is geographic variability among the different types of mountain and valley wind events (as a sub-category of the severe weather hazard). Santa Ana winds occur in Southern California, Diablo winds occur in North-Central California, and Sundowner winds occur almost exclusively in Santa Barbara County, California.

Extent of the Hazard

Severe weather hazards are non-spatial hazards that potentially affect all San José State campus areas equally. However, the smallest geographic unit of measurement for almost all official severe weather event data is at the county level. Because the severe weather data used do not exist at the campus level, it is assumed that the same (or similar) severe weather risks to San José State campuses reflect those of the surrounding community and County. As a result, all assets and people at San José State campuses are at risk from the effects of severe weather and can expect to experience at least some (or the complete range of) endemic severe weather hazards. In consideration of the campus’ design, layout, and operations, the severe weather history and degree of severity in the San Jose (Santa Clara County) and Moss Landing (Monterey County) areas, and the history and degree of severity of each severe weather sub-type identified by the extent scales (below), the campus planning committee ranks the overall extent of the Severe Weather hazard as MODERATE. See each sub-hazard below for the planning committee’s sub-type extent ranking.

\textbf{Wind Hazard: Non-Rotational}

The Beaufort Scale is an empirical measure that relates wind speed to observed conditions at sea or on land. Its full name is the Beaufort wind force scale.\textsuperscript{138} First developed in 1805, it is still used today to estimate wind strengths.\textsuperscript{139}

Table 22-29: Beaufort Wind Force Scale\textsuperscript{140}

<table>
<thead>
<tr>
<th>Force</th>
<th>Speed (mph)</th>
<th>Speed (knots)</th>
<th>Description</th>
<th>Specifications for use at sea</th>
<th>Specifications for use on land</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0-1</td>
<td>0-1</td>
<td>Calm</td>
<td>Sea like a mirror.</td>
<td>Calm; smoke rises vertically.</td>
</tr>
<tr>
<td>1</td>
<td>1-3</td>
<td>1-3</td>
<td>Light Air</td>
<td>Ripples with the appearance of scales are formed, but without foam crests.</td>
<td>Direction of wind shown by smoke drift, but not by wind vanes.</td>
</tr>
<tr>
<td>2</td>
<td>4-7</td>
<td>4-6</td>
<td>Light Breeze</td>
<td>Small wavelets, still short, but more pronounced. Crests have a glassy appearance and do not break.</td>
<td>Wind felt on face; leaves rustle; ordinary vanes moved by wind.</td>
</tr>
<tr>
<td>3</td>
<td>8-12</td>
<td>7-10</td>
<td>Gentle Breeze</td>
<td>Large wavelets. Crests begin to break. Foam of glassy appearance. Perhaps scattered white horses.</td>
<td>Leaves and small twigs in constant motion; wind extends light flag.</td>
</tr>
<tr>
<td>4</td>
<td>13-18</td>
<td>11-16</td>
<td>Moderate Breeze</td>
<td>Small waves, becoming larger; fairly frequent white horses.</td>
<td>Raises dust and loose paper; small branches are moved.</td>
</tr>
<tr>
<td>5</td>
<td>19-24</td>
<td>17-21</td>
<td>Fresh Breeze</td>
<td>Moderate waves, taking a more pronounced long form; many white horses are formed.</td>
<td>Small trees in leaf begin to sway; crested wavelets form on inland waters.</td>
</tr>
</tbody>
</table>

\textsuperscript{138} Retrieved on 07.15.2021 from https://www.rmets.org/resource/beaufort-scale

\textsuperscript{139} Retrieved on 07.15.2021 from https://www.weather.gov/mfl/beaufort

\textsuperscript{140} Retrieved on 07.15.2021 from https://www.weather.gov/mfl/beaufort
<table>
<thead>
<tr>
<th>Number</th>
<th>Range</th>
<th>Force</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>6</td>
<td>25-31</td>
<td>Strong Breeze</td>
<td>Large waves begin to form; the white foam crests are more extensive everywhere.</td>
</tr>
<tr>
<td></td>
<td>22-27</td>
<td></td>
<td>Large branches in motion; whistling heard in telegraph wires; umbrellas used with difficulty.</td>
</tr>
<tr>
<td>7</td>
<td>32-38</td>
<td>Near Gale</td>
<td>Sea heaps up and white foam from breaking waves begins to be blown in streaks along the direction of the wind.</td>
</tr>
<tr>
<td></td>
<td>28-33</td>
<td></td>
<td>Whole trees in motion; inconvenience felt when walking against the wind.</td>
</tr>
<tr>
<td>8</td>
<td>39-46</td>
<td>Gale</td>
<td>Moderately high waves of greater length; edges of crests begin to break into spindrift. The foam is blown in well-marked streaks along the direction of the wind.</td>
</tr>
<tr>
<td></td>
<td>34-40</td>
<td></td>
<td>Breaks twigs off trees; generally impedes progress.</td>
</tr>
<tr>
<td>9</td>
<td>47-54</td>
<td>Severe Gale</td>
<td>High waves. Dense streaks of foam along the direction of the wind. Crests of waves begin to topple, tumble and roll over. Spray may affect visibility.</td>
</tr>
<tr>
<td></td>
<td>41-47</td>
<td></td>
<td>Slight structural damage occurs (chimney-pots and slates removed)</td>
</tr>
<tr>
<td>10</td>
<td>55-63</td>
<td>Storm</td>
<td>Very high waves with long overhanging crests. The resulting foam, in great patches, is blown in dense white streaks along the direction of the wind. On the whole the surface of the sea takes on a white appearance. The tumbling of the sea becomes heavy and shock-like. Visibility affected.</td>
</tr>
<tr>
<td></td>
<td>48-55</td>
<td></td>
<td>Seldom experienced inland; trees uprooted; considerable structural damage occurs.</td>
</tr>
<tr>
<td>11</td>
<td>64-72</td>
<td>Violent Storm</td>
<td>Exceptionally high waves (small and medium-size ships might be for a time lost to view behind the waves). The sea is completely covered with long white patches of foam lying along the direction of the wind. Everywhere the edges of the wave crests are blown into froth. Visibility affected.</td>
</tr>
<tr>
<td></td>
<td>56-63</td>
<td></td>
<td>Very rarely experienced; accompanied by widespread damage.</td>
</tr>
</tbody>
</table>
The air is filled with foam and spray. Sea completely white with driving spray; visibility very seriously affected.

Based on those extent ranking factors identified (above), the planning committee ranks the extent of non-rotational wind hazards as **MODERATE**.

**Extent: Tornado**

Tornadoes have their own severity/extent scale. Until 2007, tornadoes were measured and described according to the Fujita Scale.\textsuperscript{141}

In February 2007, use of the Fujita Scale was discontinued. In its place, the Enhanced Fujita (EF) Scale is used. The Enhanced Fujita scale considers how most structures are designed and is thought to be a much more accurate representation of the surface wind speeds in the most violent tornadoes. Like the original Fujita scale, the Enhanced Fujita scale is a set of wind estimates (not measurements) based on damage.

It is important to note the date that a tornado occurred. Tornadoes that occurred prior to February, 2007 are classified using the original Fujita scale and will not be converted to the Enhanced Fujita Scale.

Table below illustrates the Fujita Scale in use prior to February 2007.

### Table 22-30: Fujita Tornado Scale (Pre-February 2007) \textsuperscript{142}

<table>
<thead>
<tr>
<th>F-Scale Number</th>
<th>Intensity Phrase</th>
<th>Wind Speed</th>
<th>Type of Damage</th>
</tr>
</thead>
<tbody>
<tr>
<td>F0</td>
<td>Gale tornado</td>
<td>40-72 mph</td>
<td>Some damage to chimneys; breaks branches off trees; pushes over shallow-rooted trees; damages sign boards.</td>
</tr>
<tr>
<td>F1</td>
<td>Moderate tornado</td>
<td>73-112 mph</td>
<td>The lower limit is the beginning of hurricane wind speed; peels surface off roofs; mobile homes pushed off foundations or overturned; moving autos pushed off the roads; attached garages may be destroyed.</td>
</tr>
<tr>
<td>F2</td>
<td>Significant tornado</td>
<td>113-157 mph</td>
<td>Considerable damage. Roofs torn off frame houses; mobile homes demolished; boxcars pushed over;</td>
</tr>
</tbody>
</table>

\textsuperscript{141} Retrieved on 07.19.2021 from https://www.weather.gov/tae/ef_scale

<table>
<thead>
<tr>
<th>F3</th>
<th>Severe tornado</th>
<th>158-206 mph</th>
<th>Roof and some walls torn off well-constructed houses; trains overturned; most trees in forest uprooted.</th>
</tr>
</thead>
<tbody>
<tr>
<td>F4</td>
<td>Devastating tornado</td>
<td>207-260 mph</td>
<td>Well-constructed houses leveled; structures with weak foundations blown off some distance; cars thrown and large missiles generated.</td>
</tr>
<tr>
<td>F5</td>
<td>Incredible tornado</td>
<td>261-318 mph</td>
<td>Strong frame houses lifted off foundations and carried considerable distances to disintegrate; automobile sized missiles fly through the air in excess of 100 meters; trees debarked; steel reinforced concrete structures badly damaged.</td>
</tr>
<tr>
<td>F6</td>
<td>Inconceivable tornado</td>
<td>319-379 mph</td>
<td>These winds are very unlikely. The small area of damage they might produce would probably not be recognizable along with the mess produced by F4 and F5 wind that would surround the F6 winds. Missiles, such as cars and refrigerators would do serious secondary damage that could not be directly identified as F6 damage. If this level is ever achieved, evidence for it might only be found in some manner of ground swirl pattern, for it may never be identifiable through engineering studies.</td>
</tr>
</tbody>
</table>

Table below illustrates the Enhanced Fujita (EF) Scale, currently in use. Tornadoes that have occurred since February, 2007 are classified using the Enhanced Fujita Scale.
**Table 22-31: Enhanced Fujita Scale (February 2007 and Later)**

<table>
<thead>
<tr>
<th>Enhanced Fujita Category</th>
<th>Wind Speed</th>
<th>Potential Damage</th>
</tr>
</thead>
<tbody>
<tr>
<td>EF0</td>
<td>65-85 mph</td>
<td>Light damage. Peels surface off some roofs; some damage to gutters or siding; branches broken off trees; shallow-rooted trees pushed over.</td>
</tr>
<tr>
<td>EF1</td>
<td>86-110 mph</td>
<td>Moderate damage. Roofs severely stripped; mobile homes overturned or badly damaged; loss of exterior doors; windows and other glass broken.</td>
</tr>
<tr>
<td>EF2</td>
<td>111-135 mph</td>
<td>Considerable damage. Roofs torn off well-constructed houses; foundations of frame homes shifted; mobile homes completely destroyed; large trees snapped or uprooted; light-object missiles generated; cars lifted off ground.</td>
</tr>
<tr>
<td>EF3</td>
<td>136-165 mph</td>
<td>Severe damage. Entire stories of well-constructed houses destroyed; severe damage to large buildings such as shopping malls; trains overturned; trees debarked; heavy cars lifted off the ground and thrown; structures with weak foundations blown away some distance.</td>
</tr>
<tr>
<td>EF4</td>
<td>166-200 mph</td>
<td>Devastating damage. Well-constructed houses and whole frame houses completely leveled; cars thrown and small missiles generated.</td>
</tr>
<tr>
<td>EF5</td>
<td>&gt;200 mph</td>
<td>Incredible damage. Strong frame houses leveled off foundations and swept away; automobile-sized missiles fly through the air in excess of 100 m (107 yd); high-rise buildings have significant structural deformation; incredible phenomena will occur.</td>
</tr>
</tbody>
</table>

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Based on the extent ranking factors identified (above), the planning committee ranks the extent of tornados as **LOW**.

**Extent: Hail**

The National Oceanic and Atmospheric Administration and the Tornado and Storm Research Organization (TORRO) have combined efforts to create the Hailstorm Intensity Scale. Table 22-XX provides details of this scale.

Table 22-32: Combined NOAA/TORRO Hailstorm Intensity Scale

<table>
<thead>
<tr>
<th>Size Code</th>
<th>Intensity Category</th>
<th>Typical Hail Diameter</th>
<th>Approximate Size</th>
<th>Typical Damage Impacts</th>
</tr>
</thead>
<tbody>
<tr>
<td>H0</td>
<td>Hard Hail</td>
<td>Up to 0.33”</td>
<td>Pea</td>
<td>No damage</td>
</tr>
<tr>
<td>H1</td>
<td>Potentially Damaging</td>
<td>0.33” – 0.60”</td>
<td>Marble or Mothball</td>
<td>Slight damage to plants and crops</td>
</tr>
<tr>
<td>H2</td>
<td>Potentially Damaging</td>
<td>0.60” – 0.80”</td>
<td>Dime or grape</td>
<td>Significant damage to fruit, crops, and vegetation</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>H3</th>
<th>Severe</th>
<th>0.80” – 1.20”</th>
<th>Nickel to Quarter</th>
<th>Severe damage to fruit and crops, damage to glass and plastic structures, paint and wood scored</th>
</tr>
</thead>
<tbody>
<tr>
<td>H4</td>
<td>Severe</td>
<td>1.20” – 1.60”</td>
<td>Half Dollar to Ping Pong Ball</td>
<td>Widespread glass damage, vehicle body damage</td>
</tr>
<tr>
<td>H5</td>
<td>Destructive</td>
<td>1.60” – 2.0”</td>
<td>Silver Dollar to Golf Ball</td>
<td>Wholesale destruction of glass, damage to tiled roofs, significant risk of injuries</td>
</tr>
<tr>
<td>H6</td>
<td>Destructive</td>
<td>2.0” – 2.4”</td>
<td>Lime or Egg</td>
<td>Aircraft body dented; brick walls pitted</td>
</tr>
<tr>
<td>H7</td>
<td>Very Destructive</td>
<td>2.4” – 3.0”</td>
<td>Tennis Ball</td>
<td>Severe roof damage, risk of serious injuries</td>
</tr>
<tr>
<td>H8</td>
<td>Very Destructive</td>
<td>3.0” – 3.5”</td>
<td>Baseball to Orange</td>
<td>Severe damage to aircraft body</td>
</tr>
</tbody>
</table>
Based on those extent ranking factors identified (above), the planning committee ranks the extent of the hail hazard as **LOW**.

**Extent: Lightning**

The National Weather Service (NWS) uses a Lightning Activity Level (LAL) scale to indicate the frequency and character of cloud-to-ground (C/G) lightning. The scale uses a range of 1 – 6, with 6 being the high end of the scale. Table 22-XX provides details of the LAL scale.

Table 22-33: Lightning Activity Level (LAL) Scale\(^{145}\)

<table>
<thead>
<tr>
<th>Rank</th>
<th>Cloud and Storm Development</th>
<th>Areal Coverage</th>
<th>Counts C/G per 5 Minutes</th>
<th>Counts C/G per 15 Minutes</th>
<th>Average C/G per Minute</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>No Thunderstorms</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>2</td>
<td>Cumulus clouds are common but only a few reaches the towering stage. A single thunderstorm must be confirmed in the rating area. The clouds mostly produce virga, but light rain will occasionally reach ground. Lightning is very infrequent.</td>
<td>&lt;15%</td>
<td>1-5</td>
<td>1-8</td>
<td>&lt;1</td>
</tr>
</tbody>
</table>

---

## Lightning Activity Level Scale

<table>
<thead>
<tr>
<th>Rank</th>
<th>Cloud and Storm Development</th>
<th>Areal Coverage</th>
<th>Counts C/G per 5 Minutes</th>
<th>Counts C/G per 15 Minutes</th>
<th>Average C/G per Minute</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>Cumulus clouds are common. Swelling and towering cumulus cover less than 2/10 of the sky. Thunderstorms are few, but 2 to 3 occur within the observation area. Light to moderate rain will reach the ground, and lightning is infrequent.</td>
<td>15% to 24%</td>
<td>6-10</td>
<td>9-15</td>
<td>1-2</td>
</tr>
<tr>
<td>4</td>
<td>Swelling cumulus and towering cumulus cover 2-3/10 of the sky. Thunderstorms are scattered but more than three must occur within the observation area. Moderate rain is commonly produced, and lightning is frequent.</td>
<td>25% to 50%</td>
<td>11-15</td>
<td>16-25</td>
<td>2-3</td>
</tr>
<tr>
<td>5</td>
<td>Towering cumulus and thunderstorms are numerous. They cover more than 3/10 and occasionally obscure the sky. Rain is moderate to heavy, and lightning is frequent and intense.</td>
<td>&gt;50%</td>
<td>&gt;15</td>
<td>&gt;25</td>
<td>&gt;3</td>
</tr>
<tr>
<td>6</td>
<td>Dry lightning outbreak. (LAL of 3 or greater with majority of storms producing little or no rainfall.)</td>
<td>&gt;15%</td>
<td>None</td>
<td>None</td>
<td>None</td>
</tr>
</tbody>
</table>

Based on those extent ranking factors identified (above), the planning committee ranks the extent of the lightening hazard as **LOW**.
**Extent: Thunderstorms that Generate Wind, Tornado, Hail, and Lightning Hazard Events**

Thunderstorms are not explicitly identified as a severe weather category for this hazard profile. However, they are responsible for most tornado, lightning, and hail hazard events – as well as a significant number of wind hazard events – across California and the CSU system. While individual thunderstorms affect relatively small areas, there are many instances in which thunderstorms can cluster together and/or travel in a line over long distances, producing significant damage over large geographic areas.

A thunderstorm is classified as “severe” when certain meteorological parameters within the thunderstorm are reached (i.e., damaging winds or speeds of 58 mph (50 knots) or greater, hail 1 inch in diameter or larger, and/or a tornado). However, there is currently no established, objective severity scale for thunderstorms.\(^\text{146}\) \(^\text{147}\) That said, according to the *Glossary of Meteorology* published by the American Meteorological Society (AMS), a thunderstorm is reported as *light*, *medium*, or *heavy* according to following five (5) characteristics:

- the nature of the lightning and thunder;
- the type and intensity of the precipitation, if any;
- the speed and gustiness of the wind;
- the appearance of the clouds; and
- the effect upon surface temperature.\(^\text{148}\)

A thunderstorm may also be classified by the nature of the overall weather situation in which the thunderstorm is produced, including:

- **Airmass Thunderstorm**: A thunderstorm produced by local convection within an unstable air mass;\(^\text{149}\)
- **Frontal Thunderstorm**: An individual thunderstorm the initiation of which results from rising motion associated with a front, or a thunderstorm within a convective system generated and organized by frontal rising motion;\(^\text{150}\)

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\(^{146}\) Retrieved on 07.15.2021 from https://www.noaa.gov/explainers/severe-storms

\(^{147}\) Retrieved on 07.15.2021 from https://www.weather.gov/safety/thunderstorm


**Squall-line Thunderstorm**: An individual thunderstorm included within a squall line (i.e., a continuous or broken line of active deep moist convection frequently associated with thunder).  

Based on the extent ranking factors identified (above) in relation to campus layout and operations, and past event low degree of severity, the planning committee ranks the extent of the thunderstorm hazard as **LOW**.

**History of the Hazard**

Severe weather hazards have been an annual occurrence in Santa Clara County and on the San Diego State main campus. Severe weather hazards have also been an annual occurrence in Monterey County and at the Moss Landing Marine Laboratories campus in Moss Landing, CA. Historical data for these hazards are presented below.

**Historical Storm Data Collection: NCEI Storm Events Database**

Historical information regarding severe weather hazards can be found using The National Centers for Environmental Information (NCEI) Storm Events Database. The Storm Events Database contains searchable, archived National Weather Service (NWS) storm data from January 1950 to April 2021, as entered by NOAA’s National Weather Service (NWS). Due to changes in the data collection and processing procedures over time, there are unique periods of record available depending on the event type. For example, from 1950 through 1954, only tornado events were recorded; from 1955 through 1995, only tornado, thunderstorm wind, and hail events were introduced into the database; from 1996 to present, 45 additional event types are recorded, including high wind, strong wind, and lightning events. To obtain the most accurate portrayal of severe weather event frequency, searches of the Storm Events Database are conducted using data collected since 01/01/1996.

**Santa Clara County**

*Wind Hazards (excluding Tornadoes)*

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Information obtained from the NCEI Storm Event Database website shows the number of events (or occurrences) of wind hazard events in Santa Clara County since 1996.\textsuperscript{155} Here, wind hazard events include all “High Wind,” “Strong Wind,” and “Thunderstorm Wind” storm reports.

- **High Wind:** at least 128 events, or approximately 5.05 events per year
- **Strong Wind:** at least 319 events, or 12.59 events per year
- **Thunderstorm Wind:** at least 9 events, or approximately ### events per year
- **All Wind Hazard events** (excluding Tornadoes): at least 450 events, or approximately 0.36 events per year. (Note: This was determined by conducting a simultaneous search of the component wind hazards of high wind, strong wind and thunderstorm wind.)

Overall, in Santa Clara County, there have been at least 450 wind hazard events since 1996, excluding tornadoes.\textsuperscript{156} That translates to an approximate average historical frequency of occurrence of \textbf{17.76} wind hazard events per year.

Please note: Differences between the sums of individual component severe weather hazard event Database searches (i.e., 456 events) and simultaneous Database searches of all severe weather hazard events (i.e., 450 events) may be due to the following factors: (1) multiple event types in the same record (e.g., “Thunderstorm Wind/Hail” or “Hail/Tornado;” or (2) severe weather hazard events such as “Thunderstorm Wind” reported for Santa Clara County have actually taken place hundreds of miles away, but are erroneously recorded as events that have occurred in the County.\textsuperscript{157} When such a discrepancy arises, the more conservative aggregate hazard wind event value (i.e., 450 events) is used to determine the historical frequency of occurrence for the severe weather hazard. The origin of this error is unknown at this time.

Please note: Differences between the sums of individual component severe weather hazard event Database searches (i.e., 456 events) and simultaneous Database searches of all severe weather hazard events (i.e., 450 events) may be due to the following factors: (1) multiple event types are in the same record (e.g., “Thunderstorm Wind/Hail” or


\textsuperscript{156} National Climatic Data Center. Storm Events Database. Retrieved 07.31.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28Z%29+High+Wind&eventType=%28Z%29+Strong+Wind&eventType=%28C%29+Thunderstorm+Wind&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=SANTA%2BCLARA%3A85&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA

“Hail/Tornado;” and/or (2) severe weather hazard events such as “Thunderstorm Wind” or “Hail” that are reported for Santa Clara County have actually taken place hundreds of miles away, but are erroneously recorded as events that have occurred in the County.\textsuperscript{158} When such a discrepancy arises, the more conservative aggregate hazard wind event value (i.e., 450 events) is used to determine the historical frequency of occurrence for the severe weather hazard. The origin of this discrepancy is unknown at this time.

**Historical Wind Hazard Losses for Santa Clara County since 1996**

According to the NCEI Storm Events Database, the wind hazard events that Santa Clara County has experienced since 1996 have been costly. There have been 7 deaths and 10 injuries, and property damage estimates have totaled approximately $7,400,000; there have been no crop damages reported.

**Tornado Wind Hazards**

Information from the NCEI Storm Events Database indicates that since 1996, there have been 5 reported events of tornadoes in Santa Clara County, which translates to approximately \textbf{0.20} tornado events per year. The tornado hazard events reported in Santa Clara County since 1996 have had severity ratings ranging from F0/EF0 to F2/EF2. of tornadoes with a severity rating of F0/EF0.\textsuperscript{159}

**Historical Tornado Hazard Losses for Santa Clara County since 1996**

According to the NCEI Storm Events Database, the five (5) tornado hazard events that Santa Clara County has experienced since 1996 have been costly. While there have been no deaths, there have been two (2) injuries, and property damage estimates have totaled approximately $4,221,000; no crop damage estimates have been reported.\textsuperscript{160}


\textsuperscript{159} National Climatic Data Center. Storm Events Database. Retrieved 07.31.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Tornado&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=SAINTA%2BCLARA%3A85&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA

\textsuperscript{160} National Climatic Data Center. Storm Events Database. Retrieved 07.31.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Tornado&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=SAINTA%2BCLARA%3A85&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA
**Hail**

Information from the NCEI Storm Events Database indicates that since 1996, there have been 33 reported events of hail in Santa Clara County, which translates to approximately **1.34** hail events per year.\(^{161}\) (Note: The NCEI Storm Event Database search results for hail indicate that there has been a total of 34 reports of hail since 1996. However, one (1) entry is for a hail event in San Diego County, hundreds of miles away from Santa Clara County. The origin of this error is unknown at this time.)

**Historical Hail Hazard Losses for Santa Clara County since 1996**

According to the NCEI Storm Events Database, the hail hazard events that Santa Clara County has experienced since 1996 have been costly. While there have been no deaths or injuries, property damage estimates have totaled approximately $10,000,000; crop damage estimates have been negligible (i.e., $60).\(^{162}\) (Note: The San Diego County hail event that was included erroneously in the search results for hail hazard events in Santa Clara County accounted for all injuries (i.e., 5) and crop damage estimates (i.e., $300,000) presented in the search results.)

**Lightning**

Information from the NCEI Storm Events Database indicates that since 1996, there have been five (5) reported events of lightning in Santa Clara County, which translates to approximately **0.20** lightning events per year.\(^{163}\)

**Historical Lightning Hazard Losses for Santa Clara County since 1996**

\(^{161}\) National Climatic Data Center. Storm Events Database. Retrieved 07.31.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Hail&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=SANTACLARA%3A85&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitButton=Search&statefips=6%2CCALIFORNIA

\(^{162}\) National Climatic Data Center. Storm Events Database. Retrieved 07.31.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Hail&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=SANTACLARA%3A85&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitButton=Search&statefips=6%2CCALIFORNIA

\(^{163}\) National Climatic Data Center. Storm Events Database. Retrieved 07.31.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Lightning&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=SANTACLARA%3A85&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitButton=Search&statefips=6%2CCALIFORNIA
According to the NCEI Storm Events Database, the lightning hazard events that Santa Clara County has experienced since 1996 have produced no deaths, injuries, property damage, or crop damage.\textsuperscript{164}

All Severe Weather Hazard Events Recorded by the NCEI Storm Events Database

(Santa Clara County)

Information obtained from the NCEI Storm Events Database indicates that there have been 493 occurrences of the severe weather hazard in Santa Clara County. This translates to \textbf{19.46} severe weather hazard occurrences per year.\textsuperscript{165}

Please note: Differences between the sums of individual component severe weather hazard event Database searches (i.e., 500 events) and simultaneous Database searches of all severe weather hazard events (i.e., 493 events) may be due to the following factors: (1) multiple event types are in the same record (e.g., “Thunderstorm Wind/Hail” or “Hail/Tornado;” and/or (2) severe weather hazard events such as “Thunderstorm Wind” or “Hail” that are reported for Santa Clara County have actually taken place hundreds of miles away, but are erroneously recorded as events that have occurred in the County.\textsuperscript{166} When such a discrepancy arises, the more conservative aggregate hazard wind event value (i.e., 493 events) is used to determine the historical frequency of occurrence for the severe weather hazard. The origin of this discrepancy is unknown at this time.

Historical, Aggregated Severe Hazard Losses for Santa Clara County since 1996

According to the NCEI Storm Events Database, the severe weather events that Santa Clara County has experienced since 1996 have been costly. There have been 7 deaths and 12 injuries, and property and crop damage estimates have totaled approximately

\textsuperscript{164} National Climatic Data Center. Storm Events Database. Retrieved 07.31.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Lightning&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=SANTA%2BCLARA%3A85&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA

\textsuperscript{165} National Climatic Data Center. Storm Events Database. Retrieved 07.31.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Hail&eventType=%28Z%29+High+Wind&eventType=%28C%29+Lightning&eventType=%28Z%29+Strong+Wind&eventType=%28C%29+Thunderstorm+Wind&eventType=%28C%29+Tornado&beginDate_mm=01&endDate_dd=01&endDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=SANTA%2BCLARA%3A85&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA

$21,621,000 and $60, respectively.\textsuperscript{167} It is important to note that for all Santa Clara County severe weather hazard events recorded on the Storm Events Database, all deaths and most injuries (i.e., 83.3%) have been caused by wind hazard events alone. However, property damage has been associated with hail, wind, and tornado hazard events; hail has been associated with almost half (i.e., 46.3%) of all property damage, followed by wind (i.e., 34.2%) and tornado (i.e., 19.5%) hazard events.

**Monterey County**

**Wind Hazards (excluding Tornadoes)**

Information obtained from the NCEI Storm Event Database website shows the number of events (or occurrences) of wind hazard events in Monterey County since 1996.\textsuperscript{168} Here, wind hazard events include all “High Wind,” “Strong Wind,” and “Thunderstorm Wind” storm reports.\textsuperscript{169}

- **High Wind**: at least 52 events, or approximately 2.05 events per year\textsuperscript{170}
- **Strong Wind**: at least 115 events, or 4.54 events per year\textsuperscript{171}
- **Thunderstorm Wind**: at least 7 events, or approximately 0.28 events per year\textsuperscript{172}

\textsuperscript{167} National Climatic Data Center. Storm Events Database. Retrieved 07.31.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Hail&eventType=%28Z%29+HighWind&eventType=%28C%29+Lightning&eventType=%28Z%29+Strong+Wind&eventType=%28C%29+Thunderstorm+Wind&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=SANTA%2BCLARA%3A85&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA


\textsuperscript{170} National Climatic Data Center. Storm Events Database. Retrieved 07.30.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28Z%29+High+Wind&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=MONTEREY%3A53&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA

\textsuperscript{171} National Climatic Data Center. Storm Events Database. Retrieved 07.30.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28Z%29+Strong+Wind&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=MONTEREY%3A53&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA

\textsuperscript{172} National Climatic Data Center. Storm Events Database. Retrieved 07.30.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Thunderstorm+Wind&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=202
All Wind Hazard events (excluding Tornadoes): at least 168 events, or approximately 6.63 events per year.\textsuperscript{173} (Note: This was determined by conducting a simultaneous search of the component wind hazards of high wind, strong wind and thunderstorm wind.)

Overall, in Monterey County, there have been at least 168 wind hazard events since 1996, excluding tornadoes.\textsuperscript{174} That translates to an approximate average historical frequency of occurrence of 6.63 wind hazard events per year.

Please note: Differences between the sums of individual component severe weather hazard event Database searches (i.e., 174 events) and simultaneous Database searches of all severe weather hazard events (i.e., 168 events) may be due to the following factors: (1) multiple event types are in the same record (e.g., "Thunderstorm Wind/Hail" or "Hail/Tornado," and/or (2) severe weather hazard events such as "Thunderstorm Wind" or "Hail" that are reported for Monterey County have actually taken place hundreds of miles away, but are erroneously recorded as events that have occurred in the County.\textsuperscript{175} When such a discrepancy arises, the more conservative aggregate hazard wind event value (i.e., 168 events) is used to determine the historical frequency of occurrence for the severe weather hazard. The origin of this discrepancy is unknown at this time.

Historical Wind Hazard Losses for Monterey County since 1996

According to the NCEI Storm Events Database, the wind hazard events that Monterey County has experienced since 1996 have been costly. There have been 1 death and 1

\textsuperscript{173} National Climatic Data Center. Storm Events Database. Retrieved 07.30.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28Z%29+High+Wind&eventType=%28Z%29+Strong+Wind&eventType=%28C%29+Thunderstorm+Wind&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=MONTEREY%3A53&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA

\textsuperscript{174} National Climatic Data Center. Storm Events Database. Retrieved 07.30.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28Z%29+High+Wind&eventType=%28Z%29+Strong+Wind&eventType=%28C%29+Thunderstorm+Wind&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=MONTEREY%3A53&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA

injury, and property damage estimates have totaled approximately $1,600,000; however, there has been no reported crop damage.\footnote{National Climatic Data Center. Storm Events Database. Retrieved 07.30.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28Z%29+High+Wind&eventType=%28Z%29+Strong+Wind&eventType=%28C%29+Thunderstorm+Wind&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=MONTEREY%3A53&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA}

**Tornado Wind Hazards**

Information from the NCEI Storm Events Database indicates that since 1996, there has been one (1) reported event of a tornado in Monterey County, which translates to approximately 0.04 tornado events per year.\footnote{National Climatic Data Center. Storm Events Database. Retrieved 07.30.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Tornado&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=MONTEREY%3A53&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA} The reported severity rating of the lone tornado is EF0.\footnote{National Climatic Data Center. Storm Events Database. Retrieved 07.30.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Tornado&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=MONTEREY%3A53&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA}

**Historical Tornado Hazard Losses for Monterey County since 1996**

According to the NCEI Storm Events Database, the one (1) tornado hazard event that Monterey County has experienced since 1996 has produced no deaths or injuries, and has generated no property or crop damages.\footnote{National Climatic Data Center. Storm Events Database. Retrieved 07.30.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Tornado&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=MONTEREY%3A53&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA}

**Hail**

Information from the NCEI Storm Events Database indicates that since 1996, there have been 20 reported events of hail in Monterey County, which translates to approximately 0.79 hail events per year.\footnote{National Climatic Data Center. Storm Events Database. Retrieved 07.30.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Hail&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=MONT
indicate that there has been a total of 21 reports of hail since 1996. However, one (1) entry is for a hail event in San Diego County, hundreds of miles away from Monterey County. The origin of this error is unknown at this time.)

**Historical Hail Hazard Losses for Monterey County since 1996**

According to the NCEI Storm Events Database, the hail hazard events that Monterey County has experienced since 1996 have been minimal. There have been no deaths or injuries, and property and crop damage estimates have totaled approximately $60 and $50, respectively.181 (Note: The San Diego County hail event that was included erroneously in the search results for hail hazard events in Monterey County accounted for all injuries (i.e., 5) and crop damage estimates (i.e., $300,000) presented in the search results.)

**Lightning**

Information from the NCEI Storm Events Database indicates that since 1996, there has been one (1) reported event of lightning in Monterey County, which translates to approximately 0.04 lightning hazard events per year.182

**Historical Lightning Hazard Losses for Monterey County since 1996**

According to the NCEI Storm Events Database, the lightning hazard events that Monterey County has experienced since 1996 have produced no deaths or injuries, and have generated no property or crop damage.183

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181 National Climatic Data Center. Storm Events Database. Retrieved 07.30.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Hail&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=MONTEREY%3A53&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCA
LIFORNIA

182 National Climatic Data Center. Storm Events Database. Retrieved 07.30.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Lightning&beginDate_mm=01&
beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=MONTEREY%3A53&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCA
LIFORNIA

183 National Climatic Data Center. Storm Events Database. Retrieved 07.30.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Lightning&beginDate_mm=01&
beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=MONTEREY%3A53&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCA
LIFORNIA
All Severe Weather Hazard Events Recorded by the NCEI Storm Events Database (Monterey County)

Information obtained from the NCEI Storm Events Database indicates that there have been 190 occurrences of the severe weather hazard in Monterey County. This translates to 7.50 severe weather hazard occurrences per year.\textsuperscript{184}

Please note: Differences between the sums of individual component severe weather hazard event Database searches (i.e., 197 events) and simultaneous Database searches of all severe weather hazard events (i.e., 190 events) may be due to the following factors: (1) multiple event types are in the same record (e.g., “Thunderstorm Wind/Hail” or “Hail/Tornado;” and/or (2) severe weather hazard events such as “Thunderstorm Wind” or “Hail” that are reported for Monterey County have actually taken place hundreds of miles away, but are erroneously recorded as events that have occurred in the County.\textsuperscript{185} When such a discrepancy arises, the more conservative aggregate hazard wind event value (i.e., 190 events) is used to determine the historical frequency of occurrence for the severe weather hazard. The origin of this discrepancy is unknown at this time.

Historical, Aggregated Severe Hazard Losses for Monterey County since 1996

According to the NCEI Storm Events Database, the severe weather events that Monterey County has experienced since 1996 have been costly. There have been 1 death and 1 injury, and property and damage estimates have totaled approximately $1,600,000 and $50, respectively.\textsuperscript{186} However, it is important to note that for all Monterey County severe weather hazard events recorded on the Storm Events Database, all deaths, injuries, and property damage have been attributed to wind hazard events alone.

\textsuperscript{184} National Climatic Data Center. Storm Events Database. Retrieved 07.30.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Hail&eventType=%28Z%29+HighWind&eventType=%28C%29+Lightning&eventType=%28Z%29+StrongWind&eventType=%28C%29+ThunderstormWind&eventType=%28C%29+Tornado&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=MONTEREY%3A53&hailfilter=0.00&tornadofilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA


\textsuperscript{186} National Climatic Data Center. Storm Events Database. Retrieved 07.30.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Hail&eventType=%28Z%29+HighWind&eventType=%28C%29+Lightning&eventType=%28Z%29+StrongWind&eventType=%28C%29+ThunderstormWind&eventType=%28C%29+Tornado&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=MONTEREY%3A53&hailfilter=0.00&tornadofilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA
Wind Hazards Not Included in the NCEI Storm Events Database

Santa Ana Winds

Santa Ana wind events occur at least twice per month from October through April.\textsuperscript{187} From 1948 to 2012, total of 2056 events on the 65-year record were recorded in the Southern California region, yielding an average of 32 occurrences per year. Typical Santa Ana wind events last 1–2 days and represent 27\% of the occurrences, with events lasting up to 6 days accounting for 90\% of all occurrences. The remaining 10\% are made up almost entirely of events lasting between 7 and 12 days.\textsuperscript{188} \textsuperscript{189}

Figure below shows the mean monthly frequency per season of Santa Ana Wind events detected from 1948 to 2012. Extreme Santa Ana wind events are shown in dark red, and are defined as those events that are above the 90th percentile of all events on record.


Diablo Winds

Diablo wind events occur approximately **2.5 events per year**. These events are most frequent during the fall and early winter seasons, with the highest frequency of events occurring in October. As a result, the highest risk of Diablo-wind-related damage is in the fall and early winter.\(^{192}\)

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Figure below shows the monthly frequency of Diablo winds (along with average live fuel moisture content). The Diablo Wind data are derived from a 17-year climatology of San Francisco Bay Area regional surface weather stations.\textsuperscript{193}

Figure 22-21: Monthly Frequency of Diablo Winds and Average Live Fuel Moisture Content (Dashed Line)\textsuperscript{194}

\textbf{Sundowner Winds}

Strong sundowner wind events occur approximately \textbf{2-3 times per year}. These events can create sharp temperature rises, local gale force winds, and significant weather-related problems. Rare, “explosive” types of sundowner wind events occur about 6 times per century that present dangerous weather situations, generating extremely strong and hot winds that can reach gale force or higher speeds.\textsuperscript{195}

\textbf{Historical Frequency of All Severe Weather Hazards}

\begin{figure}[h]
\centering
\includegraphics[width=\textwidth]{diablo_winds_freq.png}
\caption{Monthly Frequency of Diablo Winds and Average Live Fuel Moisture Content (Dashed Line)}\textsuperscript{194}
\end{figure}

\textsuperscript{193} Retrieved on 07.15.2021 from https://www.fireweather.org/diablo-winds

\textsuperscript{194} Retrieved on 07.13.2021 from https://www.fireweather.org/diablo-winds

The following tables show the average historical frequencies of severe weather hazard events for Santa Clara County and Monterey County, respectively, since 1996.

Table 22-34: Severe Weather Hazard Event

Frequencies for Santa Clara County since 1996.

<table>
<thead>
<tr>
<th>Severe Weather Hazard Category</th>
<th>Average Number of Hazard Events Per Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wind (Includes High, Strong and Thunderstorm Winds ONLY)</td>
<td>17.76</td>
</tr>
<tr>
<td>Tornado</td>
<td>0.20</td>
</tr>
<tr>
<td>Hail</td>
<td>1.34</td>
</tr>
<tr>
<td>Lightning</td>
<td>0.20</td>
</tr>
<tr>
<td>Diablo Wind</td>
<td>2.5</td>
</tr>
<tr>
<td>Santa Ana Wind *</td>
<td>32</td>
</tr>
<tr>
<td>Sundowner Wind*</td>
<td>2 to 3</td>
</tr>
</tbody>
</table>

* Note: The Santa Ana and Sundowner wind hazards are not present in Santa Clara County. They are included here for information purposes only.

Table 22-35: Severe Weather Hazard Event

Frequencies for Monterey County since 1996.

<table>
<thead>
<tr>
<th>Severe Weather Hazard Category</th>
<th>Average Number of Hazard Events Per Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wind (Includes High, Strong and Thunderstorm Winds ONLY)</td>
<td>6.63</td>
</tr>
<tr>
<td>Tornado</td>
<td>0.04</td>
</tr>
<tr>
<td>Hail</td>
<td>0.79</td>
</tr>
<tr>
<td>Lightning</td>
<td>0.04</td>
</tr>
</tbody>
</table>
### Diablo Wind*

2.5

### Santa Ana Wind

32

### Sundowner Wind*

2 to 3

*Note: The Diablo and Sundowner wind hazards are not present in Monterey County. They are included here for information purposes only.

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**Potential Impacts of the Hazard**

The significance (or priority) of a hazard’s potential impacts is based primarily on the frequency and resulting damage caused by the hazard, including deaths/injuries and property, crop, and economic damage. All assets and people within San Jose State campus areas are at risk from the effects of severe weather hazards.

**Wind Hazards (Including Tornadoes)**

Wind hazard events have the potential to impact people, property, and operations on campuses across the CSU system. People caught in the open during an extreme wind event are exposed to high winds and debris, and could be injured or killed.

The habitability of buildings can be compromised (by damaging roofs, windows, or other weak points in the building envelope), leading to long-term operational issues for the campus. As with most university campuses, space is always at a premium at the San José State campuses, and the loss of any currently utilized space due to building or structural damage would likely disrupt operations and the University’s mission.

Extreme wind events can result in power failure, which would impact the operation of the campus. Fallen tree limbs and other potential transportation hazards may also cause disruption to the surrounding community and limit ingress/egress to the campus.

**San José State Main Campus, San Jose (Santa Clara County)**

According to 2017 Santa Clara County Operational Area Hazard Mitigation Plan, one of the most common “severe weather hazard” events that occurs in the County is “high winds” (including tornadoes). This wind hazard is rated in the Plan as having a “medium” or **MODERATE** potential impact on people and property in the County and (by extension) on the San José State main campus.196

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San José State – Moss Landing Laboratories Campus, Moss Landing (Monterey County)

The only severe weather hazard that is significant enough to be profiled in the 2016 Monterey County Multi-Jurisdictional Hazard Mitigation Plan (MJHMP) is the “Windstorm” hazard; tornadoes are not considered to be significant hazards for the County and therefore are not profiled. (According to the MJHMP, a “windstorm” is a strong wind event either from cyclonic systems and their cold fronts in the winter, or from thermally forced circulations during the spring/summer months (i.e., sea breezes)). Windstorms are considered to be hazards that have a MEDIUM significance for the County; areas of wind hazard susceptibility (and therefore potential impact) within the County differ between the winter and spring/summer months, spreading the impact of the hazard across the year. As a result, wind hazards are considered to have a MODERATE potential impact on the County and (by extension) the San José State – Moss Landing Laboratories campus. Because tornadoes are not considered to be significant hazards for the County, they have MINIMAL potential impact on the County and (by extension) the San José State – Moss Landing Laboratories campus.

Hail

Hail typically impacts property by damaging structures, cars, and utilities as it falls. Dents in cars, broken glass, and holes in roofs are common impacts of hail. Injuries to people from hail are less common, though they can happen, as hail is a hard object falling in an unpredictable manner at a fairly high rate of speed.

San José State Main Campus, San Jose (Santa Clara County)

According to 2017 Santa Clara County Operational Area Hazard Mitigation Plan, hail hazards accompany but are not always present in “severe weather” thunderstorm events. As a result, hail is considered to have a low or MINIMAL potential impact on the County and (by extension) on the San José State main campus.


San José State – Moss Landing Laboratories Campus, Moss Landing (Monterey County)

The 2016 Monterey County Multi-Jurisdictional Hazard Mitigation Plan does not explicitly profile hail, as it is not considered to be a significant severe weather hazard event in Monterey County. As a result, hail hazards are considered to be of LOW significance, and therefore to have a MINIMAL potential impact on the city and (by extension) the San José State – Moss Landing Laboratories campus.  

Lightning

Lightning strikes the United States about 20-25 million times a year. Although most lightning occurs in the summer months, people can be struck at any time of year. Since 1990, lightning has killed an average of 39 people each year in the United States, and hundreds more have been injured. Property losses due to lightning have been very costly across the U.S. For example, from 2005 through 2020, U.S. homeowner’s insurance claim payouts for lightning losses totaled approximately $15,334,600,000, or $958,412,500 worth of payouts per year. (Commercial claim payouts for lightning losses for the U.S. were not available.)

San José State Main Campus, San Jose (Santa Clara County)

According to 2017 Santa Clara County Operational Area Hazard Mitigation Plan, a common “severe weather hazard” event that occurs in the County is the “thunderstorm;” it is a hazard event that is rated by the Plan as having a “medium” impact on people and property in the County. By definition, lightning is a hazard that is always present in a thunderstorm. As a result, lightning is also considered to have a “medium” or MODERATE potential impact on people and property in the County and (by extension) on the San José State main campus.

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San José State – Moss Landing Laboratories Campus, Moss Landing (Monterey County)

The 2016 Monterey County Multi-Jurisdictional Hazard Mitigation Plan does not explicitly profile lightning as a significant severe weather hazard event in Monterey County, although it is included as a causal event for wildfire hazards. As a result, lightning hazards are considered to be of LOW severe weather significance, and therefore to have a MINIMAL severe weather potential impact on the city and (by extension) the San José State – Moss Landing Laboratories campus.\(^{205}\)

Probability of Future Occurrence of the Hazard

Areas throughout California, including all California State University (CSU) campuses, experience severe weather events every year. Future occurrences of such events are projected to increase in both their frequency and intensity.

San José State Main Campus, San Jose (Santa Clara County)

The 2017 Santa Clara County Operational Area Hazard Mitigation Plan states that there is a high “probability of occurrence” (based on likelihood of annual occurrence) for the severe weather hazard. According to the Plan, this means severe weather hazard events are likely to occur within the next 25 years.\(^{206}\) Also, according to the NCEI Storm Events Database, some severe weather hazard events have occurred in Santa Clara County at least once per year; for example, wind hazards have occurred on average 17.76 times per year since 1996. Furthermore, while the severe weather hazard is a non-spatial hazard that affects all areas of the San José State main campus equally, the smallest geographic unit of measurement for almost all official severe weather event data is at the county level. Because the severe weather data used in this assessment do not exist at the campus level, it is assumed that the severe weather probabilities for the San José State main campus reflect those of the surrounding community and County identified in the Table below.

Based on the data available from both the 2017 Santa Clara County Operational Area Hazard Mitigation Plan and the NCEI Storm Events Database, the severe weather hazard is expected to occur on (or otherwise impact) the San José State main campus at least once on an annual basis. Therefore, the probability of future occurrence of the severe weather hazard for the San José State main campus is HIGHLY LIKELY.


San José State – Moss Landing Laboratories Campus, Moss Landing (Monterey County)

The 2016 Monterey County Multi-Jurisdictional Hazard Mitigation Plan states that there is between 10% and 100% chance that “Windstorm” hazards (i.e., wind hazards, excluding tornadoes) will occur in the future, and that its probability of future occurrence is “likely.” However, according to the NCEI Storm Events Database, wind hazards have occurred in Monterey County far more than once annually – an average of 6.63 times per year since 1996. Furthermore, while the severe weather hazard is a non-spatial hazard that affects all areas of the San José State – Moss Landing Laboratories campus equally, the smallest geographic unit of measurement for almost all official severe weather event data is at the county level. Because the severe weather data used in this assessment do not exist at the campus level, it is assumed that the severe weather probabilities for the San José State – Moss Landing Laboratories campus reflect those of the surrounding community and County.

Based on the data available from both 2016 Monterey County Multi-Jurisdictional Hazard Mitigation Plan and the NCEI Storm Events Database, the severe weather hazard is expected to occur on (or otherwise impact) the San José State – Moss Landing Laboratories campus at least once on an annual basis. Therefore, the probability of future occurrence of the severe weather hazard for the San José State – Moss Landing Laboratories campus is HIGHLY LIKELY.

San José State University – All Campus Areas

The probability of future occurrence of the severe weather hazard for all San José State University campus areas is HIGHLY LIKELY.

The following tables show the probabilities of future occurrence for component severe weather hazards for San José State campuses in Santa Clara County and Monterey County.

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Table 22-36: Severe Weather Hazard Probabilities of Future Occurrence for Santa Clara County and San José State University (San Jose, CA)

<table>
<thead>
<tr>
<th>Severe Weather Hazard Category</th>
<th>Average Number of Hazard Events Per Year</th>
<th>Probability of Future Occurrence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wind (Includes High, Strong and Thunderstorm Winds ONLY)</td>
<td>17.76</td>
<td>Highly Likely</td>
</tr>
<tr>
<td>Tornado</td>
<td>0.20</td>
<td>Possible</td>
</tr>
<tr>
<td>Hail</td>
<td>1.34</td>
<td>Highly Likely</td>
</tr>
<tr>
<td>Lightning</td>
<td>0.20</td>
<td>Possible</td>
</tr>
<tr>
<td>Diablo Wind</td>
<td>2.5</td>
<td>Highly Likely</td>
</tr>
<tr>
<td>Santa Ana Wind**</td>
<td>32</td>
<td>Not Rated</td>
</tr>
<tr>
<td>Sundowner Wind**</td>
<td>2 to 3</td>
<td>Not Rated</td>
</tr>
</tbody>
</table>

** Severe Weather Hazard Highly Likely

** Note: The Santa Ana and Sundowner wind hazards are not present in Santa Clara County, and therefore are not rated for probability of future occurrence. They are included here for information purposes only.
Table 22-37: Severe Weather Hazard Probabilities of Future Occurrence for Monterey County and Moss Landing Marine Laboratories

<table>
<thead>
<tr>
<th>Severe Weather Hazard Category</th>
<th>Average Number of Hazard Events Per Year</th>
<th>Probability of Future Occurrence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wind (Includes High, Strong and Thunderstorm Winds ONLY)</td>
<td>6.63</td>
<td>Highly Likely</td>
</tr>
<tr>
<td>Tornado</td>
<td>0.04</td>
<td>Unlikely</td>
</tr>
<tr>
<td>Hail</td>
<td>0.79</td>
<td>Highly Likely</td>
</tr>
<tr>
<td>Lightning</td>
<td>0.04</td>
<td>Unlikely</td>
</tr>
<tr>
<td>Diablo Wind**</td>
<td>2.5</td>
<td>Not Rated</td>
</tr>
<tr>
<td>Santa Ana Wind</td>
<td>32</td>
<td>Highly Likely</td>
</tr>
<tr>
<td>Sundowner Wind**</td>
<td>2 to 3</td>
<td>Not Rated</td>
</tr>
</tbody>
</table>

** Note: The Santa Ana, Diablo, and/or Sundowner wind hazards are not present in Monterey County, and therefore are not rated for probability of future occurrence. They are included here for information purposes only.

Vulnerability to the Hazard

People, structures, and assets at both San José State campuses are all vulnerable to the impacts associated with severe weather. Infrastructure can be damaged or destroyed by hail, wind, tornadoes, thunderstorms, and lightning, which can result in service interruptions and outages. Structures can be damaged or destroyed by hail, wind, tornadoes, thunderstorms, and lightning. People can be injured or killed by lightning, flying debris, hail, or extreme wind events. San José State also has vehicles that are all vulnerable to a severe weather event.

Estimate of Potential Losses

Severe weather is a non-spatial hazard that affects all San José State campus areas. Each of the hazards associated with severe weather can result in losses throughout the planning area.

All structures at both San José State campuses are at risk from severe weather. There are approximately 90 buildings on the main campus that could be damaged by wind, hail, and/or lightning. If even a fraction of these assets were to be damaged, the resulting estimated losses would still be in the millions of dollars. The total replacement costs due
to severe weather hazard are $1,129,789,581 for 65 buildings, and are unknown for the remaining 25 buildings. An analysis of projected dollar losses to campus buildings from severe weather as a percentage of building replacement costs is also not currently available, though CSU leadership may pursue such data in the future.

The population at both San José State campuses varies throughout the day. As of Fall, 2019, San José State had 33,282 students and 3,568 faculty and staff. All are at risk

Vulnerability Assessment Conclusions

Severe weather presents a variety of hazards to San José State campuses. People, assets, infrastructure, and vehicles can all be damaged by this hazard, and losses can quickly begin to rise. In the aggregate, severe weather is a frequently occurring hazard (mostly in the form of wind hazard events) that presents a variety of risks to San José State.

It is evident that San José State has vulnerabilities to and risks from severe weather hazard incidents, and that pre-event planning, communication, and mitigation efforts should be implemented. Public education and outreach regarding areas of shelter that could be used by campus populations during severe weather events is considered by campus leadership to be one viable mitigation option. The campus planning committee will continue to look for feasible and cost-effective options for the mitigation of severe weather risks going forward.

Identified Data Limitations

Numerous federal agencies maintain a variety of records regarding losses associated with hazards. Unfortunately, no single source is considered to offer a definitive accounting of all losses. The Federal Emergency Management Agency (FEMA) maintains records on federal expenditures associated with declared major disasters. The US Army Corps of Engineers (USACE) and the Natural Resources Conservation Service (NRCS) collect data on losses during the course of some of their ongoing projects and studies. Additionally, the National Oceanic and Atmospheric Administration’s (NOAA) National Centers for Environmental Information (NCEI) collects and maintains data about natural hazards in summary format, as well as occurrences, dates, injuries, deaths, and estimated costs for individual storm events. Many of these databases and other data collection services, including the NCEI, have inherent data limitations when searching for information at a scale as small as a single campus.

The best available data and records have been used throughout this section. Where no data or records exist or could be located, that deficiency is noted.

208 Retrieved on 07.19.2021 from https://www2.calstate.edu/csu-system/about-the-csu/facts-about-the-csu/enrollment/Pages/default.aspx
**Tsunami**

**Description of the Hazard**

A tsunami is a wave triggered by any form of land displacement along the edge or bottom of an ocean or lake. Land displacement can be in the form of submarine landslides or submarine dip-slip faults. These types of faults cause ruptures that result in seafloor uplift or down-drop. This mass movement translates to a tsunami or gravity wave within the overlying water at the surface.

Tsunamis travel radially outward from the area of initiation. The size of a tsunami is proportional to the mass that moved to generate the tsunami. As a tsunami approaches the shore and the depth of the water column decreases, the energy in the wave pushes the wave crest above the water surface resulting in a larger wave height. Wave runup is the elevation above mean sea level on dry land that a tsunami reaches. Run-up is what causes inundation of coastal areas that are below the run-up height.

There are two types of source regions for tsunamis—resulting in local and distant source tsunamis as viewed from the affected shoreline. Local tsunamis are typically more threatening because they afford at-risk populations only a few minutes to find safety. California is vulnerable to, and must consider, both types. Identifying tsunami hazards requires 1) evaluating the potential for submarine mass movement.

both locally and at great ocean distances, and 2) identifying coastal regions within the direct or indirect path of a potential tsunami wave that are below the run-up height.

Tsunamis can travel at speeds of over 600 miles per hour in the open ocean and can grow to over 50 feet in height when they approach a shallow shoreline, potentially causing severe damage to coastal development. At the shoreline, tsunamis may take the form of a fast-rising tide, a cresting wave, or a bore (a large, turbulent wall-like wave). The bore phenomenon resembles a step-like change in the water level that advances rapidly (from 10 to 60 miles per hour). The first wave is usually followed by several larger and more destructive waves.

**Location of the Hazard:**

Although the main campus is unlikely to face tsunami concerns, the MLML location is at risk. The aquaculture building (7722 Sandholdt Rd, Moss Landing, CA 95039), Norte Facility (Flounder Way, Moss Landing, CA 95039), and the Small Boat and Diving Operations building (7539 Sandholdt Rd, Moss Landing CA). These spaces are within the tsunami hazard area.

**Extent of the Hazard:**

The factors shaping the extent or severity of the hazard are a combination of geophysical forces (the amount of vertical and horizontal motion of the sea floor, the area over which
it occurs, and the efficiency with which energy is transferred from the earth’s crust to the ocean water) and the geographic range of coastal development to be impacted.

More specifically, as a tsunami approaches the shore, wave run-up is the elevation above mean sea level on dry land that a tsunami reaches. A tsunami’s potential severity can be forecasted as a function of the wave’s mass along with the difference between the wave’s run-up height and the ground elevation of the affected coastal location.

There are two types of source regions for tsunamis—resulting in local and distant source tsunamis as viewed from the affected shoreline. Local tsunamis are typically more threatening because they afford at-risk populations only a few minutes to find safety. California is vulnerable to, and must consider, both types. Identifying tsunami hazards requires 1) evaluating the potential for submarine mass movement both locally and at great ocean distances, and 2) identifying coastal regions within the direct or indirect path of a potential tsunami wave that are below the run-up height.

Given the specific asset locations proximate to the tsunami inundation zone, the campus planning committee ranks the extent of the hazard as Moderate.

History of the Hazard:

The California Seismic Safety Commission report, the Tsunami Threat to California Findings and Recommendations on Tsunami Hazards Risks, published in December 2005, indicates that over 80 tsunamis have been observed or recorded along the coast of California in the past 150 years. That said, no tsunamis have impacted CSU campus locations.

According to the National Centers for Environmental Information (NCEI), have been eight tsunamis have caused damage to ports and harbors or coastal inundation in California since 1946. The most significant events are as follows:

- In 1964, a tsunami caused by a Magnitude 9.2 earthquake offshore from Alaska resulted in 13 deaths in California and destroyed portions of downtown Crescent City.
- A 2006 tsunami (originating in the Kuril Islands region north of Japan) caused approximately $20 million in damage to Crescent City harbor.
- A 2010 tsunami (originating offshore from Chile) caused millions of dollars in damage to ports and harbors in the state.
- A tsunami in 2011 (caused by a Magnitude 9.0 earthquake offshore of Japan) killed one person at the mouth of the Klamath River and caused up to $100 million of damage to 27 ports, harbors, and marinas throughout the State. The most damage occurred in Crescent City, Santa Cruz and Moss Landing harbors and a federal disaster was declared in Del Norte, Santa Cruz, and

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Monterey Counties. Both Crescent City and Santa Cruz harbors sustained damage to all docks, and oil spills and water/sediment contamination that resulted from sunk or damaged boats. Because recovery efforts in these two harbors took several years to complete, both harbors incurred business/economic losses that have been difficult to recapture.

In addition, the Worldwide Tsunami Database, www.ngdc.noaa.gov) provides information on tsunami run-up levels and earthquake magnitude factors. Although data for the most recent events is not available, additional (earlier) tsunami events are recorded.

Table 12-38: Tsunami Events in California 1930-2013

<table>
<thead>
<tr>
<th>Date</th>
<th>Location</th>
<th>Maximum Run-up (m)</th>
<th>Earthquake Magnitude</th>
</tr>
</thead>
<tbody>
<tr>
<td>08/31/1930</td>
<td>Redondo Beach</td>
<td>6.1</td>
<td>5.2</td>
</tr>
<tr>
<td>08/31/1930</td>
<td>Santa Monica</td>
<td>6.1</td>
<td>5.2</td>
</tr>
<tr>
<td>08/31/1930</td>
<td>Venice</td>
<td>6.1</td>
<td>5.2</td>
</tr>
<tr>
<td>03/11/1933</td>
<td>La Jolla</td>
<td>0.1</td>
<td>6.3</td>
</tr>
<tr>
<td>03/11/1933</td>
<td>Long Beach *</td>
<td>0.1</td>
<td>6.3</td>
</tr>
<tr>
<td>08/21/1934</td>
<td>Newport Beach</td>
<td>12.0</td>
<td>Unknown</td>
</tr>
<tr>
<td>02/09/1941</td>
<td>San Diego</td>
<td>Unknown</td>
<td>6.6</td>
</tr>
<tr>
<td>10/18/1989</td>
<td>Monterey</td>
<td>0.4</td>
<td>7.1</td>
</tr>
<tr>
<td>10/18/1989</td>
<td>Moss Landing</td>
<td>1.0</td>
<td>7.1</td>
</tr>
<tr>
<td>10/18/1989</td>
<td>Santa Cruz</td>
<td>0.1</td>
<td>7.1</td>
</tr>
<tr>
<td>04/25/1992</td>
<td>Arena Cove</td>
<td>0.1</td>
<td>7.1</td>
</tr>
<tr>
<td>04/25/1992</td>
<td>Monterey</td>
<td>0.1</td>
<td>7.1</td>
</tr>
<tr>
<td>09/01/1994</td>
<td>Crescent City</td>
<td>0.1</td>
<td>7.1</td>
</tr>
<tr>
<td>11/04/2000</td>
<td>Point Arguello</td>
<td>5.0</td>
<td>Unknown</td>
</tr>
<tr>
<td>06/15/2005</td>
<td>N. California</td>
<td>0.1</td>
<td>7.2</td>
</tr>
</tbody>
</table>

Potential Impacts of the Hazard:

Tsunamis can travel at speeds of over 600 miles per hour in the open ocean and can grow to over 50 feet in height when they approach a shallow shoreline, potentially causing total devastation to coastal development.

The configuration of the coastline, the shape of the ocean floor, and the characteristics of advancing waves play important roles in the destructiveness of the waves. Bays, sounds,
inlets, rivers, streams, offshore canyons, islands, and flood control channels may cause various effects that alter the level of damage. Offshore canyons can focus tsunami wave energy, and islands can filter the energy. It has been estimated that a tsunami wave entering a flood control channel could reach a mile or more inland, especially if it enters at high tide. The orientation of the coastline determines whether the waves strike head-on or are refracted from other parts of the coastline.

Potential impacts to the campus are specific to the aquaculture building, the Norte Facility, and the Small Boat and Diving Operations buildings in Moss Landing. Tsunamis that impact both harbors and communities also can produce free-floating debris hazards and environmental contamination from chemical spills.

**Probability of Future Occurrence of the Hazard:**

The California Seismic Safety Commission report, the Tsunami Threat to California Findings and Recommendations on Tsunami Hazards Risks, published in December 2005, indicates that over 80 tsunamis have been observed or recorded along the coast of California in the past 150 years.210 If we consider historical occurrence as one data set for estimating future events, the average rate of occurrence over the past 150 years is 1 tsunami every 1.9 years statewide. Currently, no analysis is available which differentiates this statewide probability specifically for the impacted assets.

That said, the rate of future occurrence may change and may be able to make target estimates for specific locations in the future; the California State Tsunami Program is trying to refine the accuracy of the data. In doing so, the State Tsunami Program is completing a set of Probabilistic Tsunami Hazard Analysis (PTHA) maps representing risk levels from 100-year to 3000-year average return periods. Analysis using these probabilistically based products will allow for a more common platform for comparison to other seismic and flood probabilistic analyses. 211

**Vulnerability to the Hazard:**

Regarding the vulnerabilities for the campus, the aquaculture building, the Norte Facility, and the Small Boat and Diving Operations buildings in Moss Landing are all vulnerable to the hazard as they fall within the tsunami inundation area. Tsunami “maximum run-up” projections were modeled by the University of Southern California and distributed by the California Office of Emergency Services for the purposes of identifying tsunami hazards. The tsunami model was the result of a combination of inundation modeling and onsite surveys and determined the maximum projected inundation levels from tsunamis. Given


211 2018 State of California Hazard Mitigation Plan
that inundation modeling changes over time and is not able to predict real world outcomes with 100% accuracy, it is conceivable that an actual worst case tsunami event could impact the campus.

Given that the entire campus is not impacted, the vulnerability is specific to the operations of the three facilities and should not have a significant impact on campus operations.

**Vulnerability of Populations**

The populations most vulnerable to the tsunami hazard are the elderly, disabled and very young who reside near beaches, low-lying coastal areas, tidal flats and river deltas that empty into ocean going waters. In the event of a local tsunami generated near the coast, little warning time would exist, so more of the population would be vulnerable. While direct impacts to campus staff and students are not projected, the city’s evacuation capability could be exceeded by a worst-case event.

**Estimate of Potential Losses**

Estimates of potential losses specific to CSU campuses have not been conducted yet. Improvements have been made in the ability to estimate losses from tsunami impacts which can be brought to bear on loss estimation for CSU campuses in the future.

**Vulnerability Assessment Conclusions:**

According to the 2018 State of California Hazard Mitigation Plan, community exposure to tsunamis in California varies considerably—some communities may experience great losses that reflect only a small part of their community and others may experience relatively small losses that devastate them. Among the 94 incorporated communities and 83 unincorporated areas of the 20 coastal counties, the communities of Alameda, Oakland, *Long Beach*, Los Angeles, Huntington Beach, and San Diego have the highest number of people and businesses in the tsunami inundation zone.\(^\text{212}\)

For improving assessments of vulnerability, FEMA has developed a new tsunami loss estimation module for HAZUS using existing numerical model results for tsunami inundation, flow depth, velocity, and force. This HAZUS module allows new capability for estimation of economic losses, and site-specific analysis of content losses, casualties, infrastructure damage, and evacuation time. The module calibrates losses based on safe zones and community preparedness levels. Such technological improvements in assessment capability can be utilized for tsunami hazard analysis and planning purposes for the campus assets.

Along with new probability-based tsunami maps, the HAZUS module will improve the ability to compare tsunami impacts to those of other hazards. Moreover, the probability mapping will be used for numerous applications including identifying potential tsunami hazard “zones of required investigation” under the Seismic Hazards Mapping Act and will assist state and local agencies in making land use planning decisions. They will also help regional and state planners understand the flood potential from tsunamis representing different risk levels.²¹³

Identified Data Limitations:

As identified in the vulnerability conclusions (above), with regard to the current planning effort, the primary data limitations for assessing the tsunami hazard for CSU campuses mostly pertain to a complete set of valuations for the assets of the campus assets lying within the tsunami inundation zone. In addition, the CSU system-wide effort would benefit from FEMA’s new probability mapping techniques and tsunami loss estimation module to the footprint of those campuses proximate to the inundation zone to ensure that the current “not at risk of direct impact” to staff, students and physical assets still holds true. That said, CSU leadership and planning teams intends to pursue such data in the future.

²¹³ 2018 State of California Hazard Mitigation Plan
22.4 Social Resilience Assessment

Overview

While every person is vulnerable to risk, individuals from diverse populations such as those with access and functional needs are disproportionately more vulnerable and may be at a higher risk to harm in a disaster event. In addition to physical vulnerabilities, the intersectionality between physical hazard risks and population social vulnerabilities must be considered to holistically address overall campus risk.

As inclusivity is a high priority for CSU, addressing campus risk and resilience must be done through the lens of inclusion and equity. Addressing social vulnerability is an increasingly critical requirement of state and national doctrines and described in Section 4.4 of the HVRA Base Plan. Every individual of the campus’s richly diverse population group needs to have the capacity, skills, and knowledge in order to understand, access, and participate in risk reduction and disaster response in ways that are meaningful to their own unique situation. In a campus community, having strong social support networks and active involvement in community disaster responses may negatively or positively impact these opportunities and reduce the resilience-building process. This section offers a glimpse into the CSU San Jose campus’s unique social construct, population demographics, strengths and concerns and presents a high-level assessment of the resilience, coping capacities and potential social vulnerabilities of students, staff and faculty. The research variables that were asked are often considered sensitive subjects, and few are traditionally included in emergency management/hazard mitigation planning.

This social resilience assessment of college campuses is the first of its kind in the nation. The research methodology unfolded as the interviews with campuses progressed. The assessment data presented are not definitive or authoritative. The answers, analysis, and suggested trends are strictly indicators for potential social risk. They do not represent an accurate data capture as limitations on the data gathering process influenced an ability to provide accuracy. This assessment provides indications of increased risk, not accuracy of response or a true reflection of the situation of the campus. The information presented is to be considered in the context of the more detailed system-wide CSU social vulnerability assessment that is included in the baseline HVRA.

Campus-Identified Populations of Concern

During the campus interview, the following responses were provided when asked, “In considering the diverse population group(s) amongst student body, faculty and staff, which are of the most concern in your emergency management planning?”
Table 22-39: High level summary of campus populations of concern

<table>
<thead>
<tr>
<th>Question</th>
<th>Campus Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>Which population groups amongst the student body, faculty, and staff, are of the most concern for physical and social vulnerabilities in emergency management planning?</td>
<td>Access and functional needs</td>
</tr>
<tr>
<td>Which population groups are most difficult to reach in an event?</td>
<td>N/A</td>
</tr>
<tr>
<td>Which population groups have little/limited support networks if impacted by an event?</td>
<td>N/A</td>
</tr>
</tbody>
</table>

Note: San Jose State was early interview, so interview process and question structure were not fully defined.

Resilience Variables Related to Campus Emergency Management

The interviewees were asked to reflect on a set of 12 variables for the campus populations of student, faculty and staff: homelessness (*housing insecurity*), food security, health and wellness, disability/access and functional needs (AFN), racial equity, digital equity, communications, international students, immigrants/immigration status issues (*undocumented, DACA, etc.*), LGBTQI (Lesbian Gay Bisexual Transgender Questioning (or queer) Intersex), and transportation dependency. They were also offered an opportunity to add any other factor they wanted to include. The following two questions were asked:

- Is this factor a particular issue of concern for emergency management on your campus? Responses were summarized as **Very High, High, Medium, Low**
- Is this factor reflected in the emergency plans and processes for your campus? Responses were summarized as **Yes, No, In Progress, NA**

In order to provide a high-level qualitative response for the answers, the approach of averaging response was taken. If conflicting answers were expressed by the interviewees,
the answer (code) was averaged out. A detailed explanation of the response averaging approach is included in the base HVRA.

Table 22-40: Campus-specific emergency management issues of concern and inclusion in emergency management plans and processes

<table>
<thead>
<tr>
<th>Issue of Concern</th>
<th>Plans &amp; Processes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Homelessness (Housing Insecurity)</td>
<td>Low</td>
</tr>
<tr>
<td>Food Security</td>
<td>Low</td>
</tr>
<tr>
<td>Health &amp; Wellness</td>
<td>Low</td>
</tr>
<tr>
<td>AFN</td>
<td>Medium</td>
</tr>
<tr>
<td>Digital Equity</td>
<td>Low</td>
</tr>
<tr>
<td>Comms.</td>
<td>Low</td>
</tr>
<tr>
<td>International Students</td>
<td>Low</td>
</tr>
<tr>
<td>Immigrants / Immigration Status</td>
<td>Low</td>
</tr>
<tr>
<td>LGBTQI</td>
<td>Low</td>
</tr>
</tbody>
</table>

Qualitative Narrative: Campus Overview of Potential Resilience Vulnerabilities

The following are interview notes of interest:

- Have a large group of international students; noted that they should have a copy of the separate plan and policies prepared by the International Dept.
- LGBTQI are not treated any differently; all [campus population] groups are treated the same way.
- If had an event, undocumented students would not be arrested.
Campus High Hazards and Potentially Vulnerable Populations

This section provides a brief introduction to the link between socially vulnerable populations and a particular hazard type. While extensive research has been conducted on the impacts of hazards, not all linkages have been documented or published, and detail for finding them are beyond the scope of this assessment. It’s important to note, the intersectional nature of what makes an individual’s personal experience and resilience to an event is played out by unique factors for that individual or population. The nuanced social vulnerabilities often come from the social and physical environment in which a person is embedded.

In order to aid in further assessing campus resilience, below is a general description of the known impacts. From some hazards, the descriptions are robust, while others are only brief introductions.

Table 22-41: CSU San Jose Highly Likely, Likely and Possible Hazards

<table>
<thead>
<tr>
<th>Hazard</th>
<th>Future Occurrence Probability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Communicable Disease</td>
<td>Highly Likely</td>
</tr>
<tr>
<td>Drought</td>
<td>Highly Likely</td>
</tr>
<tr>
<td>Earthquake</td>
<td>Possible</td>
</tr>
<tr>
<td>Erosion</td>
<td>Likely</td>
</tr>
<tr>
<td>Extreme Temperature</td>
<td>Likely (Heat); Unlikely (Cold)</td>
</tr>
<tr>
<td>Flood</td>
<td>Possible</td>
</tr>
<tr>
<td>Hazardous Materials</td>
<td>Possible</td>
</tr>
<tr>
<td>Power Outage</td>
<td>Likely</td>
</tr>
<tr>
<td>Wildfire</td>
<td>Unlikely (Fire); Possible (Smoke)</td>
</tr>
</tbody>
</table>
**Drought**

The 2012-2016 drought had severe effects on two vulnerable sectors of our population: those in low-income brackets, and those, especially Native Americans, who rely on subsistence fishing for their livelihoods.\(^{214}\) Water bills increased throughout the state. Due to rising water prices, for the working poor, many have paid four to five percent of their income for water. Since many CSU students are commuters, and many living with families, future drought impacts may potentially affect a percentage of non-resident students. NASA’s modeling shows that future droughts are likely to last longer and be more intense, even leading to “megadroughts” in the western states.\(^{215}\) Fresh water supplies are predicted to be full of extremes, with both droughts and extreme precipitation events being more severe. The interrelationship between drought and other hazard conditions may lead to a set of secondary impacts. Drought conditions lead to water quality issues due to loss of drinking water, increased fire danger that leads to drought-induced fires and elevated AQI levels, as well as extreme heat or prolonged heat events.

**Earthquake**

Impacts on populations from earthquakes are complex, with long-term implications on social stability for all populations. In addition to the physical impact exposure during a no-notice earthquake event and the social and logistical challenges of a recovering community, an earthquake can have lasting impacts long afterwards due to post traumatic stress disorder (PTSD).

Socioeconomic vulnerabilities of populations at risk were analyzed in the hypothetical yet scientifically realistic earthquake sequence that is being used to better understand hazards for the San Francisco Bay region during and after a magnitude-7 earthquake (mainshock) on the Hayward Fault and its aftershocks. In this study, the at-risk populations located in areas of concentrated damage are anticipated to experience longer recovery trajectories, increased long term housing displacement, and transportation impacts due to dependencies on transit dependencies. When neighborhood schools close, families with school age children may move to other areas to keep their children in schools. Persons with access and functions needs are likely to be more dependent on access to functioning medical, social and personal health care services that would be overwhelmed by the event and therefore increasing their vulnerabilities. For the homeless populations, the loss of social community services and damages to shelters could add to protracted relocations. For the young and mobile populations who rent, the

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22-169
major disruption to housing, jobs and transit will also drive relocation. Widespread housing damage and preexisting housing market constraints will make it “extremely challenging” for the socially and economically vulnerable populations to find alternative housing near their home communities. Those who utilize interim and irregular housing for months and years after a disaster are more vulnerable to physical, social, and mental disorders, including suicide, substance abuse, and physical and verbal abuse. Aftershocks and post disaster conditions delay population return and increase outmigration.216

**Erosion**

Risk from erosion relates to earthen and infrastructural losses. The degree of vulnerability to these events and their impacts depends on human behavior and the traditional social factors such as situational awareness, prior knowledge of hazards, social capital and decision-making capabilities, as well as increased vulnerability due to social factors, such as racial and economic disparities.

**Extreme Temps**

People susceptible to respiratory ailments (asthma, lower and upper respiratory disease) disproportionately suffer from the effects of fire, smoke, air pollutions, allergens, heat and PSPS. Those with limited income or without resources are affected disproportionately due to the inability to provide safe shelter, air conditioning, cooling, air purification, medical care, and quality foods, and are also least able to obtain information related to climate risks and adaptation strategies.

**Heat**

Heatstroke, cardiovascular disease, respiratory disease and cerebrovascular disease are related to extreme heat events. Increased number of heat waves creates heat-related physical stress on populations and is exacerbated in the metropolitan areas where greater amounts of heat-absorbing surfaces (e.g., asphalt and concrete) trap heat and emit higher temperatures throughout the night.

The heat also extends the geographic range and the distribution of disease-carrying insects and pests. Health professionals are concerned that California’s warming climate will allow species to acclimate. Such vectors include such pests as ticks that carry Lyme disease, and mosquitoes that transmit Zika, dengue fever, West Nile, plague and tularemia. Some others, such as chikungunya, Chagas disease, and Rift Valley fever virus, are threats as well.

Some communities of color and some low-income, homeless, and immigrant populations are more exposed to heat waves, as these groups often reside in urban areas affected by heat island effects. In addition, these populations are likely to have limited adaptive capacity due to a lack of adequately insulated housing, inability to afford or to use air conditioning, inadequate access to public shelters such as cooling centers, and inadequate access to both routine and emergency health care. These social, economic, and health risk factors give rise to the observed increase in deaths and disease from extreme heat in some immigrant and impoverished communities.

Heat stroke, the most serious heat-related illness, occurs when the body is unable to control its temperature. Body temperature rises rapidly, the sweating mechanism fails, and the body cannot cool down. In extreme causes, heat stroke can cause confusion and unconsciousness, so the victim is unable to seek treatment without assistance.

There are several groups of people who are uniquely vulnerable to the effects of extreme heat, such as infants and children, older adults aged 65 and up, athletes and outdoor workers, low-income households, and individuals with certain chronic medical conditions.

When dealing with an extreme heat event, the most common impacts are those generally felt by the people living in the targeted area. For people in particular, heat can kill when the body is pushed beyond its limits. Most heat disorders occur because the victim has been overexposed to heat. As discussed, the major human risks associated with extreme heat include dehydration, sunburn, fatigue, heat exhaustion, heat stroke, and in severe cases, death.

Some portions of the population are more at risk to the effects of extreme heat. The very young, the elderly, and certain groups with chronic medical conditions (such as asthma or other pulmonary illnesses, heart disease, poor blood circulation, neurological illnesses, and obesity) are generally more vulnerable to the effects of extreme heat, and are more likely to suffer illness or death as a result.

This is especially true if exposure is extended for a period of time and preventative measures are not taken immediately. Distributional implications of impacts, and even less on distributional implications of adaptation actions.” 217

**Flood**

Risk from floods relates to community risk, exposure and infrastructural losses. The degree of vulnerability to these events and their impacts depends on human behavior and the traditional social factors such as situational awareness, prior knowledge of hazards, social capital and decision-making capabilities. The exposure of humans to floods continues to increase, driven by changes in hydrology and land use. The adverse

impacts on socially vulnerable populations are amplified because a disproportionately high number live in flood-prone areas. Research has shown that places of social vulnerabilities are places characterized by housing and racial disparities, such as mobile home parks, structural fragility and poverty, and higher percentages of populations such as Black and Native Americans, and others with shared histories of discrimination, marginalization and exclusion. 218

Health impacts from flooding are well recognized due to the extensive history of flooding in California and around the nation. The impacts range from waterborne illnesses from contaminated waters, respiratory illnesses that impact the lungs, throat, and airways from airborne particles, mold on flooded buildings that can trigger asthma, allergies and other illnesses—all which are particularly impactful to older, younger and individuals with pre-existing health condition. Foodborne illnesses can increase if there are issues with power outages or sewer overflows. Individuals with increased mental health concerns can be impacted by the stress or anxiety from the impacts of the flood. Poor quality housing can increase vulnerability to many flood risks, including flood inundation, power outages, mold growth, rodent vectors, and serious health impacts. For those with limited finances, flood inundation and impacts to infrastructure or farmlands may lead to extensive income losses.

The poorest residents suffer disproportionately to flood situations, especially those who have been less able to fund homeowner’s insurance to protect against flood losses. Loss of life is not unusual in flooding situations, as is loss of property, livestock, pets, workplaces, and tourist industries. There is a strong interrelationship between water events and other hazards. Flooding, storms and water quality are related to each other. Drought conditions can exacerbate floods as the surface soils are hardened and not as ready to allow surface water absorption. Extreme heat events can cause snowmelt, inundating waterways and causing flood and water quality issues. Flooding and storm events can have impacts on public health, environmental health, agricultural health and economic system health. Mental health issues are reported for all people who have experience flood losses, including anxiety, fear, anger, anger, sadness and grief. 219

Additionally, waterborne disease outbreaks are reported weeks after the flood events. Mold contamination leads to indoor air issues. Damp indoor environments lead to increased prevalence of asthma, and also upper and lower respiratory symptoms.

These issues may influence the diverse CSU populations, both on and off campus, in a number of ways long after a flood event, or the related hazards impacts, has concluded.


**Hazardous Materials**

The severity of a hazardous materials release depends upon the type of material released, the amount of the release, and the proximity to populations or environmentally sensitive areas such as wetlands or waterways. The release of materials can lead to injuries or evacuation of nearby residents. Wind direction at the time of the release can also have a bearing on the severity (as well as the location and extent) of a hazardous materials release.

The primary threat from the hazardous materials incident hazard is to the structures located along transmission lines and transportation routes or near facilities that use or store hazardous materials. Minor incidents would likely cause no damage and little disruption, assuming they could be contained quickly. Major incidents could have fatal and disastrous consequences. The severity of a hazardous material release relates primarily to its impact on human safety and welfare and on the threat to the environment. Threats to human safety and welfare include:

- Poisoning of water or food sources and/or supply
- Presence of toxic fumes or explosive conditions
- Damage to personal property
- Need for the evacuation of people
- Interference with public or commercial transportation

Environmental risks are not uniformly distributed across groups of people. Age, poverty, and minority status place some groups at a disproportionately high risk for environmental disease.\(^220\) Poor access to health information and health care means less health promotion, less risk avoidance, a less healthy diet, and more adverse conditions that increase susceptibility to exposure. Delayed recognition of exposure, diagnosis, and treatment allows effects to accumulate.\(^221\)

**Power Outage/Public Safety Power Shutdowns (PSPS)**

Loss of power creates economic hardship to a region experiencing regular PSPS events, such as those experienced throughout the state over the recent years. Many businesses close, including gas stations, grocery stores, and local retail establishments. These impacts may deeply impact students dependent on support jobs, as well impacting family members of campus staff and faculty. PSPS increases risks to the public due to inability to use medical devices, spoilage of food and medicines, and disruption to infrastructure, such as supply of clean water and electricity used to run home medical equipment, such as lift chairs and ventilators.

\(^{220}\) [https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3222496/](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3222496/)

Volcanoes

There has been limited analysis on the full social and economic impacts of volcanic eruptions, but known impacts show extensive disruption to livelihoods, through evacuation or destruction of land and resources. Typically, indirect fatalities happen across even longer time scales than primary fatalities, and so social processes associated with wellbeing and secure livelihoods are even more likely to be a driver for risky behavior.\(^{222}\) Having access to (or neglecting) warning systems impacts one’s decision to leave. A volcanic eruption can impact health. Ashfall from volcanoes contain carbon dioxide and fluorine, gases that can be toxic to humans, and can collect in volcanic ash. The resulting ashfall can lead to crop failure, animal death and deformity (impacting financial security for those dependent on farming), and human illness. Ash's abrasive particles can scratch the surface of the skin and eyes, causing discomfort and inflammation. Further effects are the deterioration of water quality, fewer periods of rain, crop damages, and the destruction of vegetation. During volcanic eruptions and their immediate aftermath, increased respiratory system morbidity has been observed as well as mortality among those affected by volcanic eruptions. Health hazards can range from minor to life threatening. Exposure to acid gases such as sulfur dioxide, hydrogen sulfide, and hydrogen chloride can damage eyes and mucous membranes along with the respiratory system and, under extreme conditions, can lead to death.\(^{223}\)

Although ashfall is typically a nonlethal volcanic hazard, it is the most widespread and disruptive. Falling ash can damage crops, electronics, and machinery. It can also impact human health by irritating the respiratory tract, eyes, and skin. The particles may enter drinking water and structures and may cause structure failure if it is thick and heavy enough. Even a fine layer of ash can disrupt utilities. A portion of California’s major electric transmission lines, aerial telecommunication lifelines, transportation corridors, and water storage and conveyance lie within the state’s volcano hazard zones.

The potential impacts of gases released during volcanic eruptions are as follows:

- Carbon dioxide typically becomes diluted very quickly and is not life threatening. However, it can become trapped in higher concentrations in low-lying areas and has the potential to be fatal.


- Sulfur dioxide can cause acid rain and air pollution downwind of a volcano.
- Hydrogen sulfide can cause irritation of the upper respiratory tract. At high concentrations it can cause unconsciousness and death.
- Hydrogen halides can coat ash particles and once deposited, poison drinking water, agricultural crops, and grazing land.

**Wildfire**

Increased wildfire threat occurs especially in the end of fall, when conditions are driest, but before the winter rains have come; an east-to-west wind gusts exacerbate fire risk. Wildfire threats have the concomitant threat of Public Safety Power Shutoffs (PSPS). And, in the case of an actual wildfire, danger exists both from fire and from the smoke. Recent wildfires have demonstrated that some demographics are disproportionately affected. Native Americans are six times more likely to be affected than white people. Blacks and Hispanic people are 50 percent more vulnerable. These values take into account the likelihood of a community being affected and the greater difficulty of that community to recover. These statistics reflect the lack of access to resources to pay for insurance, to rebuild and recover, to implement fire safety measures, and to access other resources. Price gouging after a fire (such as documented in Sonoma County after the 2017 Tubbs Fire) further exacerbates the disparity. Moreover, the disabled and the elderly are at particular risk from extreme wildfire conditions, as they are often not as able to effectively evacuate. Of the 85 people who died in the Camp Fire in Butte in 2018, 62 of them were at least 65 years old.

Smoke from wildfires creates a significant public health threat. Especially vulnerable are individuals who have heart or lung issues, such heart disease, lung disease or asthma. Those most vulnerable include the medically fragile, elderly and children. Air Quality Indexes track the level of the following: particulate matter, surface levels of ozone, carbon monoxide, sulfur dioxide, and nitrogen dioxide. All of these can cause respiratory distress and harm lungs.

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The California Department of Public Health reports the increased public health risks, and risk indicators that include: heat-related ED visits, populations living in wildfire areas, adults with multiple chronic conditions, populations living in poverty, race/ethnicity, outdoor workers, public transit access, air conditioner ownership and tree canopy.\textsuperscript{228}

Hazard Mitigation and Emergency Management Planning

The goal of this high-level assessment is to provide a starting point to encourage further exploring campus social risks and vulnerabilities, as well as to inform and to enhance holistic emergency management and hazard mitigation decision making, planning processes and future adaptive risk management strategies. By including the social resilience factors, mitigation investments may move beyond standardized planning and regulations, structure and infrastructure projects, and natural systems protections to embrace a more expanded, customized emergency operations plan and an education and outreach program unique to the campus.

A more robust social resilience inquiry is strongly encouraged to develop an accurate picture, based on methodical and scientific research-based data. Such an effort would be envisioned through both nuanced discussions with a variety of campus stakeholders and the invitation of nontraditional stakeholders to join in a collaborative resilience partnership. Such a forward-leaning effort would be directly in keeping with CSU’s commitment to inclusion and equity in risk reduction.

Section 23
Cal Poly San Luis Obispo

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23.1 University Profile

University History

Cal Poly San Luis Obispo held its first classes on October 1, 1903, two years after Governor Gage signs a bill on March 8, 1901 establishing the California Polytechnic School. By 1947, the California Polytechnic School is renamed the California State Polytechnic College and begins offering graduate programs in education.

Cal Poly is designated as an Asian American and Native American Pacific Islander-Serving Institution (AANAPISI).

University Governance

The campus president is the chief executive officer who oversees the administration of the entire university. The president manages campus operations and fundraising, sets campus priorities, and oversees the hiring and support of staff and faculty. The president also maintains a close working relationship with the CSU’s systemwide office, reporting to the chancellor and participating in the systemwide Executive Council.

The provost is the chief academic officer of the university, overseeing all academic affairs and programs of the university. The provost reports directly to the president.

The president receives advisory support from The President’s Council of Advisors, a carefully selected group of professionals. The Council of Advisors enhances the relationship between the university and its constituent communities, including business, industry, agriculture, the professions and the arts. The President’s Council of Advisors is a group of individuals who represent leaders of professions, business, industry and communities. The Council convenes regularly to provide advice, advocacy, access, leverage and resources for the university.

University Mission

“Cal Poly fosters teaching, scholarship, and service in a learn-by-doing environment in which students, staff, and faculty are partners in discovery. As a polytechnic university, Cal Poly promotes the application of theory to practice. As a comprehensive institution, Cal Poly provides a balanced education in the arts, sciences, and technology, while encouraging cross-disciplinary and co-curricular experiences. As an academic community, Cal Poly values free inquiry, cultural and intellectual diversity, mutual respect, civic engagement, and social and environmental responsibility.”

University Location

Cal Poly San Luis Obispo is located in San Luis Obispo on California’s Central Coast, about halfway between Los Angeles and San Francisco. Cal Poly students benefit from hands-on research in agriculture, winemaking and distinctive coastal ecosystems, as well
University Population

Cal Poly San Luis Obispo’s student body exceed 21,000 students, both undergrad and graduate.

23.2 Interim Final Rule for Hazard Vulnerability and Risk Assessment

Requirement §201.6(c)(2): The plan shall include a risk assessment that provides the factual basis for activities proposed in the strategy to reduce losses from identified hazards. Local risk assessments must provide sufficient information to enable the jurisdiction to identify and prioritize appropriate mitigation actions to reduce losses from identified hazards.

Requirement §201.6(c)(2)(i): [The risk assessment shall include a] description of the type...location and extent of all natural hazards that can affect the jurisdiction. The plan shall include information on previous occurrences of hazard events and on the probability of future hazard events.

Requirement §201.6(c)(2)(ii): [The risk assessment shall include a] description of the jurisdiction’s vulnerability to the hazards described in paragraph (c)(2)(i) of this section. This description shall include an overall summary of each hazard and its impact on the community.

Requirement §201.6(c)(2)(ii): [The risk assessment] must also address National Flood Insurance Program (NFIP) insured structures that have been repetitively damaged floods.

Requirement §201.6(c)(2)(ii)(A): The plan should describe vulnerability in terms of the types and numbers of existing and future buildings, infrastructure, and critical facilities located in the identified hazard area.

Requirement §201.6(c)(2)(ii)(B): [The plan should describe vulnerability in terms of an] estimate of the potential dollar losses to vulnerable structures identified in paragraph (c)(2)(ii)(A) of this section and a description of the methodology used to prepare the estimate..

Requirement §201.6(c)(2)(ii)(C): [The plan should describe vulnerability in terms of] providing a general description of land uses and development trends within the community so that mitigation options can be considered in future land use decisions.

Requirement §201.6(c)(2)(iii): For multi-jurisdictional plans, the risk assessment must assess each jurisdiction’s risks where they vary from the risks facing the entire planning area.
23.3 Hazard Identification and Risk Assessment

Overview of Cal Poly San Luis Obispo History of Hazards

Numerous federal agencies maintain a variety of records regarding losses associated with hazards. Unfortunately, no single source is considered to offer a definitive accounting of all losses. The Federal Emergency Management Agency (FEMA) maintains records on federal expenditures associated with declared major disasters. The US Army Corps of Engineers (USACE) and the Natural Resources Conservation Service (NRCS) collect data on losses during the course of some of their ongoing projects and studies. Additionally, the National Oceanic and Atmospheric Administration’s (NOAA) National Centers for Environmental Information (NCEI) database collects and maintains data about natural hazards in summary format. The data includes occurrences, dates, injuries, deaths, and estimated costs. Many of these databases and other data collection services, including the NCEI, have inherent data limitations when searching for information at a university scale.

The best available data and records were used throughout this assessment.

Hazard Identification

As part of the initial hazard identification process, the Campus Assessment Team considered potential hazards with the most chance to significantly affect the planning area. The hazards include those that have occurred in the past and may occur in the future. A variety of sources were used to develop the list of hazards considered including national, regional, and local sources such as emergency operations plans, FEMA’s How-To Series, websites, published documents, databases, and maps, as well as discussion among the Campus Assessment Team members.

In the initial phase of the planning process, the Campus Assessment Team considered 14 hazards and the risks they create for the University and its material assets, population, and operations. The hazards initially considered, and the determinations as to the treatment of those hazards, are shown in Table 23-1 (following).

Table 23-1: Hazard Identification Determinations

<table>
<thead>
<tr>
<th>Hazard</th>
<th>Determination (Yes/No)</th>
<th>Reason for Determination</th>
<th>Future Occurrence Probability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Communicable Disease</td>
<td>Yes</td>
<td>Hazard of concern to campus</td>
<td>Highly Likely</td>
</tr>
<tr>
<td>Dam and Levee Failure</td>
<td>Yes</td>
<td>Hazard of concern to campus</td>
<td>Unlikely</td>
</tr>
<tr>
<td>Drought</td>
<td>Yes</td>
<td>Hazard of concern to campus</td>
<td>Highly Likely</td>
</tr>
<tr>
<td>Earthquake</td>
<td>Yes</td>
<td>Hazard of concern to campus</td>
<td>Possible</td>
</tr>
<tr>
<td>Hazard Type</td>
<td>Yes/No</td>
<td>Hazard of concern to campus</td>
<td>Occurrence Probability</td>
</tr>
<tr>
<td>--------------------------</td>
<td>--------</td>
<td>----------------------------</td>
<td>------------------------</td>
</tr>
<tr>
<td>Erosion</td>
<td>Yes</td>
<td>Hazard of concern to campus</td>
<td>Unlikely</td>
</tr>
<tr>
<td>Extreme Temperature</td>
<td>Yes - Heat; No - Cold</td>
<td>Hazard of concern to campus</td>
<td>Possible (Heat only)</td>
</tr>
<tr>
<td>Flood</td>
<td>Yes</td>
<td>Hazard of concern to campus</td>
<td>Possible</td>
</tr>
<tr>
<td>Hazardous Materials</td>
<td>Yes</td>
<td>Hazard of concern to campus</td>
<td>Unlikely</td>
</tr>
<tr>
<td>Landslide</td>
<td>Yes</td>
<td>Hazard of concern to campus</td>
<td>Likely</td>
</tr>
<tr>
<td>Power Outage</td>
<td>Yes</td>
<td>Hazard of concern to campus</td>
<td>Likely</td>
</tr>
<tr>
<td>Sea Level Rise</td>
<td>No</td>
<td>Not a hazard of concern to campus</td>
<td>N/A</td>
</tr>
<tr>
<td>Tsunami</td>
<td>No</td>
<td>Not a hazard of concern to campus</td>
<td>N/A</td>
</tr>
<tr>
<td>Volcano</td>
<td>Yes</td>
<td>Hazard of concern to campus</td>
<td>Unlikely</td>
</tr>
<tr>
<td>Wildfire</td>
<td>Yes</td>
<td>Hazard of concern to campus</td>
<td>Likely (Fire); Possible (Smoke)</td>
</tr>
</tbody>
</table>

**Future Occurrence Probability**

In order to determine the probability of future occurrences of each hazard profiled, the following scale was developed:

- **Highly Likely**- 76%-100% that the hazard would occur annually.
- **Likely**- 50%-75% that the hazard would occur annually.
- **Possible**- 11%-49% that the hazard would occur each annually.
- **Unlikely**- 0%-10% that the hazard would occur each annually.
Communicable Disease

Description of the Hazard

Communicable diseases are illnesses that occur due to infectious agents or their toxic products and are infectious due to their potential of transmission from one person or species to another by a replicating agent.¹ They may be transmitted from a reservoir to a susceptible host either directly as from an infected person or animal or indirectly through the agency of an intermediate plant or animal host, vector, or the inanimate environment. Communicable diseases are clinically evident illness resulting from the presence of pathogenic microbial agents, including pathogenic viruses, pathogenic bacteria, fungi, protozoa, multi-cellular parasites, and aberrant proteins known as prions.² The degree of spread of a communicable disease depends on both the ability of an organism to enter, survive and multiply in the host and the comparative ease with which the disease is transmitted to other hosts.³

Some ways in which communicable diseases spread are by:

- Travel through the air, such as tuberculosis, measles, or COVID-19;
- Physical contact with an infected person, such as through touch (staphylococcus), sexual intercourse (gonorrhea, HIV), fecal/oral transmission (hepatitis A), or droplets (influenza, TB, COVID-19);
- Contact with a contaminated surface or object (Norwalk virus), food (salmonella, E. coli), blood (HIV, hepatitis B), or water (cholera); and
- Bites from insects or animals capable of transmitting the disease (mosquito: malaria and yellow fever; flea: plague)⁴

Collectively, the twenty-three (23) campuses and Chancellor’s Office of the California State University (CSU) system have identified nine (9) communicable disease hazards that have had significant impacts on their respective student, faculty, and staff populations. Of these communicable diseases, COVID-19 is considered to be the most prominent and widespread agent across all CSU campuses. (See Table 23-2 below.)

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Table 23-2: Communicable Diseases Identified CSU Campuses

<table>
<thead>
<tr>
<th>Collective List of Communicable Diseases Identified by All CSU Campuses</th>
<th>Number of CSU Campuses (Including Chancellor’s Office) Identifying Communicable Disease Having Significant Impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>COVID-19 (SARS-CoV-2)</td>
<td>24</td>
</tr>
<tr>
<td>Meningitis</td>
<td>7</td>
</tr>
<tr>
<td>Measles</td>
<td>6</td>
</tr>
<tr>
<td>Influenza (Including H1N1/Swine Flu)</td>
<td>6</td>
</tr>
<tr>
<td>Tuberculosis</td>
<td>5</td>
</tr>
<tr>
<td>Norovirus</td>
<td>4</td>
</tr>
<tr>
<td>Mumps</td>
<td>2</td>
</tr>
<tr>
<td>E. Coli</td>
<td>2</td>
</tr>
<tr>
<td>Sexually Transmitted Diseases (STDs)</td>
<td>2</td>
</tr>
</tbody>
</table>

(Source: Interviews with CSU campus staff at CSU campuses and at CSU Chancellor’s Office.)

With the exception of COVID-19, there is variability among CSU campuses regarding which communicable diseases have had the greatest impact on individual campus communities. Table 23-3 shows the communicable disease hazards that have had the greatest impact on each CSU campus.

Table 23-3: Communicable Disease Hazards at CSU Campuses with Greatest Impact

<table>
<thead>
<tr>
<th>CSU Campus</th>
<th>Identified Communicable Disease Hazards with the Greatest Impact on CSU Campus</th>
</tr>
</thead>
<tbody>
<tr>
<td>CSU Bakersfield</td>
<td>COVID-19, Meningitis</td>
</tr>
<tr>
<td>CSU Channel Islands</td>
<td>COVID-19, Measles</td>
</tr>
<tr>
<td>Chico State</td>
<td>COVID-19, Tuberculosis</td>
</tr>
<tr>
<td>CSU Dominguez Hills</td>
<td>COVID-19</td>
</tr>
<tr>
<td>Cal State East Bay</td>
<td>COVID-19, Meningitis</td>
</tr>
<tr>
<td>Fresno State</td>
<td>COVID-19, Meningitis, Tuberculosis</td>
</tr>
<tr>
<td>Cal State Fullerton</td>
<td>COVID-19, Influenza</td>
</tr>
<tr>
<td>Humboldt State</td>
<td>COVID-19, Measles, Norovirus, Influenza, STDs</td>
</tr>
<tr>
<td>Cal State Long Beach</td>
<td>COVID-19</td>
</tr>
<tr>
<td>Institution</td>
<td>Communicable Disease Hazards</td>
</tr>
<tr>
<td>--------------------------------</td>
<td>------------------------------------------------------------------</td>
</tr>
<tr>
<td>Cal State LA</td>
<td>COVID-19, E. coli, Measles</td>
</tr>
<tr>
<td>Cal Maritime</td>
<td>COVID-19</td>
</tr>
<tr>
<td>CSU Monterey Bay</td>
<td>COVID-19</td>
</tr>
<tr>
<td>CSUN (Northridge)</td>
<td>COVID-19, Measles</td>
</tr>
<tr>
<td>Cal Poly Pomona</td>
<td>COVID-19, Influenza (Swine Flu - H1N1)</td>
</tr>
<tr>
<td>Sacramento State</td>
<td>COVID-19</td>
</tr>
<tr>
<td>Cal State San Bernardino</td>
<td>COVID-19, Tuberculosis</td>
</tr>
<tr>
<td>San Diego State</td>
<td>COVID-19, Meningitis, Mumps</td>
</tr>
<tr>
<td>San Francisco State</td>
<td>COVID-19</td>
</tr>
<tr>
<td>San José State</td>
<td>COVID-19, H1N1</td>
</tr>
<tr>
<td>Cal Poly San Luis Obispo</td>
<td>COVID-19, Meningitis, Norovirus</td>
</tr>
<tr>
<td>CSU San Marcos</td>
<td>COVID-19</td>
</tr>
<tr>
<td>Sonoma State</td>
<td>COVID-19, H1N1, Norovirus</td>
</tr>
<tr>
<td>Stanislaus State</td>
<td>COVID-19, Tuberculosis</td>
</tr>
<tr>
<td>Office of the Chancellor</td>
<td>COVID-19</td>
</tr>
<tr>
<td>CSU System-Wide</td>
<td>COVID-19, Meningitis, Measles, Tuberculosis, Influenza-Swine Flu-H1N1, Mumps, Norovirus, E. coli, STDs</td>
</tr>
</tbody>
</table>

(Source: Interviews with CSU campus staff at CSU campuses and at CSU Chancellor’s Office.)

**Descriptions of Identified Communicable Disease Hazards at Cal Poly San Luis Obispo**

Cal Poly San Luis Obispo (Cal Poly SLO) has identified three (3) communicable disease hazards that have had the greatest impact on campus – COVID-19, Meningitis, and Norovirus. The following are brief descriptions of the communicable disease hazards at Cal Poly SLO.

**COVID-19 (SARS-CoV-2)**

Coronaviruses are a family of viruses that can cause illnesses such as the common cold, severe acute respiratory syndrome (SARS) and Middle East respiratory syndrome (MERS). In 2019, a new coronavirus was identified as the cause of a disease outbreak that originated in China. This virus is now known as the **severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2)**. The disease it causes is called Coronavirus Disease 2019 (COVID-19). In March 2020, the World Health Organization (WHO) declared the COVID-19 outbreak a pandemic.
Signs and symptoms of coronavirus disease 2019 (i.e., COVID-19) may appear two to 14 days after exposure. Common signs and symptoms can include fever, cough, and tiredness. Early symptoms of COVID-19 may also include a loss of taste or smell.

The virus that causes COVID-19 spreads easily among people, and more continues to be discovered over time about how it spreads. Data has shown that the COVID-19 virus spreads mainly from person to person among those in close contact (within about 6 feet, or 2 meters). The virus is transmitted by respiratory droplets being released when someone with the virus coughs, sneezes, breathes, sings or talks. These droplets can be inhaled or land in the mouth, nose or eyes of a person nearby. In some situations, the COVID-19 virus can spread by a person being exposed to small droplets or aerosols that stay in the air for several minutes or hours (i.e., airborne transmission). It's not yet known how common it is for the virus to spread this way. The COVID-19 virus can also spread if a person touches a surface or object with the virus on it and then touches his or her mouth, nose or eyes; however, this is not considered to be a main way it spreads.

The severity of COVID-19 symptoms can range from very mild to severe. Some people may have only a few symptoms, and some people may have no symptoms at all. However, some people may experience worsened symptoms, such as worsened shortness of breath and pneumonia. People who are older have a higher risk of serious illness from COVID-19, and the risk increases with age. People who have existing medical conditions also may have a higher risk of serious illness from COVID-19. In some cases, the disease can cause severe medical complications and may even lead to death.

**Meningitis**

Meningitis is an inflammation of the fluid and membranes (meninges) surrounding the brain and spinal cord. The swelling from meningitis typically triggers signs and symptoms such as headache, fever and a stiff neck. Early meningitis symptoms may mimic the flu (influenza). Symptoms may develop over several hours or over a few days.

Most cases of meningitis in the United States are caused by a viral infection, but bacterial, parasitic and fungal infections are other causes. Some cases of meningitis improve without treatment in a few weeks. Others can be life-threatening and require emergency antibiotic treatment. Bacterial meningitis is particularly serious and can be fatal within days without prompt antibiotic treatment. Delayed treatment also increases the risk of permanent brain damage or death.

**Norovirus**

Norovirus is a highly contagious virus commonly spread through food or water that is contaminated by fecal material during food preparation or by contaminated surfaces.

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Specifically, this virus can be transmitted through: consuming contaminated food, drinking contaminated water, and touching one’s hand to one’s mouth after the hand has been in contact with a contaminated surface or object. Norovirus can also be transmitted through close contact with an infected person.

Norovirus infections occur most frequently in closed and crowded environments such as hospitals, nursing homes, child care centers, schools and cruise ships. Noroviruses are difficult to kill off because they can withstand hot and cold temperatures and most disinfectants.

Symptoms such as diarrhea, stomach pain and vomiting typically begin 12 to 48 hours after exposure, and usually last one to three days. Most people recover from norovirus completely without treatment. However, for some people — especially infants, older adults and people with underlying disease — vomiting and diarrhea can be severely dehydrating and require medical attention. 7

Location of the Hazard

Communicable diseases have the potential to affect the entire Cal Poly San Luis Obispo (Cal Poly SLO) planning area equally. As a result, the communicable disease hazard can be found at the Cal Poly SLO campus located in San Luis Obispo, CA (San Luis Obispo County), as well as at the Cal-Poly-SLO-owned 3000-foot research pier in nearby Avila Beach (San Luis Obispo County) that is used for field work, research cruises, and scientific diving programs. Because of the ubiquitous nature of many communicable diseases, students, faculty, staff at (and visitors to) the Cal Poly SLO main campus and affiliated facilities are at risk of exposure to the communicable disease hazard.

CSU Student Housing Locations and Populations

Although CSU-campus-owned student housing opportunities have been severely limited due to the COVID-19 pandemic, this situation is temporary. Eventually, students will be allowed back on campus at full capacity, and many of these students will be living in campus-owned housing. When this occurs, over 53,000 students (i.e., just over 11% of the CSU total enrollment) will be at increased risk of exposure to communicable disease hazards, owing to the “close-quarters” living arrangements in student housing. Table 23-4 shows the number of students that were living in CSU-campus-owned housing in Fall, 2019, prior to the COVID-19 pandemic. For Cal Poly SLO, approximately 37% of its 21,242 enrolled students (or 7,860 students) reside in student housing. 8,9


Extent of the Hazard

Various communicable diseases are categorized by the Center for Disease Control and Prevention (CDC) by levels of containment called Biosafety Levels (or BSLs). The higher the BSL, the greater the level of containment and level of effort necessary to prevent transmission of the disease, and therefore the greater the hazard. Biosafety Levels prescribe procedures and levels of containment for a particular microorganism or material (including research involving recombinant or synthetic nucleic acid molecules) and procedures associated with that containment. BSLs also consider primary barriers (e.g., biosafety cabinets), secondary barriers, facility design, air handling, laboratory security, etc. BSLs are graded from 1 to 4; as the BSL increases so does the relative risk of the agent/procedures as well the stringency of procedures and facility design.

Figure 23-1 describes the different BSLs, and provides examples of communicable diseases that would typically fall in to these classifications, as well as the typical protections that would be necessary to prevent transmission of each of the diseases.

Figure 23-1: Biosafety Levels (BSLs)

The Extent of Cal Poly San Luis Obispo (SLO) Communicable Disease Hazards Except COVID-19:

Before the COVID-19 pandemic, there were cases of Meningitis and Norovirus at Cal Poly SLO. Meningitis would be classified at the BSL-2 containment level, and Norovirus would also be classified at the BSL-2 containment level. 11

The Extent of Cal Poly San Luis Obispo (SLO) COVID-19 Communicable Disease Hazard:

As a microorganism, the SARS-CoV-2 (COVID-19) virus requires a high level of containment. It is therefore classified at BSL-3. 12

History of the Hazard

Over an approximately one-year period, from mid-March, 2020 to March 23, 2021, there were a reported 1,626 cases of COVID-19 at Cal Poly SLO. CSU-campus-specific COVID-19 case data for Cal Poly SLO can be found in the History of the Hazard section below.

Most communicable disease data are maintained by at the state and at the county levels, and are not generally available at the municipal or campus levels, unless (a) the CSU campus falls under the jurisdiction of a city-level health department, or (b) a geographically specific outbreak occurs on campus or in the local community. The exception to this is the current COVID-19 pandemic, where both campus and County-level case data have been collected. As a result, it is important to provide COVID-19 case statistics for both CSU campuses and the counties where CSU campus assets are located.

Tables 23-5 and 23-6 show campus-level and County-level COVID-19 Case data for Cal Poly San Luis Obispo (Cal Poly SLO). These case data are updated on at least a weekly basis. (Please note that the COVID-19 case numbers here may not reflect the most recent updates.)

Table 23-4: Campus-level Case data for Cal Poly San Luis Obispo (as of 03/22/2021) 13

<table>
<thead>
<tr>
<th>Case Type</th>
<th>Number of Cases</th>
</tr>
</thead>
<tbody>
<tr>
<td>On-Campus</td>
<td>588</td>
</tr>
<tr>
<td>Off-campus</td>
<td>95</td>
</tr>
<tr>
<td>Total Confirmed Cases</td>
<td>1626</td>
</tr>
</tbody>
</table>

(Nete: On-campus and off-campus case data reflect only tests administered through Campus Health and Wellbeing or through the university’s ongoing testing program. Total confirmed case data include additional campus resident students who have tested)


Positive via off-campus testing sites. Positive tests for employees or off-campus resident students obtained off campus are not reported to Cal Poly SLO unless they require contact investigation or isolation/quarantine actions on campus. Instead, these off-campus positive tests are reflected in countywide and community-specific statistics (for their community of residence).

Table 23-5: Confirmed COVID-19 Statistics for San Luis Obispo County (as of 03/22/2021):

<table>
<thead>
<tr>
<th>COVID-19 Statistic</th>
<th>Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cases</td>
<td>20,260</td>
</tr>
<tr>
<td>Deaths</td>
<td>253</td>
</tr>
</tbody>
</table>

Potential Impacts of the Hazard

Communicable disease outbreaks and pandemics potentially have (and will continue to have) direct impact on life, health, and safety across the CSU system, including the Cal Poly SLO campus. The extent of this impact is contingent on the type of infection or contagion, the severity of the outbreak, and the speed at which it is transmitted. Property and infrastructure integrity may be affected if large portions of the campus population contract communicable diseases at the same time and are therefore unable to perform maintenance, operations, and educational tasks. This would be particularly disruptive if those impacted are first responders or other essential personnel. Long-term outbreaks affecting large numbers of Cal Poly SLO students could result in cancelled classes, delayed matriculation, or other disruptions to the CSU System’s mission. This has already occurred with the current COVID-19 pandemic and could occur again with more virulent strains of communicable diseases, including COVID-19.

Communicable disease hazards found across the CSU system (including Cal Poly SLO) vary both by level of containment (BSL) (described previously) and by level of individual/public health risk, or Risk Group (RG) level. While BSLs describe the procedures and required levels of containment in a laboratory setting, Risk Groups (RGs) reflect the potential effects of disease exposure on humans or animals. Like BSLs, RGs range from Level 1 (RG1) to Level 4 (RG4), with Level 1 (RG1) posing minimal risk to healthy individuals and public health and Level 4 (RG4) posing a very serious or extreme risks to individuals and public. BSLs generally correlate with Risk Group (RG) Levels (e.g., a RG2 agent is worked with at BSL-2), but there are exceptions (e.g., production volumes, high-risk procedures, etc.). 15


The World Health Organization’s (WHO) Laboratory Biosafety Manual, 3rd ed., NIH Guidelines, categorizes Risk Groups (RGs) in the following way:

Table 23-6: WHO Risk Group Categorization16

<table>
<thead>
<tr>
<th>Risk Group (RG)</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>RG1</td>
<td>Rarely associated with disease in healthy adult humans or animals and pose no-to-little public health risk (e.g., Saccharomyces cerevisiae, E. coli K-12 strain derivatives often used for recombinant/molecular biology, many environmental organisms)</td>
</tr>
<tr>
<td>RG2</td>
<td>Associated with mild to moderate disease for which preventative measures or post exposure treatments are often available; public health impact is limited (e.g., Streptococcus pyogenes, Salmonella, hepatitis B virus)</td>
</tr>
<tr>
<td>RG3</td>
<td>Associated with serious to lethal human disease for which preventative vaccines or post-exposure therapies may be scarce. Public health impact is limited-to-moderate (e.g., Mycobacterium tuberculosis, hantaviruses, West Nile virus, SARS)</td>
</tr>
<tr>
<td>RG4</td>
<td>Associated with serious to lethal human disease for which preventative vaccines or post exposure therapies are not usually available. Public health impact is high (e.g., Ebola virus, Marburg virus, smallpox virus, etc.)</td>
</tr>
</tbody>
</table>

Table 23-8 describes the four (4) Risk Group Levels (RGs), and provides examples of communicable diseases that would typically fall in to these classifications, and the typical protections that would be necessary to prevent transmission of the disease. It is important to note that all but two (2) communicable disease hazards identified by CSU campuses fall under either the lower-risk RG1 or RG2 categories. COVID-19 and tuberculosis are the two (2) communicable diseases fall under the higher-risk RG3 category. However, with the advent of the recently-developed COVID-19 vaccine, and with the expectation of an increasingly robust vaccine supply, it is possible that the RG level for COVID-19 could be lowered in the future, thereby reducing both the extent and the potential impact of COVID-19.

<table>
<thead>
<tr>
<th>Level</th>
<th>Examples</th>
<th>Typical Protection to Prevent Transmission</th>
</tr>
</thead>
<tbody>
<tr>
<td>RG 1</td>
<td>E. Coli</td>
<td>Precautions are minimal, most likely involving gloves and some sort of facial protection. Usually, contaminated materials are left in open (but separately indicated) waste receptacles. Decontamination procedures for this level are similar in most respects to modern precautions against everyday viruses (i.e.: washing one's hands with anti-bacterial soap, washing all exposed surfaces of the lab with disinfectants, etc.).</td>
</tr>
<tr>
<td>RG 2</td>
<td>Chicken Pox, Hepatitis A, B, C, Lyme disease, Salmonella, Mumps, Measles, Measles, Malaria, Scrapie, Dengue Fever, HIV</td>
<td>These bacteria and viruses cause mild disease in humans or are difficult to contract via aerosol. Routine diagnostic work with clinical specimens can be done safely at BSL-2, using BSL-2 practices and procedures.</td>
</tr>
</tbody>
</table>

These bacteria and viruses cause severe to fatal disease in human, but vaccines or other treatments do exist to combat them. Laboratory personnel have specific training in handling pathogenic and potentially lethal agents and are supervised by competent scientists who are experienced in working with these agents. This is considered a neutral or warm zone.

These viruses and bacteria cause severe to fatal disease in humans, for which vaccines or other treatments are not available. When dealing with biological hazards at this level the use of a Hazmat suit and a self-contained oxygen supply is mandatory. The entrance and exit of a BSL-4 lab will contain multiple showers, a vacuum room, an ultraviolet light room, autonomous detection system, and other safety precautions designed to destroy all traces of the biohazard. Multiple airlocks are employed and are electronically secured to prevent both doors opening at the same time. All air and water service going to and coming from a BSL-4 lab will undergo similar decontamination procedures to eliminate the possibility of an accidental release.

### Probability of Future Occurrence of the Hazard

There are significant data limitations regarding non-COVID-19 communicable disease cases, as the information thereof is outdated, anecdotal, and/or inadequate. As a result, it is not feasible to provide quantitative probabilities of future occurrence for non-COVID-19 communicable disease hazards. However, based on the limited data, it is feasible to present qualitative probabilities of future occurrence based on ranges of communicable disease frequency. Table 23-9 shows a probability scale of future occurrence for the nine (9) communicable disease hazards profiled in this assessment. This scale is divided into four (4) levels of probability:

| RG 3 | Anthrax  
|      | West Nile Virus  
|      | SARS Virus (Including COVID-19)  
|      | Tuberculosis  
|      | Typhus  
|      | Yellow Fever  
|      | Hantaviruses  
|      | Avian Flu  

| RG 4 | H5N1 (Bird Flu)  
|      | Dengue  
|      | Hemorrhagic Fever  
|      | Marburg Virus  
|      | Ebola Virus  
|      | Smallpox  
|      | Lassa Fever  
|      | Crimean-Congo Hemorrhagic Fever  
|      | Other Hemorrhagic Diseases  

23-16
Table 23-8: Likelihood of Future Hazard Occurrence

<table>
<thead>
<tr>
<th>Likelihood</th>
<th>Parameters for Determining Likelihood</th>
</tr>
</thead>
<tbody>
<tr>
<td>Highly Likely</td>
<td>76 – 100% probability that hazard will occur annually (high to very high frequency)</td>
</tr>
<tr>
<td>Likely</td>
<td>50 – 75% probability that hazard will occur annually (moderate to high frequency)</td>
</tr>
<tr>
<td>Possible</td>
<td>11 – 49% probability that hazard will occur annually (low to moderate frequency)</td>
</tr>
<tr>
<td>Unlikely</td>
<td>0 – 10% probability that hazard will occur annually (very low to low frequency)</td>
</tr>
</tbody>
</table>

Due to significant data limitations surrounding non-COVID communicable diseases, the probability of future occurrence of CSU-system-wide communicable disease is measured by the proportion of campuses that have identified a particular communicable disease as having an impact on the campus community. In this measure, the more frequent a communicable disease is seen as impactful CSU-wide, the greater the probability of future occurrence.

*Note: Each communicable disease’s probability of future occurrence ranking CSU-system-wide reflects the ranking at the individual CSU campus level unless noted otherwise.*

Table 23-9: Probability of Future Occurrence of Communicable Disease Hazard for CSU System.

<table>
<thead>
<tr>
<th>Collective List ofCommunicable Diseases Identified by All CSU Campuses</th>
<th>Number of CSU Campuses (Including Chancellor’s Office)IdentifyingCommunicable Disease Having Significant Impact</th>
<th>Proportion of CSU Campuses IdentifyingCommunicable Disease as Having Significant Impact System-Wide</th>
<th>CSU System-Wide Probability Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>COVID-19 (SARS-CoV-2)</td>
<td>24</td>
<td>1.00</td>
<td>Highly Likely</td>
</tr>
<tr>
<td>Meningitis</td>
<td>7</td>
<td>0.29</td>
<td>Possible</td>
</tr>
<tr>
<td>Measles</td>
<td>6</td>
<td>0.25</td>
<td>Possible</td>
</tr>
<tr>
<td>Influenza (Including H1N1/Swine Flu)</td>
<td>6</td>
<td>0.25</td>
<td>Possible</td>
</tr>
<tr>
<td>Tuberculosis</td>
<td>5</td>
<td>0.21</td>
<td>Possible</td>
</tr>
<tr>
<td>Norovirus</td>
<td>4</td>
<td>0.17</td>
<td>Possible</td>
</tr>
<tr>
<td>Mumps</td>
<td>2</td>
<td>0.08</td>
<td>Unlikely</td>
</tr>
<tr>
<td>E. Coli</td>
<td>2</td>
<td>0.08</td>
<td>Unlikely</td>
</tr>
</tbody>
</table>
Vulnerability to the Hazard

Vulnerability to a communicable diseases hazard resides in the population of a given area – both human and animal – not in the infrastructure or physical assets. While CSU assets and infrastructure could be impacted indirectly by the communicable disease hazard, these impacts would be secondary to the impact that the communicable disease hazard would have on students, faculty, staff, and visitors at Cal Poly SLO campus.

CSU campus settings are geographically diverse, with locations ranging from small towns to medium-sized cities to densely populated urban areas. Hundreds of thousands of people work, study, and/or pass through CSU campuses on any given day. As of Fall 2019, CSU – San Luis Obispo had 21,242 students and additional faculty and staff. Each of these persons is vulnerable to communicable disease, particularly if it is a pathogen that individual has not been immunized against, or for which no immunization exists. Prolonged outbreaks could result in a loss of services, failure of infrastructure (from lack of operators or maintenance), and closure of facilities. This exact scenario has played out to some degree in the current COVID-19 pandemic on the Cal Poly SLO campus.

Estimate of Potential Losses

**COVID-19 Pandemic Health Impact on CSU Campuses and Surrounding Communities**

The most prescient metric for estimating losses from COVID-19 is loss of life. The nationwide campus-related COVID-19 death rate of 0.02% remains well below the average COVID-19 death rate in the U.S. However, due to data limitations, there is no information on CSU-campus-specific deaths by COVID-19 or by any other communicable diseases. In fact, COVID-19 is the only communicable disease for which case reports have been readily available for CSU campuses.

At some point in the future, CSU campuses will return to full capacity. Without adequate surveillance regarding campus access and student and employee interaction, CSU campuses (including Cal Poly SLO) are at risk of developing an extreme incidence of

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18 The California State University. *Enrollment*. Retrieved 05.03.2021 from: https://www2.calstate.edu/csu-system/about-the-csu/facts-about-the-csu/enrollment/Pages/default.aspx

COVID-19 and may become “super-spreaders” for adjacent communities. The emergence of more virulent COVID-19 variants would only add to the potential for high negative impacts on life safety, operations, and service delivery across the CSU system. (Other communicable diseases would also re-emerge, but with low to moderate negative impacts on life safety, operations, and service delivery.)

**Economic Impact of COVID-19 Pandemic on CSU Financial Health**

During the first few months of the COVID-19 pandemic in 2020, the CSU system suffered tremendous negative fiscal impacts. From March through July of 2020 alone, over $146 million worth of revenue losses were sustained across the CSU system due to refunds to students for parking, housing and dining service fees during Spring Semester, 2020. (See Figure 23-2 below for the economic impact to the campus). Several CSU campuses saw refund losses surpass $10 million. (See Figure 23-2.)

Figure 23-2: CSU COVID-19 Cost Tracking Showing Revenue Refund Losses and Increased Costs

<table>
<thead>
<tr>
<th>Campus</th>
<th>State Agency Code</th>
<th>Total Estimated Cost (within department operation)</th>
<th>Total Estimated Extraordinary Cost</th>
<th>Total Estimated Cost (within department operation)</th>
<th>Total Estimated Extraordinary Cost</th>
<th>Total Costs</th>
<th>Total Refunds</th>
<th>Grand Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bakersfield</td>
<td>6650</td>
<td>-</td>
<td>-</td>
<td>1,377</td>
<td>-</td>
<td>1,377</td>
<td>1,377</td>
<td>2,752</td>
</tr>
<tr>
<td>Chico</td>
<td>6630</td>
<td>27</td>
<td>746</td>
<td>777</td>
<td>9,010</td>
<td>6,808</td>
<td>772</td>
<td>772</td>
</tr>
<tr>
<td>Channe Islands</td>
<td>6650</td>
<td>1,135</td>
<td>1,135</td>
<td>1,135</td>
<td>9,610</td>
<td>6,808</td>
<td>772</td>
<td>772</td>
</tr>
<tr>
<td>Chico</td>
<td>6680</td>
<td>552</td>
<td>552</td>
<td>552</td>
<td>5,174</td>
<td>6,501</td>
<td>6,501</td>
<td>6,501</td>
</tr>
<tr>
<td>Dominguez Hills</td>
<td>6650</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>East Bay</td>
<td>6720</td>
<td>1,217</td>
<td>8</td>
<td>1,225</td>
<td>2,845</td>
<td>6,070</td>
<td>6,070</td>
<td>6,070</td>
</tr>
<tr>
<td>Fresno</td>
<td>6702</td>
<td>2,106</td>
<td>1,607</td>
<td>3,313</td>
<td>563</td>
<td>4,316</td>
<td>4,316</td>
<td>4,316</td>
</tr>
<tr>
<td>Fullerton</td>
<td>6730</td>
<td>38</td>
<td>4,935</td>
<td>5,313</td>
<td>3,313</td>
<td>8,626</td>
<td>8,626</td>
<td>8,626</td>
</tr>
<tr>
<td>Humboldt</td>
<td>6730</td>
<td>1,026</td>
<td>-</td>
<td>1,026</td>
<td>3,415</td>
<td>4,441</td>
<td>4,441</td>
<td>4,441</td>
</tr>
<tr>
<td>Long Beach</td>
<td>6740</td>
<td>2</td>
<td>-</td>
<td>2</td>
<td>3,125</td>
<td>3,125</td>
<td>3,125</td>
<td>3,125</td>
</tr>
<tr>
<td>Los Angeles</td>
<td>6750</td>
<td>3,125</td>
<td>1,480</td>
<td>4,605</td>
<td>2,812</td>
<td>4,301</td>
<td>4,301</td>
<td>4,301</td>
</tr>
<tr>
<td>Maritime Academy</td>
<td>6752</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Monterey Bay</td>
<td>6756</td>
<td>1,436</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Northridge</td>
<td>6760</td>
<td>-</td>
<td>-</td>
<td>2,173</td>
<td>5,177</td>
<td>7,350</td>
<td>7,350</td>
<td>7,350</td>
</tr>
<tr>
<td>Pomona</td>
<td>6770</td>
<td>3,969</td>
<td>21</td>
<td>5,930</td>
<td>11,879</td>
<td>17,810</td>
<td>17,810</td>
<td>17,810</td>
</tr>
<tr>
<td>Sacramento</td>
<td>6780</td>
<td>1,985</td>
<td>179</td>
<td>2,164</td>
<td>5,169</td>
<td>7,353</td>
<td>7,353</td>
<td>7,353</td>
</tr>
<tr>
<td>San Bernardino</td>
<td>6790</td>
<td>100</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>100</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>San Diego</td>
<td>6800</td>
<td>89</td>
<td>5,861</td>
<td>5,861</td>
<td>5,861</td>
<td>11,722</td>
<td>11,722</td>
<td>11,722</td>
</tr>
<tr>
<td>San Francisco</td>
<td>6800</td>
<td>5</td>
<td>3,283</td>
<td>3,283</td>
<td>3,283</td>
<td>12,416</td>
<td>12,416</td>
<td>12,416</td>
</tr>
<tr>
<td>San Jose</td>
<td>6830</td>
<td>3,615</td>
<td>9,038</td>
<td>9,038</td>
<td>9,038</td>
<td>11,408</td>
<td>11,408</td>
<td>11,408</td>
</tr>
<tr>
<td>San Luis Obispo</td>
<td>6830</td>
<td>810</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>San Marcos</td>
<td>6840</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Santa Barbara</td>
<td>6830</td>
<td>470</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Stanislaus</td>
<td>6870</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

| CSU System Total | 5,641 | 8,197 | 3,015 | 30,128 | 47,921 | 146,149 | 194,070 |

Mitigative Relief from Federal Assistance

The $1.5 billion in total federal assistance sent to the CSU system will help relieve the losses of revenues from services like dorms, parking and dining services during a year of

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mainly empty campuses. (See Table 23-11) However, because of staggering COVID-related revenue losses, the CSU system is planning for three (3) years of fiscal duress.

Table 23-10: Total Federal Assistance to CSU for COVID-19 Related Losses, 2020 – 2021

<table>
<thead>
<tr>
<th>Institution</th>
<th>December 2020 Stimulus</th>
<th>CARES Act</th>
<th>APLU Projection of HEERF Total ARP Act Funding Allocation</th>
<th>Total Estimated Federal COVID Relief Funding</th>
</tr>
</thead>
<tbody>
<tr>
<td>California Polytechnic State University</td>
<td>$20,752,799</td>
<td>$14,725,000</td>
<td>$37,000,928</td>
<td>$72,478,727</td>
</tr>
<tr>
<td>California State Polytechnic University, Pomona</td>
<td>$48,614,353</td>
<td>$31,102,000</td>
<td>$86,044,649</td>
<td>$165,761,002</td>
</tr>
<tr>
<td>California State University Channel Islands</td>
<td>$14,288,099</td>
<td>$8,512,000</td>
<td>$24,915,170</td>
<td>$47,715,269</td>
</tr>
<tr>
<td>California State University Maritime Academy</td>
<td>$1,381,700</td>
<td>$1,204,000</td>
<td>$2,472,622</td>
<td>$5,058,322</td>
</tr>
<tr>
<td>California State University - Sacramento</td>
<td>$59,891,260</td>
<td>$35,643,000</td>
<td>$104,900,133</td>
<td>$200,434,393</td>
</tr>
<tr>
<td>California State University, Bakersfield</td>
<td>$22,855,632</td>
<td>$12,483,000</td>
<td>$40,285,565</td>
<td>$75,624,197</td>
</tr>
</tbody>
</table>


<table>
<thead>
<tr>
<th>University Name</th>
<th>2019-2020 Revenue</th>
<th>2020-2021 Revenue</th>
<th>2021-2022 Revenue</th>
<th>2022-2023 Revenue</th>
</tr>
</thead>
<tbody>
<tr>
<td>California State University, Chico</td>
<td>$31,603,856</td>
<td>$20,019,000</td>
<td>$55,754,538</td>
<td>$107,377,394</td>
</tr>
<tr>
<td>California State University, Dominguez Hills</td>
<td>$31,843,563</td>
<td>$18,312,000</td>
<td>$55,915,410</td>
<td>$106,070,973</td>
</tr>
<tr>
<td>California State University, East Bay</td>
<td>$24,243,652</td>
<td>$14,394,000</td>
<td>$42,929,208</td>
<td>$81,566,860</td>
</tr>
<tr>
<td>California State University, Fresno</td>
<td>$52,725,317</td>
<td>$32,557,000</td>
<td>$92,926,594</td>
<td>$178,208,911</td>
</tr>
<tr>
<td>California State University, Fullerton</td>
<td>$67,736,949</td>
<td>$41,088,000</td>
<td>$120,859,884</td>
<td>$229,684,833</td>
</tr>
<tr>
<td>California State University, Long Beach</td>
<td>$67,421,424</td>
<td>$41,202,000</td>
<td>$119,508,329</td>
<td>$228,131,753</td>
</tr>
<tr>
<td>California State University, Los Angeles</td>
<td>$61,905,561</td>
<td>$40,067,000</td>
<td>$108,543,672</td>
<td>$210,516,233</td>
</tr>
<tr>
<td>California State University, Monterey Bay</td>
<td>$13,455,716</td>
<td>$8,705,000</td>
<td>$23,922,768</td>
<td>$46,083,484</td>
</tr>
<tr>
<td>California State University, Northridge</td>
<td>$74,004,088</td>
<td>$47,458,000</td>
<td>$131,021,450</td>
<td>$252,483,538</td>
</tr>
<tr>
<td>California State University, San Bernardino</td>
<td>$42,438,131</td>
<td>$27,924,000</td>
<td>$74,982,459</td>
<td>$145,344,590</td>
</tr>
<tr>
<td>California State University, San Marcos</td>
<td>$26,602,684</td>
<td>$15,542,000</td>
<td>$46,496,808</td>
<td>$88,641,492</td>
</tr>
<tr>
<td>California State University, Stanislaus</td>
<td>$22,007,207</td>
<td>$12,928,000</td>
<td>$38,636,391</td>
<td>$73,571,598</td>
</tr>
<tr>
<td>Humboldt State University</td>
<td>$16,130,016</td>
<td>$11,146,000</td>
<td>$28,831,619</td>
<td>$56,107,635</td>
</tr>
<tr>
<td>San Diego State University</td>
<td>$45,914,127</td>
<td>$30,394,000</td>
<td>$80,592,385</td>
<td>$156,900,512</td>
</tr>
<tr>
<td>San Francisco State University</td>
<td>$47,404,409</td>
<td>$30,000,000</td>
<td>$83,075,470</td>
<td>$160,479,879</td>
</tr>
</tbody>
</table>
Vulnerability Assessment Conclusions

Before the COVID-19 pandemic, populations at all CSU campuses and CSU-affiliated facilities were substantial. Collectively, as of Fall 2019, CSU campuses had 480,541 students and 53,763 faculty and staff. All were at risk from the communicable disease events, with 534,304 people being directly vulnerable. The COVID-19 pandemic has caused campus population numbers to plummet to a small fraction of full capacity. At some point in the future, campus population numbers will return to their pre-pandemic levels, and students, faculty, and staff will again be vulnerable to the communicable disease hazard. If just 10% of the total CSU population were to become ill with a highly infective communicable disease like influenza or another strain of SARS, this would mean that approximately 53,430 people would be sick at the same time. This scenario would likely overwhelm available on-campus medical services and could even overwhelm portions of the larger community’s medical resources – especially if there were large numbers of infected people with immune system compromises or other underlying health problems.

See Table 23-12 below for the “10% outbreak scenario” projections both for each CSU campus and for the entire CSU system.

Table 23-12: Scenario of Communicable Disease Hazard Affecting 10% of the CSU Population

<table>
<thead>
<tr>
<th></th>
<th>Approximate Enrollment Population (Fall 2019)</th>
<th>Approximate Total FT/PT Faculty/Staff Population (Fall 2019)</th>
<th>Total Combined Approximate Student and 10% Outbreak Scenario (Students and Faculty/Staff Combined)</th>
</tr>
</thead>
<tbody>
<tr>
<td>San Jose State University</td>
<td>$46,631,939</td>
<td>$30,977,000</td>
<td>$82,976,130</td>
</tr>
<tr>
<td>Sonoma State University</td>
<td>$13,980,795</td>
<td>$9,153,000</td>
<td>$24,732,994</td>
</tr>
<tr>
<td>CSU System-Wide Totals</td>
<td>$853,833,277</td>
<td>$535,535,000</td>
<td>$1,507,325,177</td>
</tr>
</tbody>
</table>


<table>
<thead>
<tr>
<th>CSU Campus</th>
<th>2021-22</th>
<th>2022-23</th>
<th>2021-22</th>
<th>2022-23</th>
</tr>
</thead>
<tbody>
<tr>
<td>CSU Bakersfield</td>
<td>11,199</td>
<td>1,277</td>
<td>12,476</td>
<td>1,248</td>
</tr>
<tr>
<td>CSU Channel Islands</td>
<td>7,093</td>
<td>994</td>
<td>8,087</td>
<td>809</td>
</tr>
<tr>
<td>Chico State</td>
<td>17,019</td>
<td>1,969</td>
<td>18,988</td>
<td>1,899</td>
</tr>
<tr>
<td>CSU Dominguez Hills</td>
<td>17,027</td>
<td>1,761</td>
<td>18,788</td>
<td>1,879</td>
</tr>
<tr>
<td>Cal State East Bay</td>
<td>14,705</td>
<td>1,764</td>
<td>16,469</td>
<td>1,647</td>
</tr>
<tr>
<td>Fresno State</td>
<td>24,139</td>
<td>2,534</td>
<td>26,673</td>
<td>2,667</td>
</tr>
<tr>
<td>Cal State Fullerton</td>
<td>39,868</td>
<td>3,736</td>
<td>43,604</td>
<td>4,360</td>
</tr>
<tr>
<td>Humboldt State</td>
<td>6,983</td>
<td>1,171</td>
<td>8,154</td>
<td>815</td>
</tr>
<tr>
<td>Cal State Long Beach</td>
<td>38,074</td>
<td>4,004</td>
<td>42,078</td>
<td>4,208</td>
</tr>
<tr>
<td>Cal State LA</td>
<td>26,361</td>
<td>2,821</td>
<td>29,182</td>
<td>2,918</td>
</tr>
<tr>
<td>Cal Maritime</td>
<td>911</td>
<td>329</td>
<td>1,240</td>
<td>124</td>
</tr>
<tr>
<td>CSU Monterey Bay</td>
<td>7,123</td>
<td>1,059</td>
<td>8,182</td>
<td>818</td>
</tr>
<tr>
<td>CSUN (Northridge)</td>
<td>38,391</td>
<td>3,832</td>
<td>42,223</td>
<td>4,222</td>
</tr>
<tr>
<td>Cal Poly Pomona</td>
<td>27,914</td>
<td>2,650</td>
<td>30,564</td>
<td>3,056</td>
</tr>
<tr>
<td>Sacramento State</td>
<td>31,156</td>
<td>3,228</td>
<td>34,384</td>
<td>3,438</td>
</tr>
<tr>
<td>Cal State San Bernardino</td>
<td>20,311</td>
<td>2,118</td>
<td>22,429</td>
<td>2,243</td>
</tr>
<tr>
<td>San Diego State</td>
<td>35,081</td>
<td>3,702</td>
<td>38,783</td>
<td>3,878</td>
</tr>
<tr>
<td>San Francisco State</td>
<td>28,880</td>
<td>3,401</td>
<td>32,281</td>
<td>3,228</td>
</tr>
<tr>
<td>San José State</td>
<td>33,282</td>
<td>3,568</td>
<td>36,850</td>
<td>3,685</td>
</tr>
<tr>
<td><strong>Cal Poly San Luis Obispo</strong></td>
<td>21,242</td>
<td>2,871</td>
<td>24,113</td>
<td>2,411</td>
</tr>
<tr>
<td>CSU San Marcos</td>
<td>14,519</td>
<td>1,687</td>
<td>16,206</td>
<td>1,621</td>
</tr>
<tr>
<td>Sonoma State</td>
<td>8,649</td>
<td>1,338</td>
<td>9,987</td>
<td>999</td>
</tr>
<tr>
<td>Stanislaus State</td>
<td>10,614</td>
<td>1,276</td>
<td>11,890</td>
<td>1,189</td>
</tr>
<tr>
<td>Office of the Chancellor</td>
<td>0</td>
<td>673</td>
<td>673</td>
<td>67</td>
</tr>
<tr>
<td><strong>CSU System-Wide</strong></td>
<td><strong>480,541</strong></td>
<td><strong>53,763</strong></td>
<td><strong>534,304</strong></td>
<td><strong>53,430</strong></td>
</tr>
</tbody>
</table>
Note: Enrollment figures do not include non-specific CSU campus International Programs (455 students) or CALStateTEACH Program (933 students).

While the case numbers of COVID-19 have been significantly lower (about 1% of the total CSU population) than those in the 10% scenario, the degree of virulence and resultant morbidity and mortality caused by COVID-19 have led to widespread campus shutdowns, educational disruption, and economic harm to the CSU system, including to Cal Poly SLO. In short, the real-time COVID-19 communicable disease outbreak scenario has proven far more devastating than the 10% simulated scenario.

Identified Data Limitations

There is a wealth of technical information available for communicable disease. However, there is also limited non-COVID-19 communicable disease data available regarding risk or vulnerability of specific populations throughout the CSU. Much of the data that does exist is protected by privacy policies, and therefore cannot be obtained for more specific populations. As a result, performing a detailed quantitative assessment for this hazard is difficult.

Data that could be collected prior to the next update in order to improve this methodology includes:

- Data regarding infection rates at the campus level and for specific populations;
- Data regarding communicable disease case numbers and outcomes, by CSU campus;
- Data regarding projected population changes;
- Data regarding absenteeism; and
- Data regarding increased operating costs as a result of absenteeism (i.e., temporary shifting of duties resulting in business interruption).

Dam and Levee Failure

Description of the Hazard

A dam failure represents the structural collapse of a dam that stores water in a reservoir behind the dam. These failures are typically the result of structural age, damage to the structure caused by earthquake or flooding, inadequate discharge or spillway capacity, inadequate maintenance, improper construction materials, or extreme inflow of water into the reservoir. Prolonged precipitation may result in overtopping of the dam resulting in structural compromise. The tremendous energy generated by a sudden breach of the dam will have significant downstream effects. Flood damage resulting from dam failures potentially will result in economic losses, environmental damage, destruction of agriculture, and human casualties. This type of incident is extremely dangerous as it can occur rapidly, with no warning resulting in an inability to effectively evacuate threatened communities.
A levee failure is similar to dam failures as the result will be a breach causing flooding on the dry side of the levee. Levees are embankments whose primary purpose is to furnish flood protection from seasonal high water or divert the flow of water. Most levees in California are intended to withstand peak water levels generated by heavy precipitation or rapid snowmelt in a watershed. Other levees are designed to withstand fluctuating water levels on a continuous basis such as those in the California Delta exposed to tidal influences. Levees routinely extend for lengthy distances immediately protecting communities. Levees can be found throughout the state but are most prominent in the Sacramento and San Joaquin Valleys.

Levee failures can vary from over toppings to small uncontrolled discharge to catastrophic failure. Areas downstream of the failure will be subject to inundation dependent on the volume of water released. These levee failures are also typically the result of structural age, damage to the structure caused by earthquake or flooding, slumping, seepage underneath the levee, high velocity flows eroding the levee, inadequate capacity, inadequate maintenance, improper construction materials, or extreme inflow of water into the system. Flood damage resulting from levee failures potentially will result in economic losses, environmental damage, destruction of agriculture, and human casualties.

Dam or levee failure flooding will vary depending on a number of factors including the extent of the collapse or breach, the volume of water behind the structure, and the nature of the exposed downstream features. This unpredictable flooding presents a threat to life and property in addition to critical infrastructure. Lifelines and supply routes will likely be damaged or made impassible by flood erosion or standing water. Water quality and health concerns would likely be cascading effects of dam or levee failures.

Location of the Hazard

San Luis Obispo County is home to a limited number of flood control facilities and levee systems. The dam facilities are mostly found along the various mountains and hills throughout the county. Levees have been constructed along the Santa Maria River channel and the Arroyo Grande Creek. The Cal Poly San Luis Obispo campus is in proximity to one small dam that is uphill to the north of the campus. The campus is not in proximity to rivers or flood control channels lined with levees.

The sole dam facility near the Cal Poly San Luis Obispo campus is the Chorro Creek Dam. The Chorro Reservoir is a small reservoir with the potential holding capacity of 90-acre feet of water when full. The San Luis Obispo campus lies outside of the dam inundation zones for the Chorro Creek facility. The Chorro Creek inundation zone extends along the Chorro Creek west of the campus. All of the above inundation zones affect transportation routes and other critical infrastructure west of San Luis Obispo potentially affecting access and support services to the campus.

Figure 23-4: Chorro Creek Dam Breach Inundation Map

28 California Department of Water Resources, Dam Breach Inundation Map Publisher, https://fmds.water.ca.gov/webgis/?appid=dam_prototype_v2
Extent of the Hazard

Dams are classified according to the hazard that they pose to life and property in the event of failure, rather than the likelihood of that failure.

- High hazard potential dams may result in loss of human life, and will likely result in economic, environmental, or lifeline losses.
- Significant hazard potential dams are not expected to result in loss of life, but are expected to cause economic, environmental, and lifeline losses.
Low hazard potential dams are not expected to result in loss of like, and there is a low expectation of economic, environmental, or lifeline losses. What losses do occur are generally limited to the dam owner.

Dams classified as high hazard are required to have Emergency Action Plans (EAP). EAPS are formal documents that identify potential emergency conditions at the dam and specify preplanned actions to be followed in case of failure. An EAP is required for all high hazard dams and is recommended for all significant hazard dams.

Table 23-12: Dams in Proximity to Cal Poly San Luis Obispo

<table>
<thead>
<tr>
<th>River</th>
<th>Dam</th>
<th>Storage</th>
<th>Hazard Severity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chorro Creek</td>
<td>Chorro Creek</td>
<td>90af</td>
<td>High Hazard</td>
</tr>
</tbody>
</table>

The Cal Poly San Luis Obispo campus lies outside of the inundation zone of the dams listed above. In the event of a catastrophic failure of the identified dams, the Cal Poly San Luis Obispo campus is expected to remain out of the inundation area. The location of the campus is 2 ½ miles to the southeast from the Chorro Creek Reservoir. However, the dam inundation zone for the Chorro Creek Reservoir turns to the west and away from the campus. The campus is 2 ½ miles from the boundary of the dam inundation zone. Additionally, State Route 1 lies within the dam inundation zones that could compromise access, evacuation, and supply routes to the west towards Morro Bay. The inundation areas have the potential to isolate areas the campus community reside or work to the west of San Luis Obispo. Based on the above factors, the planning committee ranks the extent of the hazard for the campus as **Low**.

**Extent: Levee Failure**

There are no identified levees in proximity to the campus and thus the campus is outside of any levee protected zone. As such, the planning committee ranks the extent of the hazard for the campus as **Low**.

**History of the Hazard**

There are no records or dam or levee failures in areas that present a threat to the Cal Poly San Luis Obispo campus. San Luis Obispo County has no record of dam failures.

Table 23-13: San Luis Obispo County Dam Failures

<table>
<thead>
<tr>
<th>Date</th>
<th>Dam</th>
<th>Release</th>
<th>Damage</th>
</tr>
</thead>
<tbody>
<tr>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
</tr>
</tbody>
</table>


30 San Luis Obispo County Local Hazard Mitigation Plan, October 2019
Potential Impacts of the Hazard

Dam Failure Impacts - While the campus is not within a dam inundation zone, transportation routes, critical infrastructure, and campus community members may reside within inundation zones. Water that is released due to a dam that has failed generates tremendous energy and force causing a flood that will be catastrophic to life and property. Water levels from the failed dam could be significantly higher than those experienced in worst case scenario flood events. Areas closer to the failed dam will be more likely to experience complete devastation while other areas within the inundation zone will see varying levels of flood waters. The extent of the impacts of a failed dam would vary based on a number of factors such as the volume of water released, the base flow of the river, the time of the failure, the amount of warning provided, and the distance from the dam. Impacts resulting from a dam failure include:

- Loss of life
- Property destruction or damage
- Loss of property contents
- Infrastructure damage
- Flooded or destroyed lifelines/supply routes
- Damaged or destroyed utilities
- Loss of community economic base
- Employment losses
- Agricultural (crops and livestock) damages or destruction
- Environmental damage
- Floods generating threats to public health
- Flood generated debris

Levee Failure Impacts

A levee failure may result in substantial amounts of water to enter into developed areas protected by the levee. The force and volume of water that is generated by a levee failure may cause extensive structural damage in close proximity to the breach and effects of flooding spreading well beyond the point of the failure. The extent of the impacts would vary based on a number of factors such as the volume of water released, the time of the failure, the amount of warning provided, the location of the breach, elevation, and distance from the breach. Potential impacts resulting from a levee failure include:

- Loss of life
- Property destruction or damage
- Loss of property contents
- Infrastructure damage
- Public health hazards resulting from mold, mildew, and disease due to flood water
- Flooded or destroyed lifelines/supply routes
- Damaged or destroyed utilities
- Loss of community economic base
- Employment losses
- Agricultural (crops and livestock) damages or destruction
- Environmental damage
- Prolonged periods of necessary dewatering
- Disruptions to education delivery to community

Probability of Future Occurrence of the Hazard

San Luis Obispo County remains at risk from dam failure, especially from 13 dams around the county. All but the Chorro Creek Dam are not in proximity to the Cal Poly San Luis Obispo campus and are separated by significant geographic barriers. The location of the campus is 2 ½ miles to the southeast from the Chorro Creek Reservoir. However, the dam inundation zone for the Chorro Creek Reservoir turns to the west and away from the campus. The campus is 2 ½ miles from the boundary of the dam inundation zone. There are no identified levees in proximity to the campus and thus the campus is outside of any levee protected zone. There are no official recurrence intervals that have been calculated for dam or levee failures. Based on historical experience and occurrences, the likelihood of this hazard is low.

The probability of future occurrence for both dam and levee failures is Unlikely.

Vulnerability to the Hazard

Given high priority monitoring and maintenance practices in place, a catastrophic dam or levee failure is highly unlikely. In addition, the campus does not lie within an inundation zone. As such, the campus is not considered to be truly vulnerable on a daily basis. However, in the unlikely event of a catastrophic failure, the effects of flooding from compromised dams and levees on campus would most likely be limited to indirect or secondary effects in terms of disruption to regional transportation networks and services, and the amount of time to respond to the needs of the campus community prior to inundation will be limited.

Any breach along a levee is impossible to predict where a failure may occur. It is likely that response action will not be fully implemented until the incident situational
intelligence provides adequate information as to compromised locations. These variables place all those working and living within the dam inundation and flood protection zones in vulnerable locations in the event of a low probability, catastrophic event.

The distributed placement of levees, most near development may expose significant vulnerabilities to other areas of the region even if the campus is unaffected. There is potential the campus community will be affected as a breach may cause flooding and damages to the homes of students, faculty, and staff or to access/supply routes, utilities, or other critical services. The potential for flood damaged structures being left uninhabitable including campus residence halls will result in the vulnerability of numerous displaced individuals and households. The lack of flood insurance will cause additional extreme financial burdens on those affected.

Vulnerability to a dam or levee failure on the Cal Poly San Luis Obispo campus will vary depending on the degree of breach or structural failure and when the failure were to occur. The risk to the campus population will be lessened during periods when classes are not in session or during periods of breaks. Conversely, during the days and hours that classes are in session and staff are at their workplaces, the human vulnerability increases. However, in region-wide events this vulnerability may be shared with the homes and workplaces of members of the campus community and their families.

Certain campus populations will experience greater challenges to a post-flood / failure environment. Vulnerable populations will likely need to navigate through flood generated debris, face extreme health safety issues from flood waters, experience extreme stresses of a disaster, an inability to communicate to or gain access to support networks, and find difficulty in accessing equipment or supplies to aid in a specific need.

Estimate of Potential Losses

Estimates of potential losses will be influenced by a variety of factors. The volume and force of the water will determine the scale of damages affecting campus infrastructure, equipment, and other impacted features. The proximity to the failure and elevation above flood waters will affect the level of damage and individuals exposed. The time of the academic year, the day of week, and hour in which the failure was to occur will influence the number of people on campus and potential casualties. Losses will be generated by the physical damages, the loss of revenue, loss of academic research, loss of building contents, and community wide economic reductions.

Based on estimate replacement costs of facilities and structures on campus, the total replacement costs are $660,197,687. However, it is unlikely for a dam or levee failure event to cause catastrophic destruction at Cal Poly San Luis Obispo.

Vulnerability Assessment Conclusions

While the occurrence of dam and levee failures have not been historically relevant near the Cal Poly San Luis Obispo campus, the potential for hazards related to the region’s
levees and dams still exist. However, the presence of earthquake faults in proximity to the existing dam and levee structures presents a valid danger to downstream locations in the event of an earthquake. In the unlikely event of a high priority dam’s total failure, the consequences would be catastrophic to downstream communities. The potential for dam or levee failure further generates the added potential for a number of cascading effects such as disruptions to the local economy, utility failures, disruptions to providing for the needs of the community, and development of public health hazards. These effects would be exacerbated by effects of seasonal flooding, ongoing heavy precipitation, or excessive run-off from the watershed contributing to the river system. The potential for widespread flooding and damage of structures due to the force of water has exponentially powerful impacts on particular populations among the campus community including those with access or functional needs, international students, the homeless, and students residing in the residence halls.

**Identified Data Limitations**

Data limitations include missing campus structural replacement costs, and an incomplete inventory of both building construction features and mitigation efforts to lessen the impact due to flood inundation.

**Drought**

**Description of the Hazard**

Drought is defined as a condition where moisture levels fall significantly below normal for an extended period of time over a large area that adversely affects plants, animal life, and humans. Drought is a gradual phenomenon. Although droughts are sometimes characterized as emergencies, they differ from typical emergency events. Most natural disasters, such as floods or forest fires, occur relatively rapidly and afford little time for preparing for disaster response. Droughts occur slowly, over a multi-year period, and it is often not obvious or easy to quantify when a drought begins and ends.

Throughout California, one dry year does not normally constitute a drought. California’s extensive system of water supply infrastructure (reservoirs, groundwater basins, and conveyance assets) mitigates the effect of short-term dry periods for most water users. Defining when a drought begins is a function of drought impacts to water users. Drought in one location may not constitute a drought for all water users, as some users in relative proximity may have a different water supply. For example, individual water suppliers may use a combination of sources such as rainfall/runoff, water in storage, or expected supply from a water wholesaler to define their water supply conditions.

Drought can be characterized as one or more of the four following types:
- **Meteorological drought** is defined on the basis of the degree of dryness (in comparison to some “normal” or average amount) and the duration of the dry period. A meteorological drought must be considered as region-specific since the atmospheric conditions that result in deficiencies of precipitation are highly variable from region to region.

- **Hydrological drought** is associated with the effects of periods of precipitation (including snowfall) shortfalls on surface or subsurface water supply (e.g., streamflow, reservoir and lake levels, ground water). The frequency and severity of hydrological drought is often defined on a watershed or river basin scale. Although all droughts originate with a deficiency of precipitation, hydrologists are more concerned with how this deficiency plays out through the hydrologic system. Hydrological droughts are usually out of phase with or lag the occurrence of meteorological and agricultural droughts. It takes longer for precipitation deficiencies to show up in components of the hydrological system such as soil moisture, streamflow, and ground water and reservoir levels. As a result, these impacts are out of phase with impacts in other economic sectors.

- **Agricultural drought** focus is on soil moisture deficiencies, differences between actual and potential evaporation, reduced ground water or reservoir levels, and so forth. Plant water demand depends on prevailing weather conditions, biological characteristics of the specific plant, its stage of growth, and the physical and biological properties of the soil.

- **Socioeconomic drought** refers to when physical water shortage begins to affect health, well-being, and quality of life of people, or when the drought starts to affect the supply and demand of an economic product that relies on water.

The drought issue in California is further compounded by water rights. The central challenge is how to prioritize water usage among a broad variety of contexts. It is for this reason that water is a commodity possessed and utilized under a variety of legal doctrines. As such, many competing sets of interests create a dynamic prioritization process between, for example, farming and federally protected fish habitats and water supply for municipal/public use (including usage for Cal Poly San Luis Obispo versus water usage for wildfire abatement or natural resource protection.

**Location of the Hazard**

Drought conditions have been identified throughout San Luis Obispo County (where the campus is located). Drought is not a location-specific hazard and affects the entire planning area equally. Drought location is not isolated to the campus footprint but occurs as a geographic sub-set of drought conditions occurring at larger scales. From 2000-2020,
drought conditions existed continuously in the state, with 80-100% of the state impacted for 12 of the last 20 years. 31

**Extent of the Hazard**

Given the historical occurrence of severe drought impacts throughout the planning area and across the state and the potential future impact exacerbated by climate change, the CSU Planning Committee recognizes that drought will continue to pose a high degree of risk, potentially impacting crops, livestock, water resources, the natural environment at large, buildings and infrastructure (from land subsidence), and local economies. In addition, although drought affects the entire planning equally, the potential impacts may be variable and specific to each campus/jurisdiction, depending on contextual factors such as the degree of assets and activities, historically impacted by drought within each jurisdiction.

In addition, land subsidence has occurred statewide and will continue in areas where the groundwater basin has been subject to overdraft and long-term recharge is inadequate to maintain the water table elevation, leaving underground voids. Subsidence levels have been measured up to 30-feet in California with subsidence bowls covering hundreds of square miles. As such, drought-related subsidence may result in serious structural damage to buildings, roads, irrigation ditches, underground utilities, and pipelines over the long term.

Although the campus planning team identifies the current extent of the hazard as Low (qualitatively) which corresponds to D0 – D1 on the Extent scale (below), San Luis Obispo County has experienced more severe drought conditions over the past 20 years, including 3 years of D4 levels during the statewide drought from 2012-2017. As such, the campus planning team recognizes that while historic impacts shaping the extent of drought on campus have been minimal, the potential impacts are tied to a fragile local water supply with no restrictions in place, and tied to trends across larger geographic areas, and, therefore, the committee recognizes that the extent of drought on campus has the potential to increase in the future.

The U.S. Drought Monitor developed tables of impacts reported during past droughts in California in order to depict the extent of drought risk for each level of drought on the U.S. These possible extent conditions for California complement the general impacts column of the U.S. Drought Monitor Classification Scheme.

Table 23-14: Impacts of Drought Levels as Determined by US Drought Monitor

<table>
<thead>
<tr>
<th>Category</th>
<th>Impact</th>
</tr>
</thead>
</table>


<table>
<thead>
<tr>
<th><strong>D0</strong></th>
<th>Soil is dry; irrigation delivery begins early</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Dryland crop germination is stunted</td>
</tr>
<tr>
<td></td>
<td>Active fire season begins</td>
</tr>
<tr>
<td></td>
<td>Winter resort visitation is low; snowpack is minimal</td>
</tr>
<tr>
<td><strong>D1</strong></td>
<td>Dryland pasture growth is stunted; producers give supplemental feed to cattle</td>
</tr>
<tr>
<td></td>
<td>Landscaping and gardens need irrigation earlier; wildlife patterns begin to change</td>
</tr>
<tr>
<td></td>
<td>Stock ponds and creeks are lower than usual</td>
</tr>
<tr>
<td><strong>D2</strong></td>
<td>Grazing land is inadequate</td>
</tr>
<tr>
<td></td>
<td>Producers increase water efficiency methods and drought-resistant crops</td>
</tr>
<tr>
<td></td>
<td>Fire season is longer, with high burn intensity, dry fuels, and large fire spatial extent; more fire crews are on staff</td>
</tr>
<tr>
<td></td>
<td>Wine country tourism increases; lake- and river-based tourism declines; boat ramps close</td>
</tr>
<tr>
<td></td>
<td>Trees are stressed; plants increase reproductive mechanisms; wildlife diseases increase</td>
</tr>
<tr>
<td></td>
<td>Water temperature increases; programs to divert water to protect fish begin</td>
</tr>
<tr>
<td></td>
<td>River flows decrease; reservoir levels are low and banks are exposed</td>
</tr>
<tr>
<td></td>
<td>Livestock need expensive supplemental feed, cattle and horses are sold; little pasture remains, producers find it difficult to maintain organic meat requirements</td>
</tr>
<tr>
<td></td>
<td>Fruit trees bud early; producers begin irrigating in the winter</td>
</tr>
<tr>
<td></td>
<td>Federal water is not adequate to meet irrigation contracts; extracting supplemental groundwater is expensive</td>
</tr>
<tr>
<td></td>
<td>Dairy operations close</td>
</tr>
<tr>
<td><strong>D3</strong></td>
<td>Marijuana growers illegally tap water out of rivers</td>
</tr>
<tr>
<td></td>
<td>Fire season lasts year-round; fires occur in typically wet parts of state; burn bans are implemented</td>
</tr>
<tr>
<td></td>
<td>Ski and rafting business is low, mountain communities suffer</td>
</tr>
<tr>
<td></td>
<td>Orchard removal and well drilling company business increase; panning for gold increases</td>
</tr>
<tr>
<td></td>
<td>Low river levels impede fish migration and cause lower survival rates</td>
</tr>
<tr>
<td></td>
<td>Wildlife encroach on developed areas; little native food and water is available for bears, which hibernate less</td>
</tr>
<tr>
<td>Water sanitation is a concern, reservoir levels drop significantly, surface water is nearly dry, flows are very low; water theft occurs</td>
<td></td>
</tr>
<tr>
<td>Wells and aquifer levels decrease; homeowners drill new wells</td>
<td></td>
</tr>
<tr>
<td>Water conservation rebate programs increase; water use restrictions are implemented; water transfers increase</td>
<td></td>
</tr>
<tr>
<td>Water is inadequate for agriculture, wildlife, and urban needs; reservoirs are extremely low; hydropower is restricted</td>
<td></td>
</tr>
<tr>
<td>Fields are left fallow; orchards are removed; vegetable yields are low; honey harvest is small</td>
<td></td>
</tr>
<tr>
<td>Fire season is very costly; number of fires and area burned are extensive</td>
<td></td>
</tr>
<tr>
<td>Many recreational activities are affected</td>
<td></td>
</tr>
<tr>
<td>Fish rescue and relocation begins; pine beetle infestation occurs; forest mortality is high; wetlands dry up; survival of native plants and animals is low; fewer wildflowers bloom; wildlife death is widespread; algae blooms appear</td>
<td></td>
</tr>
<tr>
<td>Policy change; agriculture unemployment is high, food aid is needed</td>
<td></td>
</tr>
<tr>
<td>Poor air quality affects health; greenhouse gas emissions increase as hydropower production decreases; West Nile Virus outbreaks rise</td>
<td></td>
</tr>
<tr>
<td>Water shortages are widespread; surface water is depleted; federal irrigation water deliveries are extremely low; junior water rights are curtailed; water prices are extremely high; wells are dry, more and deeper wells are drilled; water quality is poor;</td>
<td></td>
</tr>
</tbody>
</table>

### History of the Hazard

Historically, drought has been so prevalent in California that its presence is almost continuous, according to the US Drought Monitor, Time Series data, San Luis Obispo County (which includes the Cal Poly San Luis Obispo footprint) has experienced five or more periods of drought covering 12 years from 2000-2021.

According to the National Drought Mitigation Center, over 3,500 reports and publications covering 370 drought-related events took place across the state (many of which were statewide events) between 2000-2020. In addition, the National Center for Environmental Information (NCEI) reports more than 500 events statewide during this same time period. These events produced a comprehensive range of impacts to water supply, regulations and allocations to businesses and municipalities, budgets and resources for firefighting, water law and policy, and physical impacts to built and natural environments. As such, data records of previous occurrences can be viewed as separate time and event demarcations for a hazard almost continuously in effect across the state with cascading impact potential.
According to the Department of Water Resources, droughts exceeding three years are relatively common in Southern California, but relatively rare in Northern California - the region is the geographic source of much of the state’s developed water supply. The 1929-34 drought established the criteria commonly used in designing storage capacity and yield of large Northern California reservoirs. 34

According to the US Drought Monitor’s time series data, from 2000-2021 (with the exception of a 2–3-month period in 2000 and 2011), some degree of drought conditions have been continuously in effect somewhere in California. In fact, 80% - 100% of the state has been subjected to drought conditions for 12 of the last 20 years, with the most severe drought being the 100% state-wide event from 2012-2017.
Given the extent of the drought risk in California, the following drought event was selected as an exemplar due to its broad and significant impacts on the state and on the Cal Poly San Luis Obispo campus planning area:

**2012 – 2017** – Drought produced severe impacts to water wells throughout the state of California, with a high number of wells running dry. Land subsidence due to increased groundwater pumping also occurred in numerous areas of the state such as the San Joaquin and Central Valleys. Crop damage was widespread as well. Water allotments were drastically reduced in many towns and water agencies, with extremely high costs for procuring water. In addition, job loss occurred with many families requiring food supply assistance, and water supply assistance provided to home-owners with dry wells. According to a report released by UC Davis Center for Watershed Sciences, the 2014-2017 period of the California drought cost the state’s agriculture industry about $1 billion in lost revenue, with a total statewide economic cost of the drought calculated to be $2.2 billion. The report says, ‘it is responsible for the greatest water loss ever seen in California agriculture - about one third less than normal”. The report calls the groundwater situation in California "a slow-moving train wreck." Spring snowpack at Donner Summit reached record low levels in 2014, exceeded in 2015 by a remarkable April 1 snow-water-equivalent value of only 5% of average. Decreased precipitation since contributed to near-record low levels in the Shasta Reservoir. The ongoing drought has contributed to declines in crop values across the state. For example, crops including cotton, corn silage and barley (the field crop category) fell by 42 percent.

**Potential Impacts of the Hazard**

Drought impacts are wide-reaching and may be economic, environmental, and/or societal. This assessment of its impact recognizes that historic occurrences of drought throughout the planning area are a sub-set of larger and inter-connected local and regional droughts, and that the (related) historic impacts provide a sound basis for understanding potential (future) impacts.

The most significant potential impact associated with drought across the Cal Poly San Luis Obispo campus planning area is a reduction in water availability for the municipal

area tied to each campus. The campus planning committee reports that the municipal supply is fragile with just one water main connecting the campus. Other impacts include crop loss and damage to trees and other natural resources (See Tree Mortality below). The footprint of Cal Poly San Luis Obispo to some extent includes these vulnerable resources based on the campus landscape (trees) and the presence (and footprint size) of agricultural research crops and field stations.

As a secondary impact of drought, wildfire is directly attributable to dry atmospheric conditions. Wildfires almost always coincide with drought in California, though not limited to such. 37 However, the wildfire hazard is analyzed separately in this plan.

In reviewing drought for San Luis Obispo County, the US Drought Monitor and the National Drought Mitigation Center report that tens of millions of trees died during the (2012-2017) state-wide drought disaster. Though data sources do not provide data for tree mortality specific to Cal Poly San Luis Obispo, the broad geographic extent of the impact makes it likely that tree mortality occurred to some degree on the campus. Due to the lasting and ongoing effects of drought on the landscape, trees will continue to be impacted within the municipalities, counties and regions wherein lies the campus system as long as drought conditions continue to occur in the future.

Given the absence of data, in order for the CSU Committee to assess the impact of tree mortality, it is useful to view it as a risk sub-set to the probability, location, extent, severity and duration of the drought hazard within each campus-located municipality, county and region. Regarding potential impacts, standing dead trees could fall, posing a risk to people, buildings, power lines, roads and other infrastructure. In addition, drought-impacted trees become susceptible to diseases and insect infestations (bark beetle) further adding to the risk of tree mortality and related potential impacts. No data are currently available for tree mortality on campus, however, the CSU Planning Team will try to acquire data on this issue in the future.

As a potential tertiary impact, prolonged and repeated drought conditions over time can produce land subsidence and the risk of damage to building foundations and infrastructure on campus resulting from ground instability and collapse. Land subsidence is defined as the vertical sinking of the land over manmade or natural underground voids. Subsidence is often the direct result of groundwater over-extraction in response to drought conditions, as well as oil and gas extraction. Weight can accelerate the process of subsidence resulting from surface development and infrastructure such as roads and buildings, vibrations from construction blasting and heavy truck or train traffic. For example, the State Water Project’s 444-mile-long California Aqueduct has required repairs such as the raising of canal linings, bridges, and water control structures on the Aqueduct – in the Central Valley a five-mile reach of the Eastside Bypass was impacted by subsidence, and the Department of Water Resources estimated that it may cost in the

range of $250 million to acquire flowage easements and levee improvements to restore the design capacity of the subsided area. 38

At present, drought related damage to campus buildings and infrastructure at Cal Poly San Luis Obispo has not been reported, but the potential for such impacts is possible. With regard to overall potential impact, water supply/availability for Cal Poly San Luis Obispo is ultimately tied to a fragile local water supply and to broader inter-dependent, and more intensive modes of water use and regional scales such as agriculture and ranching, wildfire protection, larger metropolitan/municipal usage, manufacturing and commerce, tourism, recreation, and wildlife preservation. During drought periods, the State of California’s regulated water allocations are modified and often reduced. Although no restrictions are currently in place locally, if out in place, impacts tied to reduced water availability can occur for all usage contexts at Cal Poly San Luis Obispo. A reduction of electric power generation and water quality deterioration are also potential impact

Table 23-15: Summary of Drought Impacts on Water Resources

<table>
<thead>
<tr>
<th>Resource</th>
<th>Type of Impact</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sea Level</td>
<td>Direct</td>
<td>Sea level is rising and will likely impact coastal areas</td>
</tr>
<tr>
<td>Soil Moisture</td>
<td>Direct</td>
<td>Prolonged dry seasons can lead to decreases in soil moisture; drier vegetation</td>
</tr>
<tr>
<td>Vegetation</td>
<td>Indirect</td>
<td>Longer and more intense fire season with increased extent of area burned</td>
</tr>
<tr>
<td>Stream Conditions</td>
<td>Direct</td>
<td>Increases in water temperature; potential effects on fish</td>
</tr>
<tr>
<td>Snowpack</td>
<td>Indirect</td>
<td>Increases in temperature will lead to decreases in snowpack</td>
</tr>
<tr>
<td>Runoff</td>
<td>Direct</td>
<td>Warmer temperatures are likely to lead to a shift in peak runoff from spring to winter and a likely decrease in summer base flow</td>
</tr>
<tr>
<td>Hydropower</td>
<td>Indirect</td>
<td>Decreased summer flows resulting from earlier snowmelt and a shift in peak</td>
</tr>
</tbody>
</table>


runoff could affect hydropower generation during summer months

<table>
<thead>
<tr>
<th>Precipitation</th>
<th>Direct</th>
<th>Warmer winter temperatures will result in a greater percentage of precipitation falling as rain rather than as snow</th>
</tr>
</thead>
<tbody>
<tr>
<td>Groundwater</td>
<td>Indirect</td>
<td>Reduction in snowpack and extended periods of drought are likely to increase dependency on groundwater</td>
</tr>
</tbody>
</table>

**Probability of Future Occurrence of the Hazard**

**Highly Likely** — The US Drought Monitor’s time series data (2000-2020) indicates that some degree of drought has nearly a 100% probability of occurrence somewhere in the state in any given year. Given that Cal Poly San Luis Obispo lies within a drought impacted region, it is prudent to extend this likelihood of occurrence to the planning area.

**Vulnerability to the Hazard**

In California, rising temperatures are projected to increase the average lowest elevation at which snow falls, reducing water storage in the snowpack, particularly at those lower mountain elevations which are now on the margins of reliable snowpack accumulation. Higher spring temperatures will also result in earlier melting of the snowpack. The shift in snow melt to earlier in the season is critical for California’s water supply because flood control rules require that water be allowed to flow downstream and that water cannot be stored in reservoirs for use in the dry season. As such, state-level drought risk factors that have led to drought’s state-wide severity and extent, and potential impacts also create drought vulnerabilities at the level of the Cal Poly San Luis Obispo campus.

Moreover, climate change will likely adversely impact the vulnerability of watersheds and ecosystems in their ability to deliver important ecosystem services. These changes may limit the natural capacity of healthy forests to capture water and regulate stream flows. Sierra Nevada mountain winters and springs are warming, and on average, precipitation as snowfall relative to rain is decreasing. A warming climate with reduced snowpack will result in earlier snowmelt and will subsequently reduce downstream water availability during summer and early fall.

As such, the state and the Cal Poly San Luis Obispo planning area stakeholders potentially have less capacity to address future drought risks due to projected temperature increases and shortages in water; ground-water withdrawals have been occurring at a deficit rate of 1 – 2-million-acre feet per year, where the impacts of drought include decreased availability of water for agriculture and environmental uses. 40

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forested and other vegetated areas, prolonged drought decreases the moisture content of forest fuels and increases the risk of high severity wildfires.

It should be pointed out that California is the single most productive agricultural state and its agricultural industry relies heavily on reservoir water supplied by snowmelt and rainfall runoff. Yearly variations in snowpack depths have implications for water availability as snowmelt from the winter snowpack feeds a network of reservoirs. Spring snowpack at Donner Summit reached record low levels in 2014, exceeded in 2015 by a remarkable April 1 snow-water-equivalent value of only 5% of average. Decreased precipitation since 2011 has contributed to near-record low levels in the Shasta Reservoir.

Vulnerability of Populations

Drought vulnerabilities on California’s population include agricultural sector job loss, secondary economic losses to local businesses and public recreational resources, increased cost to local and state government for large-scale water acquisition and delivery, and water rationing and water wells running dry for individuals and families. As drought is often accompanied by prolonged periods of extreme heat, negative health impacts such as dehydration can also occur, where children and elderly are most susceptible. Air quality often declines in times of drought which can affect those with respiratory ailments. These same vulnerabilities apply to the students, faculty and staff of the Cal Poly San Luis Obispo campus.

Property Vulnerability

Drought vulnerabilities for property statewide include crop loss, injury and death of livestock and pets, and damage to infrastructure, homes and other buildings resulting from the secondary drought impact of land subsidence. The related drought impacts of tree mortality and land subsidence pose risks to vulnerable critical infrastructure and property. These same vulnerabilities apply to the properties of the Cal Poly San Luis Obispo campus over the long term, given the fragile and expensive local water supply.

Natural Environment Vulnerability

Drought vulnerabilities for the natural environment on campus are primarily campus landscaping and other flora. Statewide, widespread vulnerabilities exist throughout public and private lands, including tree mortality, impacts to all flora and fauna, and destabilization (subsidence) of land along streams and rivers, and within watersheds. The core issue shaping drought vulnerabilities throughout California and on campus is water supply and demand. The campus planning committee indicates that water supply is a low protocol issue locally, with no restrictions in place, although it is quite costly for the

campus, with supply limited to one water main. These issues are tied to broader factors including groundwater basins, surface water run-off, public and agricultural demand, and surface water storage water sheds. A USGS led analysis was first conducted in 2010 through the Forest and Rangeland Assessment and ongoing through the USGS Forest and Rangeland Ecosystem Science Center to identify threats and assets where water supply would benefit from environmental management designed to protect or enhance water resources, the key effort which, in part, both defines and mitigates the severity of drought risk and vulnerabilities.

With regard to overall threat and asset findings shaping the potential severity of drought, the watersheds in the Sierra region contribute most greatly to the state’s water supply, but are under threat from climate change, wildfire and development. In addition, groundwater basins in the San Joaquin Valley and Sacramento Valley bioregions are an abundant resource that is heavily threatened by over pumping.

**Critical Facilities Vulnerabilities**

Drought vulnerabilities for Cal Poly San Luis Obispo’s critical facilities include water shortfalls for facility operations and critical functions, and potential structural destabilization and damage resulting from land subsidence over the long term.

**Estimate of Potential Losses**

An estimate of potential losses from drought has not been calculated for the campus or the CSU system as a whole. However, drought related losses to the City of San Luis Obispo and the surrounding region such as crop loss and cost increases for water resources have re-occurred over time. Please consult city and county level government, and/or state agricultural agencies for data on the financial impacts from drought.

**Vulnerability Assessment Conclusions**

The CSPU Planning Committee understands that the high degree of vulnerability posed by drought centers on the low priority for restricting local usage and the need to improve campus access beyond one water main while reducing cost. These issues will be exacerbated by greater climate variation in the future and therefore greater variation and uncertainty regarding the availability of water supplies which are already under tremendous stress. In response to such vulnerability, state legislation passed in 2014 requires local governments to regulate pumping and recharge to better manage groundwater supplies, and groundwater-dependent regions are required to halt overdraft and bring basins into sustainable levels of pumping and recharge by the early 2040s. That said, the Committee will continue to work with local, regional and state partners and stakeholders to explore solutions for mitigating the drought hazard on its campus by accessing the best available data and resources on climate change and its relationship to

**Identified Data Limitations**

Data are limited concerning campus-related agricultural assets as well as data on campus tree mortality.
**Earthquake**

**Description of the Hazard**

An earthquake is a sudden motion or shaking caused by the release of pressure accumulated along the edge of tectonic plates covering the earth. These huge plates are constantly moving and move ever so slowly under, over, or by passing one another. This movement is gradual however the plates may lock together accumulating enormous amounts of energy. When this energy builds, stress develops, and the adjoining plates will eventually break free and result in ground shaking – an earthquake.

Large earthquakes may result in fissuring, ground settlement, and/or vertical or horizontal displacement. Earthquakes occur without warning and can result in extensive damages and human casualties. Damages associated to earthquake generated ground shaking is normally confined to a narrow area along fault trend from the earthquake epicenter. However, seismic waves may generate ground shaking resulting in damages in areas outside of the fault trend.

**Fault Rupture** – The rupture of faults is the differential movement of the two sides of the earth’s plates at the point of the fault. Horizontal or vertical displacement may be significant and occur over great distances. The movement and energy that occurs along a fault is released in waves resulting in ground shaking. The intensity of ground shaking varies based on the magnitude of the earthquake, the proximity to the earthquake epicenter, the composition of the ground sediment or rock the waves travel through, and the depth of the earthquake.

**Liquefaction** – In addition to the primary fault rupture that occurs right along a fault during an earthquake, the ground many miles away can also fail during intense shaking. As seismic waves travel through saturated granular soil; the soil begins to liquefy and act as a fluid. Soil strength and stability is lost causing the effects of ground shaking to intensify and for ground deformation to occur. These water saturated soils when shaken quickly lose the ability to support buildings, bridges, utilities, and other structures. Areas susceptible to liquefaction include places where sandy sediments have been deposited by rivers along their course or by wave action along beaches. The greater the magnitude of an earthquake and longer duration of strong ground shaking will result in an enhanced potential for liquefaction to occur. Settlement can cause damage when the amount settlement varies significantly across the length of a structure. Lateral spreading occurs when liquefaction occurs on gently sloping ground and the liquefied material at depth allows the area to slide, often toward a vertical discontinuity or “free face” such as a creek or stream channel. Liquefaction can occur in susceptible soils below bodies of water, and settlement and lateral spreading can damage structures built on or adjacent to these areas. Transportation bridges across water bodies, wharves, piers and other structures at ports and harbors, and underwater utility lines can be severely damaged by this hidden hazard.
**Subsidence** - Changes in the local environment that cause subsidence or sinkholes are called triggering mechanisms. Water is the primary factor that affects the local environment and causes subsidence. Water level decline, changes in groundwater flow, increased loading, and deterioration (such as abandoned mines) are all triggering mechanisms. Water level decline may occur naturally, or it may be the result of human action. Factors that lead to water decline are pumping (from wells), localized drainage (for construction activities), dewatering, or drought. Changes in groundwater flow can result from an increase in the velocity of groundwater movement, and increase in the frequency of water table fluctuations, and changes in discharge (either increase or decrease). Increased loading can cause pressure in the soil, leading to the failure of underground cavities and space, such as caves. Vibrations from earthquakes, heavy machinery, and blasting may result in structural collapse, followed by surface resettlement.

**Location of the Hazard**

The State of California is particularly vulnerable to earthquake activity due to California’s location residing between two large tectonic plates. Cal Poly San Luis Obispo is located on the California Central Coast in central San Luis Obispo County. In general, fault systems surround and traverse through San Luis Obispo County including the area of Cal Poly San Luis Obispo. Throughout the county there are areas where ground is saturated with sediment eroded from the mountains and foothills via multiple stream and river channels and resulting in liquefaction zones scattered across the region.

The Pacific Plate and the North American Plate come together at the San Andreas Fault 35 miles northeast of the Cal Poly San Luis Obispo campus. In addition to the San Andreas Fault, San Luis Obispo County is home to or near additional fault systems with the potential to generate strong ground shaking. The Oceanic-West Huasna Fault follows the mountains 2 miles north of the campus. The Los Osos Fault is another southeast to northwest fault 3 ½ miles south of the campus. The Hosgri Fault parallels the coastline extending from Point Arguello to Big Sur approximately 16 miles west of the campus. The Rinconada Fault traverses south to north through Santa Margarita and Paso Robles extending 7 miles northeast of the Cal San Luis Obispo campus. There are numerous additional faults in the area on all sides of the campus.
The Cal Poly San Luis Obispo campus reside within areas designated to be liquefaction zones. All campus facilities are located within the moderate liquefaction zone or areas where liquefaction zones overlap with areas prone to landslides. Additionally, substantial areas of the community surrounding the campus reside within the liquefaction zones including access routes into and out of the campus. This includes US Highway 101, State Route 1, and the Union Pacific Railroad. The liquefaction zone generally follows the path of creeks and valley floors.

Extent of the Hazard

The extent or severity of earthquake damage is expressed in terms of magnitude, intensity, and duration. The amount of energy released during an earthquake is normally conveyed as a magnitude measured from a seismogram. Magnitude is expressed in numbers and decimals representing the physical size of the earthquake. The strength and effect of the shaking on the surface of the earth is classified as the intensity. Intensity is further defined from the effects the earthquake has on people, structures, and the natural environment. The intensity of an earthquake in terms of measuring magnitude and
evaluating its effects is generally expressed using the Modified Mercalli (MM) Intensity Scale. Duration is the length of time the earthquake’s energy is released.

The Richter magnitude scale was developed in 1935 by Charles F. Richter of the California Institute of Technology as a mathematical device to compare the size of earthquakes. The Richter Scale is the best-known scale for measuring the magnitude of earthquakes. The magnitude value is proportional to the logarithm of the amplitude of the strongest wave during an earthquake. A recording of 7, for example, indicates a disturbance with ground motion 10 times as large as a recording of 6. The energy released by an earthquake increases by a factor of 31 for every unit increase in the Richter scale.

Table 23-16: Earthquake Intensity and Frequency Comparisons

<table>
<thead>
<tr>
<th>Magnitude</th>
<th>Mercalli Intensity</th>
<th>Potential Damage</th>
<th>Global Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 2.0</td>
<td>I</td>
<td>None</td>
<td>Continually</td>
</tr>
<tr>
<td>2.0 - 2.9</td>
<td>I to II</td>
<td>None</td>
<td>&gt; 1M per year</td>
</tr>
<tr>
<td>3.0 - 3.9</td>
<td>II to IV</td>
<td>Light</td>
<td>&gt; 100,000 per year</td>
</tr>
<tr>
<td>4.0 - 4.9</td>
<td>IV to VII</td>
<td>Light</td>
<td>10K to 15K per year</td>
</tr>
<tr>
<td>5.0 - 5.9</td>
<td>VI to VII</td>
<td>Moderate</td>
<td>1K to 1,500 per year</td>
</tr>
<tr>
<td>6.0 - 6.9</td>
<td>VII to X</td>
<td>Heavy</td>
<td>100 to 150 per year</td>
</tr>
<tr>
<td>7.0 - 7.9</td>
<td>VII &lt;</td>
<td>Very Heavy</td>
<td>10 - 20 per year</td>
</tr>
<tr>
<td>8.0 - 8.9</td>
<td>VII &lt;</td>
<td>Very Heavy</td>
<td>1 per year</td>
</tr>
<tr>
<td>&gt; 9.0</td>
<td>VII &lt;</td>
<td></td>
<td>1 per 10-50 years</td>
</tr>
</tbody>
</table>

The Modified Mercalli Intensity Scale provides descriptive values of earthquake intensity that may provide greater meaning to the broader population as the description of intensity refers to the effects actually experienced. This scale uses an arbitrary ranking based on observed earthquake effects. The scale is composed of increasing levels of intensity ranging from shaking that is not recognizable to intense shaking resulting in catastrophic damages and casualties. The Modified Mercalli Intensity Scale is demonstrated below:

Table 23-17: Modified Mercalli Intensity Scale

<table>
<thead>
<tr>
<th>Intensity</th>
<th>Shaking</th>
<th>Description / Damage</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Type</th>
<th>Intensity</th>
<th>Characteristics</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Not felt</td>
<td>Not felt except by a very few under especially favorable conditions.</td>
</tr>
<tr>
<td>II</td>
<td>Weak</td>
<td>Felt only by a few persons at rest, especially on upper floors of buildings.</td>
</tr>
<tr>
<td>III</td>
<td>Weak</td>
<td>Felt quite noticeably by persons indoors, especially on upper floors of buildings. Many people do not recognize it as an earthquake. Standing motor cars may rock slightly. Vibrations similar to the passing of a truck. Duration estimated.</td>
</tr>
<tr>
<td>IV</td>
<td>Light</td>
<td>Felt indoors by many, outdoors by few during the day. At night, some awakened. Dishes, windows, doors disturbed; walls make cracking sound. Sensation like heavy truck striking building. Standing motor cars rocked noticeably.</td>
</tr>
<tr>
<td>V</td>
<td>Moderate</td>
<td>Felt by nearly everyone; many awakened. Some dishes, windows broken. Unstable objects overturned. Pendulum clocks may stop.</td>
</tr>
<tr>
<td>VI</td>
<td>Strong</td>
<td>Felt by all, many frightened. Some heavy furniture moved; a few instances of fallen plaster. Damage slight.</td>
</tr>
<tr>
<td>VII</td>
<td>Very strong</td>
<td>Damage negligible in buildings of good design and construction; slight to moderate in well-built ordinary structures; considerable damage in poorly built or badly designed structures; some chimneys broken.</td>
</tr>
<tr>
<td>VIII</td>
<td>Severe</td>
<td>Damage slight in specially designed structures; considerable damage in ordinary substantial buildings with partial collapse. Damage great in poorly built structures. Fall of chimneys, factory stacks, columns, monuments, walls. Heavy furniture overturned.</td>
</tr>
<tr>
<td>IX</td>
<td>Violent</td>
<td>Damage considerable in specially designed structures; well-designed frame structures thrown out of plumb. Damage great in substantial buildings, with partial collapse. Buildings shifted off foundations.</td>
</tr>
</tbody>
</table>
The impacts of a major earthquake would be felt beyond the campus and have long reaching effects. The risk of casualties and damages would likely extend to the homes and workplaces of members of the campus community including students, staff, and faculty. Based on the location of the campus surrounded by fault lines, the southwest portion of the campus being in a liquefaction zone, the history of occurrences (some with extensive damages) in the area, and the potential for future impacts, the campus planning committee ranks the extent of the hazard as Moderate to High.

History of the Hazard

The State of California has a long history of chronic and destructive earthquakes throughout the state. On average, earthquakes strong enough to result in structural damages occur three to four times a year in California, while earthquakes Magnitude 6.0 to 6.9 occur once every two to three years. Likewise, San Luis Obispo County also has a long history of earthquake activity. The entire area of the Central Coast area is at risk to seismic activity and has a history of significant earthquakes resulting in damages.

Table 23-19: Historic Earthquakes Near San Luis Obispo, CA44

<table>
<thead>
<tr>
<th>Date</th>
<th>Location</th>
<th>Magnitude</th>
<th>Damages</th>
</tr>
</thead>
<tbody>
<tr>
<td>1/9/1857</td>
<td>Ft Tejon</td>
<td>7.9</td>
<td>Heavy property loss</td>
</tr>
<tr>
<td>4/18/1906</td>
<td>San Francisco</td>
<td>7.9</td>
<td>Extensive destruction; 3000 fatalities</td>
</tr>
<tr>
<td>12/1/1916</td>
<td>Avila Beach</td>
<td>5.1</td>
<td>Minor</td>
</tr>
<tr>
<td>7/21/1952</td>
<td>White Wolf Fault</td>
<td>7.7</td>
<td>12 fatalities, $60 million</td>
</tr>
<tr>
<td>11/21/1952</td>
<td>Bryson</td>
<td>6.2</td>
<td>Minor</td>
</tr>
<tr>
<td>6/27/1966</td>
<td>Parkfield</td>
<td>6.0</td>
<td>Minor - remote</td>
</tr>
<tr>
<td>5/2/1983</td>
<td>Coalinga</td>
<td>6.7</td>
<td>Extensive</td>
</tr>
<tr>
<td>12/22/2003</td>
<td>San Simeon</td>
<td>6.5</td>
<td>$200-300 million; 2 fatalities</td>
</tr>
<tr>
<td>9/28/2004</td>
<td>Parkfield</td>
<td>6.0</td>
<td>Minor</td>
</tr>
<tr>
<td>10/30/2007</td>
<td>Alum Rock</td>
<td>5.6</td>
<td>Minor</td>
</tr>
</tbody>
</table>

The above earthquakes had federal disaster declarations declared:

- San Simeon (DR-1505-CA)
- Coalinga (DR-682-CA)

The December 22, 2003 San Simeon Earthquake became one of the most well-known earthquakes in California history to generate changes in building codes. The earthquake caused extensive damage to buildings, bridges, water systems, and critical facilities. Damage was experienced heavily in unreinforced masonry buildings and other structures. Two people were killed and many more injured. The San Francisco Earthquake was found primarily to affect Paso Robles and Templeton but the shaking was felt from San Francisco to Los Angeles.

Potential Impacts of the Hazard

The shaking of the ground from earthquakes can result in building collapse, bridge failure, utility disruptions and other structural collapse. Large earthquakes can

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additionally cause natural gas lines to break resulting in structure fires. The proximity to the unstable soils surrounding the campus presents a potential for liquefaction creating greater ground instability during seismic events. A major earthquake in the Los Angeles area would likely result in region-wide social disruptions in addition to structural damages. The region-wide structural damages may disrupt lifelines and supply chain routes limiting the campus from effective evacuation routes and receiving necessary supplies or equipment.

Most injuries resulting from earthquakes are from collapsing walls, flying glass, or other objects moved by ground shaking. The lack of warning allows individuals minimal time to react and find areas of safety. A moderate earthquake occurring near San Luis Obispo could cause injuries or fatalities to members of the campus community or support networks the campus relies on. These earthquake effects might be aggravated by collateral incidents such as fire, flooding, hazardous material spills, dam/levee compromises, and other cascading events. A catastrophic earthquake near San Luis Obispo could result in extensive casualties, expansive structural damages, panic, widespread utility outages, communication failures, and secondary emergencies such as fire. A catastrophic earthquake would certainly affect the broader Central Coast region limiting immediate assistance that the campus may normally expect.

Local impacts to the Cal Poly San Luis Obispo campus caused by an earthquake could include:

- Injuries and damage related casualties
- Ground rupture
- Potential hazardous material releases on and off campus
- Infrastructure damage to freeway and roadway system
- Landslides blocking primary access routes including US 101 and CA SR 1
- Damage to rail lines transiting through San Luis Obispo
- Structural damage to bridges over waterways and flood control channels
- Damage to power grid and widespread power outages
- Disruption in water services
- Potential isolation of campus from community
- Potential isolation among on-campus residents
- Structural damage to flood control facilities
- Structural damage to campus academic and support buildings
- Damage or loss of academic research, documents, electronic storage, art, and literature.
- Structural damage to residence halls resulting in displaced student populations
- Structural damage to nearby residences
- Community members arriving on campus for refuge from damaged homes
- Damaged university communications, computer systems, and networks
- Gaps in service delivery to vulnerable populations
- Considerable stress and fear among community
- Spontaneous creation of tent cities or outdoor camping on personal property
- Closure or reduction of service to campus operations
- Reduction of campus revenue

**Probability of Future Occurrence of the Hazard**

The Working Group on California Earthquake Probabilities (WGCEP), a collaboration between the United States Geological Survey (USGS), the Southern California Earthquake Center (SCEC), and the California Geological Survey (CGS) develops Uniform California Earthquake Forecasts (UCERFs) using the best currently available science and technology. The UCERF version 3 provides a three-dimensional view of the likelihood a region in California will experience a Magnitude 6.7 or greater earthquake in the next 30 years. The likelihood for the San Luis Obispo County fault systems surrounding San Luis Obispo is included in the following table.
Table 23-18: Major Potentially Active Faults in Proximity to Cal Poly SLO45

<table>
<thead>
<tr>
<th>Fault Zone</th>
<th>Recurrence</th>
<th>Maximum Magnitude</th>
<th>UCERF3 Likelihood</th>
</tr>
</thead>
<tbody>
<tr>
<td>East Husana</td>
<td>Unknown</td>
<td>6.2 to 7.2</td>
<td>1-2%</td>
</tr>
<tr>
<td>Hosgri</td>
<td>Unknown</td>
<td>7.3</td>
<td>1-2%</td>
</tr>
<tr>
<td>Los Osos</td>
<td>Unknown</td>
<td>6.8</td>
<td>1%</td>
</tr>
<tr>
<td>Oceanic – West Husana</td>
<td>Unknown</td>
<td>Unknown</td>
<td>1%</td>
</tr>
<tr>
<td>Rinconada</td>
<td>Unknown</td>
<td>7.3</td>
<td>1%</td>
</tr>
<tr>
<td>San Andreas</td>
<td>Varies: 20-300 years</td>
<td>6.8 to 8.0</td>
<td>20-22%</td>
</tr>
<tr>
<td>San Juan</td>
<td>Varies</td>
<td>7.0</td>
<td>1%</td>
</tr>
<tr>
<td>San Luis Range</td>
<td>Unknown</td>
<td>7.0</td>
<td>1%</td>
</tr>
<tr>
<td>Shoreline</td>
<td>Unknown</td>
<td>6.5</td>
<td>1%</td>
</tr>
</tbody>
</table>

The San Luis Obispo County Local Hazard Mitigation Plan estimates the probability of a major earthquake to occur is likely. The Plan identifies those earthquakes ranging from magnitude 7.0 to 7.9 occur 1 out of every 10 years and earthquakes ranging from magnitude 6.0 to 6.9 occur once every two or three years on average.

Based on the earthquake shaking potential in the San Luis Obispo area, the proximity to the above listed fault systems, and liquefaction potential exists on the southwest corner of the campus, the probability of seismic ground shaking generating damage is considered **Possible**.

**Vulnerability to the Hazard**

A considerable challenge regarding earthquakes is they generally occur without warning. The fault systems surrounding the region all cross major transportation routes potentially reducing the availability of access and the supply chain. The geographic location of Cal Poly San Luis Obispo places the campus in a suburban community near residential, commercial, and industrial areas that is moderately populated. Earthquake effects experienced in the neighboring local community will likely spill over onto the campus.

The known fault systems generating the threat to San Luis Obispo generally surround the city and some cross into the city including near the Cal Poly San Luis Obispo. The campus

45 San Luis Obispo County Local Hazard Mitigation Plan, October 2019

46 Southern California Earthquake Center, Earthquake Information, https://scedc.caltech.edu/earthquake/faults.html#

resides in a region that is exposed to fault systems on all sides. The proximity and potential for large earthquake development from these surrounding systems expose significant vulnerabilities. The potential for earthquake damaged structures being left uninhabitable including campus residence halls will result in numerous displaced individuals and households. The lack of earthquake insurance will cause extreme financial burdens on those affected. Campus buildings and equipment would be vulnerable to damages from building, seismic shaking, secondary fires, and secondary building floods from broken pipes.

Elements of the vulnerability to a major earthquake on the Cal Poly San Luis Obispo campus will vary depending on when the earthquake were to strike. The primary basis of vulnerability is based on the population affected and the built environment exposed. In general, newer construction will be more earthquake resistant than older buildings as building codes and construction technology have improved. A locally centered earthquake, even from moderate events, would have the potential for more damaging results when associated with the moderate liquefaction zones of the area. This would particularly be seen with greater damages to unreinforced masonry buildings.

The risk to the campus population will be lessened during periods when classes are not in session or during periods of breaks. Conversely, during the days and hours that classes are in session and staff are at their workplaces, the human vulnerability increases. Generally, people are safer when at home in wood frame structures as earthquakes tend to generate less structural damage to wood construction than in commercial or industrial facilities. The greater number of people on campus at the time of an earthquake will result in more people being exposed to effects from damaged campus facilities or equipment and require greater evacuation assistance. However, in region-wide events this vulnerability may simply shift to the homes and workplaces of members of the campus community and their families.

The aftermath of a major earthquake will likely result in widespread search and rescue operations for trapped and injured individuals. The demand on emergency services will be great, potentially requiring the campus community to be prepared for these scenarios and initiate response actions as needed. There will be needs for emergency medical care, shelter, water, and food for individuals who have been displaced by the earthquake. In earthquakes causing significant damages, there may be a necessity to provide assistance with identification and support to local agencies in mass fatality management.

There may be a need to evacuate members of the campus community from the campus and to other locations that are deemed to be safer locations. This may be heightened in the southwestern portions of the campus as this area has been identified as being within a liquefaction zone. As the Cal Poly San Luis Obispo campus is downstream from a dam facility, the decision to evacuate will need to take into account whether flood control facilities are filled with water and the actual threat to the dam or levees.

San Luis Obispo is served by only three primary surface transportation routes. The primary route being US Highway 101 providing roadway access to the Los Angeles area.
200 miles to the south and to the San Francisco Bay Area 200 miles to the north. California State Highway 1 also extends to the north however this is a winding route along seaside cliffs subject to landslides. A major earthquake has the potential for rendering these critical lifelines and supply routes inoperable and forcing the campus community to be self-reliant for a period of time.

Certain campus populations will experience greater challenges to a post-earthquake environment. Vulnerable populations including those that rely on specific services, require electrical power, homeless students, experience disabilities, non-English speakers, those whose age make evacuating difficult, and others will be most affected. These individuals will likely need to navigate through earthquake generated debris, extreme stresses of a disaster, an inability to communicate to or gain access to support networks, and find difficulty in accessing equipment or supplies to aid in a specific need.

Estimate of Potential Losses

Estimates of potential losses will be influenced by a variety of factors. The intensity of the earthquake will determine what scale of damages affecting campus infrastructure, equipment, and other impacted features. Losses will be generated by the physical damages, the loss of revenue, loss of academic research, loss of building contents, and community wide economic reductions.

Based on estimate replacement costs of facilities and structures on campus, the maximum total replacement costs due to earthquake are $660,197,687.

Table 23-19: HAZUS Peak Ground Acceleration Zone (PGA) Estimated Losses

<table>
<thead>
<tr>
<th>PGA Zone Designation</th>
<th>Intensity</th>
<th>No of Buildings</th>
<th>Maximum Replacement Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Extreme</td>
<td>X+</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Violent</td>
<td>IX</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Severe</td>
<td>VIII</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Very Strong</td>
<td>VII</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Strong</td>
<td>VI</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Moderate</td>
<td>V</td>
<td>113</td>
<td>$660,197,687</td>
</tr>
<tr>
<td>Light</td>
<td>IV</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Weak</td>
<td>II-III</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Not Felt</td>
<td>I</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>NA</td>
<td>NA</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>No Building Value Data Provided*</td>
<td>NA</td>
<td>45</td>
<td>Unknown</td>
</tr>
</tbody>
</table>

*Buildings with no value defined are also included in the respective Zones they are found in.

Vulnerability Assessment Conclusions

It is difficult to predict the severity of casualties, property, and cascading impacts generated by future seismic events affecting the greater San Luis Obispo County and the Cal Poly San Luis Obispo campus. Each of the earthquake generated effects will vary
widely based on the intensity of the earthquake, location of the epicenter, proximity to
people and development, time of day and year, the soil composition under the impacted
structures, building construction, among others. In any case, the potential for a major
earthquake exists affecting the campus and causing extensive challenges to the Cal Poly
San Luis Obispo campus and community.

In the event that a major earthquake was to strike along the many fault systems
surrounding San Luis Obispo, the effects could be significant to the campus community
and campus operations. The widespread impacts generated by a major earthquake would
extend the effects of casualties, damages, and other impacts to the broader San Luis
Obispo County region creating large-scale regionwide needs for critical assistance and a
heavy demand on limited emergency resources. The threat and impacts presented to the
campus will be shared with the campus community from their homes and places of work.
The campus will likely be required to address critical needs independently during early
phases of the disaster.

The campus population are additionally vulnerable to the effects of major ground shaking
that are far reaching. The psychological and social impacts a major earthquake will give
rise to will potentially harm individuals and cause tremendous fear. The willingness to
return indoors may be hampered especially as after-shocks continue. These effects are
magnified for populations having specific vulnerabilities or access limitations.

Identified Data Limitations

Data limitations include missing campus structural replacement costs, and lack of a
complete inventory of building construction types to include status of earthquake
retrofitting. HAZUS generated analysis is focused on the broader community level versus
fine-tuning the analysis to the micro-level for facilities such as a university campus.

**Erosion**

**Description of the Hazard**

The US Geological Survey (USGS) defines erosion as “the process whereby materials of
the earth’s crust are loosened, dissolved, or worn away and simultaneously moved from
one place to another” 48 Erosion may occur in areas of streams and rivers, along bluffs,
around immovable objects (such as buildings or bridge abutments), or as a cascading
result of other natural hazards, such as earthquakes or wildfires. When erosion occurs
along bodies of water, the removal of material causes the shore to move further
landward.

Forces such as sea level rise and changes in sediment supply impact erosion gradually and can be difficult to recognize. In contrast, the impacts of short-term events, such as storms and flooding, can be severe and are immediately recognizable.

Location of the Hazard

Erosion is a relatively non-spatial hazard that can occur in any location with conducive soil structure and a source of movement such as water or wind. As such, for the purpose of this campus-level analysis, the erosion hazard poses a consistent risk across the terrain of the Cal Poly San Luis Obispo campus with erosion-prone characteristics. An area’s potential for erosion is determined by several factors, including rainfall, topography, soil characteristics, and vegetative cover. Streambank and bluff erosion can occur near any riverine area.

Extent of the Hazard

While there is no published scale of severity or extent for this geologic hazard on the Cal Poly San Luis Obispo campus, erosion is likely to occur if conditions are favorable. That said, no such areas have been identified. As such, the planning committee ranks the extent of the hazard as Low.

History of the Hazard

There is no record of erosion incidents on the Cal Poly San Luis Obispo campus.

Potential Impacts of the Hazard

Erosion causes instability in soil. During high-intensity rain events, for example, eroded areas will continue to erode, resulting in additional loss of soil and ground stability in the area. This removal of sediment can result in damage to infrastructure, public health, and safety. On campus, areas of erosion can create pedestrian and transportation hazards, and structures may become unsafe if erosion is not controlled.

In agricultural areas, the erosion of soil degrades the quality of the soil, which can lead to reduced crop yields. At the Cal Poly Farm, soil erosion can create significant concerns for agriculture and research. Eroded test plots can negatively impact experiments and tests, resulting in a loss of knowledge and data.

Probability of Future Occurrence of the Hazard

Erosion is an on-going and dynamic process that occurs regularly. As climate change induces more frequent and intense weather events, such as wildfires and flooding, erosion may generally become more widespread or severe. These events can cause erosion or exacerbate areas already experiencing erosion. As a result, and in consideration of the potential extent of erosion, the probability of future occurrence is

high. That said, with regard to the campus, given the lack of historical events or existing conditions favorable to erosion, the probability of future occurrence is **Low**. However, conditions could emerge in the future which increase the probability, precipitated by climate change, changes in land-use or other factors.

**Vulnerability to the Hazard**

Topography, soil structure, land use, and precipitation are all factors of erosion. Cal Poly San Luis Obispo infrastructure, buildings, and agriculture located on steep slopes, in areas with little vegetation, or in areas with conducive soil types are more vulnerable to erosion. CSU leadership would consider performing an analysis to identify such at-risk buildings, infrastructure, slopes and soil types in the future.

In the wider San Luis Obispo community, erosion vulnerabilities include agricultural sector job loss, degradation of riverine ecosystems, and loss of water quality.

**Estimate of Potential Losses**

The historic and potential impacts of erosion on property statewide include reduced agricultural productivity, lower surface water quality, and damaged drainage networks.

Current modeling is not precise enough to allow for an assessment of potential losses to buildings and infrastructure on campus.

**Vulnerability Assessment Conclusions**

While the ability to predict future erosion on the Cal Poly San Luis Obispo campus is limited, the core issues shaping erosion vulnerability on campus are flora and landscaping. If left unchecked, erosion can cause significant damage to campus infrastructure and the surrounding environment.

**Identified Data Limitations**

The complex interactions between soil erosion factors make predictive modeling, determination of hazard areas, and quantification of loss difficult. Localized data on this hazard is also limited, resulting in more generalized findings.
**Extreme Temperatures (Includes Extreme Cold and Extreme Heat)**

**Description of the Hazard**

What is considered an excessively hot temperature varies according to the normal climate for that region. However, when temperatures are extremely high, people are at higher risk for heat-related illnesses, such as dehydration, heat exhaustion, heat stroke, and in severe cases, death.50

Hazards from extreme heat are made worse when high temperatures are accompanied by high levels of humidity, which is defined as the amount of moisture in the air.51 As the temperature climbs, the air is able to hold more moisture. High humidity prevents the human body from cooling down naturally, which leads people to perceive that the temperatures “feel” hotter. The combination of temperature and humidity is known as the heat index.52

Heat stroke, the most serious heat-related illness, occurs when the body is unable to control its temperature. Body temperature rises rapidly, the sweating mechanism fails, and the body cannot cool down.53 In extreme causes, heat stroke can cause confusion and unconsciousness, so the victim is unable to seek treatment without assistance.

There are several groups of people who are uniquely vulnerable to the effects of extreme heat, such as infants and children, older adults aged 65 and up, athletes and outdoor workers, low-income households, and individuals with certain chronic medical conditions.54

**Location of the Hazard**

Extreme heat events are a non-spatial hazard and may occur at the Cal Poly San Luis Obispo campus.

**Extent of the Hazard**

Extreme heat has a wide range of extent and severity markers and characteristics. Monthly average maximum temperatures in June through October range approximately


52 Ibid.


from the low-70s to mid-70s in San Luis Obispo County. According to data from the National Climatic Data Center (NCDC), the highest daily temperature recorded at the San Luis Obispo Polytech Station was 112° F on September 14, 1971. Given the historical occurrence of only 3 extreme heat events since 1950, and average maximum temperatures in the 70’s, the planning committee ranks the extent of the hazard as Low.

The National Weather Service issues a Heat Advisory when the heat index value is expected to reach 100° – 104° F within the next 12 to 24 hours. Excessive Heat Warnings are issued when there is an anticipated heat index of 105° F or greater that will last for two (2) or more hours. Excessive Heat Warnings are issued by the county when any location in the county is expected to reach that criteria. In anticipation of an Excessive Heat Warning, an Excessive Heat Watch may be issued 1 to 2 days in advance, when the Heat Warning criteria is 50 – 79% likely to occur.

Figure 23-10 (following) depicts the National Weather Service’s methodology for determining the heat index, using the % humidity and the actual temperature.

As the heat index rises, so does the potential danger to people and animals. Table xx (following) shows the health hazards associated with extreme heat.

Table 23-20: Health Risks Associated with Heat Index

<table>
<thead>
<tr>
<th>Category</th>
<th>Heat Index</th>
<th>Health Hazards</th>
</tr>
</thead>
<tbody>
<tr>
<td>Extreme Danger</td>
<td>130° F or higher</td>
<td>Heat stroke / sunstroke is likely with continued exposure.</td>
</tr>
<tr>
<td>Danger</td>
<td>105° – 129° F</td>
<td>Sunstroke, heat cramps, and/or heat exhaustion is likely with prolonged exposure and/or physical activity.</td>
</tr>
<tr>
<td>Extreme Caution</td>
<td>90° – 104° F</td>
<td>Sunstroke, heat cramps, and/or heat exhaustion is possible with prolonged exposure and/or physical activity.</td>
</tr>
<tr>
<td>Caution</td>
<td>80° – 89° F</td>
<td>Fatigue is possible with prolonged exposure and/or physical activity.</td>
</tr>
</tbody>
</table>

History of the Hazard

Based on data gathered from the National Centers for Environmental Information (NCEI) Storm Events Database, there have been three excessive heat events in San Luis Obispo County since 1950.

**July 22, 2006:** An extended period of excessive heat affected San Luis Obispo, Santa Barbara, Ventura, and Los Angeles Counties. Heat index values ranged from 100° to 119° F.

**September 3, 2007:** A combination of high temperatures and high humidity produced an extreme heat event across the County and throughout Southern California. Heat index values ranged from 105° to 112° F. There were eight deaths attributable to this excessive heat event.

**June 20, 2008:** Afternoon high temperatures during this extreme heat event climbed as high as 114° F. The heat resulted in several power outages due to excessive electrical use.

Potential Impacts of the Hazard

Cal Poly San Luis Obispo may experience impacts from extreme heat due to cancelled classes or postponed outdoor events in order to protect students, faculty, and staff from the weather.

In addition to the threat extreme heat poses to humans, high temperatures also pose a threat to utility production, which in turn threaten facilities and operations that rely on utilities. As temperatures rise, more people stay indoors, increasing the demand for air conditioning, fans, and other electronics. This puts a strain on the electrical grid, which

can cause temporary outages. These outages can impact operations throughout campus, resulting in interruptions and delays in service. Outages may also negatively impact research efforts on campus, as the inability to maintain a steady, constant temperature may impact research specimens and experimental results.

Probability of Future Occurrence of the Hazard

There have been no extreme heat events in San Luis Obispo County in over a decade and only 3 events in total. Therefore, using the scale provided, it is Unlikely that the hazard will occur annually.

Vulnerability to the Hazard

When dealing with an extreme heat event, the most common impacts are those generally felt by the people living in the targeted area. For people in particular, heat can kill when the body is pushed beyond its limits. Most heat disorders occur because the victim has been overexposed to heat. As discussed, the major human risks associated with extreme heat include dehydration, sunburn, fatigue, heat exhaustion, heat stroke, and in severe cases, death.

Some portions of the population are more at risk to the effects of extreme heat. The very young, the elderly, and certain groups with chronic medical conditions (such as asthma or other pulmonary illnesses, heart disease, poor blood circulation, neurological illnesses, and obesity) are generally more vulnerable to the effects of extreme heat, and are more likely to suffer illness or death as a result.57 This is especially true if exposure is extended for a period of time and preventative measures are not taken immediately.

Cal Poly’s Office of Environmental Health and Safety has published nearly two dozen Codes of Safe Practice for the campus, which are designed to follow CAL/OSHA regulations and prevent injury and illness. One such code describes precautions and rules that should be followed to prevent heat illness when there have been more than 48 hours of high heat (defined as 90° F or higher) and high humidity (defined as 80% or higher).58 The code includes practices that should be followed even at lower levels of heat and humidity for special circumstances (e.g., workers wearing heavy or protective gear or clothing). The rules include suggestions for providing water, shade, and rest breaks, as well as descriptions for concerning symptoms for heat cramps, heat exhaustion, and heat stroke.

Overall, while Cal Poly does not include extreme or excessive heat as part of its Emergency Operations Plan due to the minimal extent and probability of the hazard, the


campus’s Office of Environmental Health and Policy is aware of the risks and vulnerabilities of this hazard, particularly when it comes to the protection of staff and campus workers.

**Estimate of Potential Losses**

Based on the previous historical occurrences, annualized losses are considered to be negligible. In an extreme heat event, loss of human life or health impacts are a greater concern than is property damage.

**Vulnerability Assessment Conclusions**

While the ability to predict future heat events at the Cal Poly campus is limited, the effects of climate change may provide some information. According to the Environmental Protection Agency (EPA), South-Central California has warmed about 2 – 3 degrees on average over the last century, with less rainfall. This may lead to stronger and more frequent heat events, drought, and an increased risk of wildfires.59

That said, due to the minimal extent and probability of the hazard, campus leadership is aware of the risks and vulnerabilities of this hazard, particularly when it comes to the protection of staff and campus workers.

**Identified Data Limitations**

Numerous public and private actors conduct research, acquire data and disseminate meteorological information and forecasting to the general public, including the CSU university system. Currently, it is assumed that, apart from regular access to climate change models on changes to temperature extremes over time, the CSU community maintains sufficient access to the data needed to plan for, respond to, and mitigate the effects of extreme heat and cold.

**Flood**

**Description of the Hazard**

The incredible geographic diversity in California presents tremendous challenges for flood planning and response. The state is home to extensive mountain ranges such as the Sierra Nevada, Cascades, Klamath, Coastal Ranges, and the Southern California

Transverse Range all creating tremendous watersheds. Large river systems drain the mountains traveling through populated communities including the Sacramento and San Joaquin Rivers draining into the California Delta. The state has a complex system of reservoirs, dams, and levees providing water storage and flood protection. Finally, California’s 840-mile coastline exposes the coastal regions to tidal influences.

Floods are characterized by the rising and overflowing of excess water from a water source such as a stream, river, lake, canal, or coastal body onto an area of normally dry floodplain. A floodplain is a lowland area downstream and adjacent to water bodies that are subject to flood events. Flooding is a naturally occurring event that become hazardous when populations and property are affected.

Floods can result from excessive precipitation from weather systems generating prolonged rainfall, excessive snowmelt from watersheds upstream from the floodplain, infrastructure failure, exceeding the capacity of dams or levees, tidal influences, or a combination from any of the previous factors.

Floods represent one of the costliest and most frequent natural disasters that influences human suffering and economic impact in the United States. Flooding will likely result in significant damage to structures, infrastructure, utilities, landscapes, and the environment. Erosion of stream banks, roadways, other feature may result from the movement of flood waters. The saturated ground resulting from standing flood waters may cause ground instability, collapse, erosion, or other damages. Further, floods will often generate substantial debris that will accumulate and be deposited throughout the flooded areas.

Floods can be either slow-rise or rapid onset floods. With slow rise floods, there is often warning preceding water rise by hours or days before dangerous conditions present themselves. Slow rise floods that are expected to enter into populated areas generally allow for some time to initiate evacuation and sand bagging efforts. Flooding that occurs rapidly conversely are water events that present with extremely limited warning times and a limited ability to take response actions until flooding has already begun to occur.

Flooding may take on different forms:

- **Flash Flooding** – Flash flooding is typically characterized by a rapid rise, short duration, and large volume of water in a localized area. Heavy rainfall in areas that have limited drainage capacities often contribute to flash flooding conditions. These flooding events frequently occur with limited notice requiring immediate evacuation or rapid response efforts such as sand bagging. Flash flooding may arrive with fast moving water creating added hazardous conditions.

- **Riverine Flooding** – Riverine flooding is usually caused by prolonged rainfall or rainfall combined with heavy snowmelt. When soils are already saturated, the ability for the ground to absorb water is minimized. In a riverine flood, the water way exceeds channel capacity and extends into areas outside of the channel, often in developed communities. In California, riverine flooding is most likely to occur.
from November through April. The duration of riverine floods may vary from a period of hours to weeks.

- **Localized Flooding** – Localized flooding is commonly the result of stormwater drainage systems being overwhelmed by unusually heavy rainfall. These flooding events frequently occur in areas that are urbanized or developed with greater amounts of impervious surfaces not allowing ground absorption. This generates added runoff into the drainage systems and onto roadways creating backups.

- **Infrastructure Failure** – Failures of dams or levees presents a serious flooding concern for areas downstream from the compromised structure. This situation may result in a catastrophic flood with limited warning time and widespread areas affected.

- **Coastal Flooding** – Coastal flooding can occur in multiple areas along the California coastline. Flooding may result from intense storms coming from the Pacific Ocean that generate elevated water levels or storm surge. The size, duration, winds generated, and intensity of the storm will influence the effect the waves will have on the shoreline. Periods of high tide can aggravate the conditions allowing greater wave impingement into coastal areas.

**Atmospheric Rivers**

California, including the location of this campus, is subject to the effects of a phenomenon referred to as atmospheric rivers. These weather events consist of long, narrow regions in the atmosphere transporting tremendous amounts of water vapor from the tropics. These weather regions behave like rivers in the sky. They can carry heavy volumes of water vapor compared to the amount of water flow at the mouth of the Mississippi River. As these atmospheric rivers arrive into California they tend to generate significant rain and snow.

Atmospheric rivers can arrive in many different shapes and sizes. The larger events are able to generate extreme rainfall amounts resulting in flooding. They can stall over watersheds vulnerable to flooding, often saturated with heavy snow amounts. The atmospheric rivers known as a “Pineapple Express” coming from the tropics and arriving with warmer air may produce heavy rains that will melt ground snow adding to the water volume that will be added in the flood runoff.

These events can produce heavy amounts of precipitation creating extensive damages. However, these events may present as weaker systems that produce precipitation that is enough to be beneficial for the local water supply. At the higher elevations in the California mountains, these events have the potential to generate a tremendous snowpack providing a source of water during the dry summer months.
San Luis Obispo is located in San Luis Obispo County in the center of the Central Coast. San Luis Obispo County can experience flooding from overflowing streams and heavy precipitation events in low lying areas such as central San Luis Obispo. These areas can experience shallow flooding impacting roadways and other areas where drainage is inadequate. San Luis Obispo is located in a valley that gradually rises to the north and east toward the Santa Lucia Range. Adjacent to the Cal Poly San Luis Obispo campus are both residential neighborhoods and commercial land uses.

60 National Oceanic and Atmospheric Administration, “What are atmospheric rivers?”, https://www.noaa.gov/stories/what-are-atmospheric-rivers
The Cal Poly San Luis Obispo campus is located at the base of mountains that provide drainage through the campus. The campus is split by the Brizzolara Creek and is near Stenner Creek, Chorro Creek, and the San Luis Obispo Creek. Each of these waterways drain the upstream watersheds that capture runoff from the hills and mountains that line the San Luis Obispo Valley. These waterways are normally dry except during periods of precipitation when the potential for large volumes of water is possible. The majority of the campus is designated as Zone X (Area of Minimal Flood Hazard). However, bordering on the west side of the campus is a Zone A (Area Inundated by 1% Annual Chance for Flooding) that follows the Stenner Creek and a Zone A (Area Inundated by 1% Annual Chance for Flooding) that buffers the Brizzolara Creek that transits through the northern half of the campus.
Extent of the Hazard

The Cal Poly San Luis Obispo campus is located in a designated Zone X: Area of Minimal Flood Hazard except for the Brizzolara Creek flood control channel which is designated as Zone AE: 1% Annual Chance Flood Hazard. The access routes into and out of the campus servicing locations to the west are found in areas primarily designated as Zone X: Area of Minimal Flood Hazard, access routes that cross streams are primarily located in Zone AE: 1% Annual Chance Flood Hazard at the point of the crossing. Based on the campus being located primarily in Zone X, but also containing portions located in Zone AE along creeks, the planning committee ranks the extent of the hazard as **Low to Moderate**.

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61 Federal Emergency Management Agency, FEMA Flood Map Service Center, [https://msc.fema.gov/portal/search#searchresultsanchor](https://msc.fema.gov/portal/search#searchresultsanchor)

In support of the NFIP, FEMA identifies those areas that are more vulnerable to flooding by producing Flood Hazard Boundary Maps (FHBM), Flood Insurance Rate Maps (FIRM), and Flood Boundary and Floodway Maps (FBFM). Several areas of flood hazards are commonly identified on these maps, including the 1% annual chance flood zone. Flood zones are further delineated by risk and are assigned a letter signifier. The flood zone designations are defined and described in the following table.

Table 23-21: Flood Zone Designations and Descriptions

<table>
<thead>
<tr>
<th>Zone Designation</th>
<th>Percent Annual Chance of Flood</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Zone V</td>
<td>1%</td>
<td>Areas along coasts subject to inundation by the 1% annual chance of flooding with additional hazards associated with storm-induced waves. Because hydraulic analyses have not been performed, no BFEs or flood depths are shown.</td>
</tr>
<tr>
<td>Zones VE and V1-30</td>
<td>1%</td>
<td>Areas along coasts subject to inundation by the 1% annual chance of flooding with additional hazards associated with storm-induced waves. BFEs derived from detailed hydraulic analyses are shown within these zones. (Zone VE is used on new and revised maps in place on Zones V1-30.)</td>
</tr>
<tr>
<td>Zone A</td>
<td>1%</td>
<td>Areas with a 1% annual chance of flooding and a 26% chance of flooding over the life of a 30-year mortgage. Because detailed analyses are not performed for such areas, no depths or base flood elevations are shown within these areas.</td>
</tr>
<tr>
<td>Zone AE</td>
<td>1%</td>
<td>Areas with a 1% annual chance of flooding and a 26% chance of flooding over the life of a 30-year mortgage. In most instances, base flood elevations derived from detailed analyses are shown at selected intervals within these zones.</td>
</tr>
<tr>
<td>Zone AH</td>
<td>1%</td>
<td>Areas with a 1% annual chance of flooding where shallow flooding (usually areas of ponding) can occur with average depths between 1 – 3 feet.</td>
</tr>
<tr>
<td>Zone AO</td>
<td>1%</td>
<td>Areas with a 1% annual chance of flooding, where shallow flooding average depths are between 1 – 3 feet.</td>
</tr>
<tr>
<td>Zone X (shaded)</td>
<td>0.2%</td>
<td>Represents areas between the limits of the 1% annual chance of flooding and 0.2% chance of flooding.</td>
</tr>
</tbody>
</table>
Areas outside of the 1% annual chance floodplain and 0.2% annual chance floodplain, areas of 1% annual chance sheet flow flooding where average depths are less than 1 foot, areas of 1% annual chance stream flooding where the contributing drainage area is less than 1 square mile, or areas protected from the 1% annual chance flood by levees.

No BFE or depths are shown within this zone.

History of the Hazard

Flooding in San Luis Obispo and the broader Central Coast region have typically occurred during the winter months when Pacific storms are more common. The occurrences of significant flooding typically have been the result of successive intense storms with heavy precipitation. The region has experienced flood events that have caused tens of millions of dollars in damages and casualties. The following table (23-24) provides insight into information of past flooding events that are significant to the Cal Poly San Luis Obispo campus. Flood events on campus are reported by campus staff to primarily be occasional localized flooding or ponding in certain parts of campus. No evacuation or campus closure flood events have been reported.

Table 23-22: Historic Flooding Events in San Luis Obispo County

<table>
<thead>
<tr>
<th>Date</th>
<th>Event</th>
<th>Declaration</th>
<th>Damages</th>
</tr>
</thead>
<tbody>
<tr>
<td>February 2017</td>
<td>Flood; Winter Storms</td>
<td>DR-4308-CA</td>
<td></td>
</tr>
<tr>
<td>January 2017</td>
<td>Flood; Winter Storms</td>
<td>DR-4305-CA</td>
<td></td>
</tr>
<tr>
<td>January 2017</td>
<td>Flood; Winter Storms</td>
<td>DR-4301-CA</td>
<td></td>
</tr>
<tr>
<td>March 2011</td>
<td>Flood; Winter Storms</td>
<td>DR-1952-CA</td>
<td></td>
</tr>
<tr>
<td>December 2010</td>
<td>Flood; Heavy Rains</td>
<td>DR-1884-CA</td>
<td>$3.2 million</td>
</tr>
<tr>
<td>November 2010</td>
<td>Winter Storms</td>
<td>NA</td>
<td>Flash flooding</td>
</tr>
<tr>
<td>December 2005</td>
<td>Flood; Winter Storms</td>
<td>DR-1628-CA</td>
<td>$3 million</td>
</tr>
<tr>
<td>December 2004</td>
<td>Flood; Heavy Rains</td>
<td>NA</td>
<td>1 fatality</td>
</tr>
<tr>
<td>March 2001</td>
<td>Flood; Heavy Rains</td>
<td>NA</td>
<td>Urban flooding</td>
</tr>
<tr>
<td>January 1999</td>
<td>Flood</td>
<td>NA</td>
<td>SLO Urban flooding</td>
</tr>
<tr>
<td>February 1998</td>
<td>Flood; Winter Storms</td>
<td>DR-1203-CA</td>
<td>Countywide</td>
</tr>
<tr>
<td>January 1997</td>
<td>Flood</td>
<td>DR-1155-CA</td>
<td>Countywide</td>
</tr>
<tr>
<td>March 1995</td>
<td>Flash Flood; Heavy Rains</td>
<td>DR-1046-CA</td>
<td>SLO Urban flooding</td>
</tr>
<tr>
<td>January 1995</td>
<td>Flash Flood; Heavy Rains</td>
<td>DR-1044-CA</td>
<td>Countywide</td>
</tr>
<tr>
<td>January 1973</td>
<td>Flood; Heavy Rains</td>
<td>NA</td>
<td>SLO Urban flooding</td>
</tr>
<tr>
<td>January 1969</td>
<td>Flood; Heavy Rains</td>
<td>NA</td>
<td>SLO Urban flooding</td>
</tr>
</tbody>
</table>

63 San Luis Obispo County Local Hazard Mitigation Plan, October 2019
Potential Impacts of the Hazard

A flood will potentially result in extensive amounts of water entering onto developed areas. The force and volume of water that is generated by a flood may cause extensive structural damage in areas subject to standing or moving water. The effects of flooding may spread over significant distances covering large areas of land. The extent of the impacts would vary based on a number of factors such as the volume of water flooding, the time of the flood event, the amount of warning provided, the location and extent of the flood boundary, facility elevation, and distance from the flood source.

Potential impacts resulting from flooding include:

- Injuries or loss of life
- Property destruction or damage
- Loss of property contents
- Infrastructure damage including roadways, bridges, other transportation means
- Public health hazards resulting from mold, mildew, and disease due to flood water
- Flood inundation of the Cal Poly Water resources Facility and domestic water capabilities
- Flooded or destroyed lifelines/supply routes
- Damaged or destroyed utilities
- Loss of community economic base
- Employment losses
- Agricultural (crops and livestock) damages or destruction
- Flood exposure to on campus livestock
- Environmental damage
- Prolonged periods of necessary dewatering
- Flooding erosion may alter natural drainage channels
- Societal and community impacts
- Psychological impacts of impacted populations
- Disruptions to education delivery to community
- Damage or destruction of academic materials, fine arts, and research
- Damage or destruction of university computer systems and networks
- Damaged university infrastructure
- Inability for campus operations to resume
- Reduced or eliminated student engagement with academic programs
- Reductions in campus revenues

Additionally, individuals who were unable to evacuate in time or refused to leave will likely need assistance or rescue from the flooded area. Remaining in or being trapped by flood waters places individuals in significant risk of injury or death. The impacts extend beyond the danger placed upon the affected individual and places greater resource demands on agencies and organizations making efforts to rescue trapped individuals.

Probability of Future Occurrence of the Hazard

San Luis Obispo County is determined to have considerable portions of the county to be at high risk from flooding. The repeated historic occurrences have shown that the region is subject to flooding in any given year. Floods can occur at any time but are most common along the Central Coast with winter storms that are saturated with subtropical moisture. The area surrounding the Cal Poly San Luis Obispo campus does not generally promote conditions for flood waters to accumulate with the exception along creek channels. The majority of the campus is designated as Zone X (Area of Minimal Flood Hazard). However, bordering on the west side of the campus is a Zone A (Area Inundated by 1% Annual Chance for Flooding) that follows the Stenner Creek and a Zone A (Area Inundated by 1% Annual Chance for Flooding) that buffers the Brizzolara Creek that transits through the northern half of the campus. Much of downtown San Luis Obispo is classified as Zone AO (Area Inundated by 1% Annual Chance for Flooding with Water Depths of 1-3 Feet). Access in and out of the campus may become compromised in flooding events off campus. There are specific buildings and areas of the campus that have a greater risk for isolated flooding. However, the area is subject to isolated urban or street flood events providing a demonstration of potential flood activity.

The probability of future occurrence for flooding on the campus is Possible.

Vulnerability to the Hazard

The Cal Poly San Luis Obispo campus is subject to the effects of localized flooding resulting primarily from excessive precipitation and isolated strong storms. There is a more remote potential for flooding and damage on campus and surrounding residential and commercial areas of San Luis Obispo due to overflow or damage to flood control systems. The channels and extending irrigation channels that surround the campus have limited storage or volume capacities. The campus and the campus community are vulnerable to the effects generated by flooding from these systems.

Vulnerability to flooding on the Cal Poly San Luis Obispo campus will vary depending on when the flood was to occur. The risk to the campus population will be lessened during
periods when classes are not in session or during periods of breaks. Conversely, during the days and hours that classes are in session and staff are at their workplaces, the human vulnerability increases. Members of the campus community may become trapped on campus depending on the level of flooding occurring on surface streets. However, in rare region-wide events this vulnerability may be extended to the homes and workplaces of members of the campus community and their families.

Cal Poly San Luis Obispo is in proximity to a variety of agricultural, industrial, and commercial facilities in the surrounding communities. When these facilities are inundated with flood water, the potential for chemical release exists presenting possible exposures to individuals from the campus community. These facilities additionally line many of the primary access routes in and out of the campus.

During low probability, severe flood events, some campus buildings and infrastructure might be vulnerable to large-scale flooding reaching the university. Campus utilities and communication capabilities might be impacted by flood waters rendering them disabled. A rare flood event covering a large portion of the city would likely affect communication capabilities well beyond the boundaries of the campus. Remaining flood waters will leave behind molds and other health concerns in affected campus buildings and facilities likely requiring extensive restoration or demolishing. The residents of the on-campus residence halls may have transportation limitations requiring evacuation and alternative housing procedures to be implemented if populated. Flood waters may result in damage to campus equipment, communication systems, protected documents, artwork, academic materials, computer systems, research, and other critical activities on lower levels of buildings in areas of localized or isolated flooding.

The limited transportation routes into and out of the San Luis Obispo area creates a potential scenario in which the campus and surrounding communities may become isolated in widespread flooding situations. US Highway 101 provides the primary ground access routes to areas in California with additional services and capabilities. Flooding of this critical lifeline will impede the ability to receive supplies, equipment, and additional resources while also limiting or removing the ability to evacuate the campus community from the area.

Certain campus populations will experience greater challenges to a post-flood / failure environment. Vulnerable populations will likely need to navigate through flood generated debris, face extreme health safety issues from flood waters, experience extreme stresses of a disaster, an inability to communicate to or gain access to support networks, and find difficulty in accessing equipment or supplies to aid in a specific need. Students remaining on campus such as those residing in the residence halls would be particularly vulnerable especially those without access to adequate transportation.

Estimate of Potential Losses

Estimates of potential losses will be influenced by a variety of factors. The volume and force of the water will determine the scale of damages affecting campus infrastructure, equipment, and other impacted features. The location and elevation above flood waters
will affect the level of damage and individuals exposed. The time of the academic year, the day of week, and hour in which the flooding was to occur will influence the number of people on campus and potential casualties. The severity of the storms producing precipitation, the speed of the storms moving across the area, the level of snowpack in the higher elevations, and amount of resulting snowmelt will produce varying effects on damages produced and costs incurred. Losses will be generated by the physical damages, the loss of revenue, loss of academic research, loss of building contents, and community wide economic reductions.

Based on estimate replacement costs of facilities and structures on campus, the maximum total replacement costs due to flood are $660,197,687. However, it is unlikely for flood to cause destructive losses to the entire campus.

Table 23-23: Special Flood Hazard Area (SFHA) Estimated Losses

<table>
<thead>
<tr>
<th>Zone Designation</th>
<th>No of Buildings</th>
<th>Maximum Replacement Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Zone V</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Zone VE &amp; V 1-30</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Zone A</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Zone AE</td>
<td>2</td>
<td>$65,360</td>
</tr>
<tr>
<td>Zone AH</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Zone AO</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Zone X .2%</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Zone X Minimal Risk</td>
<td>63</td>
<td>$660,132,327</td>
</tr>
<tr>
<td>Not in a SFHA</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>No Building Value Data Provided*</td>
<td>46</td>
<td>Unknown</td>
</tr>
</tbody>
</table>

*Buildings with no value defined are also included in the respective Zones they are found in.

Vulnerability Assessment Conclusions

While the campus is mostly located in an area of minimal flooding, the primary vulnerabilities to flood on campus are people and assets exposed to mostly localized flooding from overflow of campus creeks or isolated or large-scale storms that produce heavy amounts of precipitation directly over the campus and surrounding neighborhoods. The proximity to the Chorro and Stenner Creek presents an additional minimal or limited flood hazard for the campus.

The potential for rare but severe flooding generates the added potential for a number of cascading effects such as disruptions to the local economy, utility failures, disruptions to providing for the needs of the community, and development of public health hazards. These effects would be exacerbated by effects of seasonal flooding, ongoing heavy precipitation, or excessive run-off from the watershed contributing to the river system. The potential for widespread flooding and damage of structures due to the force of water, while unlikely, has exponentially powerful impacts on particular populations among the
campus community including those with access or functional needs, international students, the homeless, and students residing in the residence halls.

**Identified Data Limitations**

Data limitations include missing campus structural replacement costs, and an incomplete inventory of both building construction features and mitigation efforts to lessen the impact due to flood inundation. HAZUS generated analysis is focused on the broader community level versus fine-tuning the analysis to the micro-level for facilities such as a university campus.

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**Hazardous Materials**

**Description of the Hazard**

A hazardous material is defined in California’s State Hazardous Materials Incident Contingency Plan (1991) as “a substance or combination of substances which, because of quantity, concentration, physical, chemical, or infectious characteristics may: cause, or significantly contribute to an increase in deaths or serious illnesses; and/or pose a substantial present or potential hazard to humans or the environment.” Hazardous materials are one or more of the following: flammable, corrosive or an irritant, oxidizing, explosive, toxic (poisonous or infectious), thermally unstable or reactive, or radioactive. Hazardous materials are ubiquitous in modern society and may be found at all stages of production, consumption, and disposal.

Federal and state laws permit the intentional release of some hazardous materials into the environment such that the risk to human health and the environment is thought to be acceptable. However, sometimes releases are unintentional, resulting from leaks, accidents, or natural hazards. This section focuses on such accidental releases and fall into the following key categories:

**Fixed Hazardous Materials Incident**: A fixed hazardous materials incident is the accidental release of chemical substances or mixtures during production or handling at a fixed facility.

**Transportation Hazardous Materials Incident**: A transportation hazardous materials incident is the accidental release of chemical substances or mixtures during highway, waterway or air transport. Populations, built and natural environments are potentially impacted.

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Pipeline Incident: A pipeline transportation incident occurs when a break in a pipeline creates the potential for an explosion or leak of a dangerous substance (oil, gas, etc.) possibly requiring evacuation. An underground pipeline incident can be caused by environmental disruption, accidental damage, or sabotage. Incidents can range from a small, slow leak to a large rupture where an explosion is possible. Inspection and maintenance of the pipeline system along with marked gas line locations and an early warning and response procedure can lessen the risk to those near the pipelines.

Hazardous materials can also be classified according to worker safety and health. Information provided by California Division of Safety and Health includes guidelines related to:

- **Safety hazards**: fire and fire byproducts, electricity, flammable gases, unstable structures, demolition, sharp or flying objects, excavations)
- **Health hazards**: carbon monoxide ash, soot and dust; asbestos; hazardous liquids; other hazardous substances; heat illness)

Natural-Technological Incidents (Natechs): During the past two decades, increasing attention has been given to hazardous materials releases resulting from Natechs or a natural disaster event that triggers a technological hazard event. Natechs are of particular concern for the following reasons:

- They can produce a simultaneous effect on many industrial facilities
- Can overwhelm response capacity
- Containment systems may fail
- May produce cascading disasters
- Response may be hindered by a disaster’s impact on the physical environment

Location of the Hazard

Hazardous materials and infrastructure such as fuel tanks, rail lines, chemicals, hazardous waste sites and gas pipelines to varying degrees are located within the CSU system and/or within its surrounding communities. The planning committee indicates that biological materials are located in the science lab on campus. At larger scales (beyond the campus planning area) hazardous materials are located throughout the city and county of


San Luis Obispo and reflect different types, configurations and scales dispersed across these geographic areas.

Extent of the Hazard

There is no comprehensive statewide vulnerability assessment available at this time. As such, the true extent of the hazardous materials risk in California and its communities is not known, meaning no overarching conclusions have been reached which have been able to integrate all qualitative and quantitative risk factors to produce a comprehensive measure of the extent of the hazard. However, for the CPSU – San Luis Obispo planning committee, although no hazmat events have taken place on campus, hazardous materials include biological material located in the science building and both railroad and gas pipeline run extremely close to the campus. Based on these factors along with the types and levels of hazardous materials in the larger community, it is prudent to rank the extent of the hazard for the CPSU – San Luis Obispo campus as Moderate, and to consider worst case scenarios as the main driver of policy in order to fully mitigate all possible hazardous materials event outcomes.

For example, according to the 2018 CA State Hazard Mitigation Plan, 400 hazardous materials problems are tied to 32 past earthquakes, including over 150 problems from the Loma Prieta Earthquake alone. That said, the plan indicates that it is likely that many such hazardous materials releases have received little attention in the past because public authorities, the media, and the public have overlooked them in the rush to address and recover from immediate disaster threats, and that responsible parties may have an incentive to understate the extent of releases or not to report them at all.

History of the Hazard

According to the CA Governor’s Office of Emergency Services’ Hazardous Materials Spill Report, the state experiences from 10 to 30 spill events daily. As of April 20th, 2021 already 2096 spill events had occurred. Such events have occurred in all the cities and/or counties where CSU campuses are located.

According to the 2018 CA State Hazard Mitigation Plan, with regard to natural-technological hazard events (Natechs), 400 hazardous materials events are tied to 32 past earthquakes, including over 150 Natech events from the Loma Prieta Earthquake alone.


For more details on specific hazmat events, please refer to the local, county and/or multi-jurisdictional hazard mitigation plans where CSU campuses are located at: https://www.caloes.ca.gov/cal-oes-divisions/hazard-mitigation/hazard-mitigation-planning/local-hazard-mitigation-program

No hazmat incidents have taken place on the CPSU – San Luis Obispo campus.

**Potential Impacts of the Hazard**

A large hazardous materials release could affect an entire community or city under certain conditions related to direction of air flow (air-based chemical release) and population density or the contamination of a community’s main water supply. Either type of release could necessitate large scale evacuation. By contrast, in the rural unincorporated areas where population densities are low, even in the event of a large release, the number of homes that may need to be evacuated would be significantly lower than in an urban environment. The occurrence of a hazmat incident can also result in the shut-down of transportation corridors which can last for hours at a time while the impacted area is stabilized.

The release of some toxic gases may cause immediate death, disablement, or sickness if absorbed through the skin, injected, ingested, or inhaled. Contaminated water resources become unsafe and unusable, depending on the amount of contaminant. Some chemicals cause painful and damaging burns if they come in direct contact with skin. Prolonged and concentrated exposure to such chemicals can produce severe long-term impacts to respiratory, endocrine and nervous systems, heart and brain health.

The potential impacts of chemicals and toxic gases discussed here also apply to the students, staff and environment on the CPSU – San Luis Obispo campus.

With regard to the natural environment overall, contamination of air, ground, or water may result in harm to fish, wildlife, livestock, and crops. The release of hazardous materials into the environment may cause debilitation, disease, or birth defects over a long period of time. Loss of livestock and crops may lead to economic hardships within the community.

Recent California examples include the 2016 Aliso Canyon methane gas leak, which caused evacuation of nearby residents, many of whom experienced temporary health problems such as difficulty breathing and eye irritation; and the 2016 Fruitland metal recycle plant fire in Maywood, which released heavy metals such as lead, magnesium, copper, aluminum, antimony, calcium, iron, sulfur, tin, potassium, and zinc which pose
severe risks to public health. Health effects from exposure to these metals included short-
term symptoms such as irritation to the eyes, nose, throat, and lungs.71

Potential Impact of the Hazard (Natechs) Natural disasters, including earthquake, flood,
and fire also pose risks to public health and the environment. For example, following the
Northridge Earthquake, California State University (CSU) Northridge laboratories and
chemical storage rooms experienced multiple chemical spills. Such incidents, triggered
by a natural disaster, pose a significant risk to students, faculty, staff, and first
responders. At a minimum, all CSU campuses with a science lab (including CPSU – San
Luis Obispo) is at risk of potential impact from a natural-technological (combined impact)
event.

In a severe flood event, floodwaters are often contaminated with hazardous materials
posing a threat to public and animal health, groundwater, and other parts of the
environment. These hazardous materials may be released from damaged or flooded
underground tank sites (e.g., gas stations or chemical storage facilities), propane tanks,
manure or human waste handling facilities, fertilizer and pesticide storage, agricultural
sites, and household hazardous waste.

In a fire event, (such as the October 2017 Northern California firestorms which destroyed
approximately 6,000 residences) entire neighborhoods can be burned to the ground.
Hazardous material release creates public health concerns which can delay the initial
steps of fire recovery, including reopening burned areas to residents and initiating debris
removal activities. The post-fire “toxic sweep” poses a risk of coming into contact with
toxic substances due to the presence of synthetic and hazardous materials.

Probability of Future Occurrence

The probability of occurrence for a hazmat event on the CPSU – San Luis Obispo campus
can be viewed in two different ways: the history of occurrence serves as a sound
predictor of future probability assuming current risk and vulnerability factors remain
somewhat constant. For the purposes of the current estimate, no current data clearly
indicates otherwise. As such, the probability of occurrence is Low because the CPSU –
San Luis Obispo campus has not experienced hazmat events. That said, hazmat
occurrences are largely based on human error, and any changes in risk and vulnerability
factors such as a decreased vigilance in materials oversight and handling practices or
changes in the amount of chemicals or exposure will likely increase the probability on
campus.

Vulnerability to the Hazard

Hazardous materials pose a risk to the CPSU – San Luis Obispo campus. As identified by
the campus planning committee and on the hazmat map, the following vulnerabilities are

71 Source: 2018 California State Hazard Mitigation Plan, section 9.2.
present on campus: chemical and biological materials are present in the science lab, and both a rail line runs and a gas pipeline are extremely close to the campus footprint. Gases, chemicals or biological materials, if spilled or released, could severely impact human health and campus operations.

Although it is quite difficult to produce a quantitative measure of vulnerability because (unlike natural hazards) the probability of occurrence is dependent on human error, which itself is variable based upon a fluctuating set of interrelated factors, some of which lack prediction or control, given the complexity of how all natural and built environments and hazmat risks factors interrelate at the local or campus level, it is prudent to assume for planning purposes that the campus’ vulnerability is a sub-set of the larger community’s vulnerability. As such, the CPSU – San Luis Obispo leadership maintains vigilance to mitigate the campus’ vulnerabilities identified above at a minimum.

Estimate of Potential Losses

As discussed previously, it is difficult if not impossible to produce an accurate quantitative measure of vulnerability because of the variable nature of a hazardous materials spill. For example, the release of a toxic airborne chemical in a populated area has severe impact potential, whereas the impact potential of a small chemical spill in a remote or rural area is most likely limited to remediation of soil. And, in both cases, the probability of occurrence is dependent on human error, which itself is variable based upon a fluctuating set of interrelated factors, some of which lack prediction or control. In all cases, different types and amounts of hazardous materials interact with fluctuating combinations of human error to produce different event outcomes with variable impact costs.

Vulnerability Assessment Conclusions

It is well understood that with regards to hazmat vulnerability, each campus and its surrounding community (including CPSU – San Luis Obispo) operates through a complex and dynamic interaction between industrial and commercial inputs and outputs and the natural and built environment. Such activity produces hazardous materials that move through the environment along both convergent and divergent routes and across all levels of land-use from site to campus to city and county and beyond. It is also clear from a review of the San Luis Obispo County hazard mitigation plan and Cal OES’ records of hazardous material spills, that such events occur with great frequency and varying degrees of severity across jurisdictions statewide. As such, in assessing the vulnerability of the CPSU – San Luis Obispo campus, campus-level risks and vulnerabilities are not discreet or isolated but can become exacerbated or augmented through connections to broader community-level hazmat risks and vulnerabilities.

Finally, in order to draw conclusions on vulnerability, it should be noted that any identified vulnerabilities at the campus level and/or community level are circumscribed and potentially reduced by targeted policy and program interventions. Numerous policies and programs have been established in recent years in response to California’s widespread and complex and integrated hazardous materials risks - California established
the Unified Program which consolidates and integrates the administrative requirements, permits, inspections, and enforcement activities of the following environmental and emergency response programs: the Aboveground Petroleum Storage Act (APSA) Program, Area Plans for Hazardous Materials Emergencies, the California Accidental Release Prevention (CalARP) Program, the Hazardous Materials Release Response Plans and Inventories (Business Plans), Hazardous Material Management Plan (HMMP) and Hazardous Material Inventory Statement (HMIS) requirements (California Fire Code), the Hazardous Waste Generator and Onsite Hazardous Waste Treatment (tiered permitting) Programs, and the Underground Storage Tank Program.

**Identified Data Limitations**

The Cal Poly San Luis Obispo planning committee has provided information on campus-level hazmat materials and risks. Data limitations pertain to a comprehensive understanding of human activity and error related to materials control over the long term.

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**Landslide**

**Description of the Hazard**

A landslide is a down-slope movement of soil, rock, or other debris, and can also be referred to as a mass movement or slope failure. These geological hazards can range in size from a few feet to over a mile in length and width and, when heavy and rapidly moving, can cause serious damage and loss of life.

Landslides are classified based on the type of material and type of movement involved. They can range from slow-moving earth flows to fast-moving debris flows, though many large slope failures involve more than one type of movement. The primary natural triggers of slope failures are water, seismic activity, and volcanic activity. Slope saturation by water can occur from intense rainfall, snowmelt, changes in ground-water levels, and surface-water level changes along coastlines. In winter months, El Nino storms or other high rainfall events may saturate soils and trigger slope failure.

**Deep-Seated Landslides**

Deep-seated landslides, ranging in depth from ten to several hundred feet, occur as a result of geologic and hydraulic changes, such as earthquakes or increased levels of groundwater. These landslides can move slowly or quickly and can cause extensive property damage, but rarely result in loss of life.

**Debris Flows Related to Shallow Landslides**

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Shallow landslides may mobilize into rapidly moving debris flows and typically occur after sudden saturation of the ground. These types of debris flows are typically more dangerous because they move rapidly, causing both property damage and loss of life.

Debris flows may also occur as a result of post-fire conditions, where wildfires have left barren ground exposed to heavy rainfall. Intense rainfall, generally greater than .5 inch per hour, has the potential to trigger a post-fire debris flow. These landslides may impact lives and properties within the deposition zone and can result in downstream flooding. Post-fire debris flows often occur during the fall and winter following major summer fires.
Location of the Hazard

The susceptibility of an area to landslides depends on several variables, including magnitude of slope gradients, water content, ground cover, presence of erosion, and slope material and structure. However, landslides are most prevalent in terrain with weak material and steep slopes, and the highest risk is found in areas with high rainfall or high earthquake potential. Slope failures are also most likely to occur in areas where they have occurred in the past. In California, the most landslide-prone areas are found along the coast and in the northern Franciscan Formation.

General landslide vulnerability can be estimated from the distribution of weak rocks and steep slopes as seen in Figure 23-14. Based on the Figure below, the campus is connected to, and surrounded by areas highly susceptible to landslide.

Figure 23-14: Deep-Seated Landslide Susceptibility Surrounding Cal Poly SLO 73

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Extent of the Hazard

Landslide events occur frequently outside of the City of San Luis Obispo, particularly along the steep slopes and coastal mountain areas. Only small landslides along unstable slopes saturated during prolonged or intense rain have occurred within the city. However, the indirect impacts of landslides in the region may cover a larger geographical extent. Based on the campus’ close proximity to the landslide hazard zone, and the history of occurrence on campus, the planning committee ranks the extent of the landslide hazard for the campus as **Moderate to High**.

History of the Hazard

The largest landslide events in the County have been associated with severe winter storms and strong El Nino events. FEMA has declared eight major disasters that included landslides, mudslides, or mud flows since 1978 in San Luis Obispo County, all of which were a result of flooding or storms.

In 2017, Fremont Hall, a dormitory on the Cal Poly SLO campus, was evacuated and closed as a result of encroaching landslide debris on a hillside east of the dormitory. The Hall remains closed.

Potential Impacts of the Hazard

CSU San Luis Obispo may be impacted by the disruption of services as a result of landslides in the region. Landslides can result in physical damage to buildings and property and have the potential to significantly effect infrastructure. As a landslide moves, it distresses structural foundations by settlement, cracking, and tilting. Fast-moving flows can remove entire structures in one instance, while other types of flows can cause damage gradually.

Transportation and utility infrastructure are particularly vulnerable to landslides, since the failure of any component can disrupt service over a large area. The loss of power and communication and disruption of transportation can have cascading effects throughout an area, including impaired disposal of sewage, contamination of water supplies, and the release of flammable fuels. Transportation routes are also often expensive to clean up, and prolonged obstruction can disrupt the movement of people and goods for long periods of time.

Probability of Future Occurrence of the Hazard

Slope failures are often triggered by other natural hazards such as heavy rainfall and earthquakes, so landslide frequency is often related to the frequency of these other hazards. As climate change impacts the frequency and intensity of triggers such as rain events, fires, and coastal erosion, landslides may generally occur more often. Historically,
landslides have occurred consistently in San Luis Obispo County and therefore are likely to occur in the future. San Luis Obispo is considered prone to deep-seated, slow-moving landslides. Given the location of the campus connected to, and surrounded by landslide susceptibility zones, and the past occurrence n campus, the planning committee ranks the probability of the landslide hazard for the campus as Possible.

Vulnerability to the Hazard

The City of San Luis Obispo is vulnerable to slope instability, especially after prolonged rainfalls. Approximately 30% of the City’s total population and seven critical facilities are exposed to high and moderate landslides. The severity is limited with limited potential impacts.

The vulnerability of the built environment to landslides depends on exposure and is more likely to incur damage as a result of proximity, rather than inferior structural design. The structures most vulnerable to landslides are buildings and utility/transportation lifelines, which can be impacted by either impact or ground deformation. Utilities and transportation infrastructure are particularly vulnerable, due to their geographic extent and susceptibility to physical distress. Any population proximal to a landslide when it occurs is vulnerable to its impacts. The campus exhibits population, building and infrastructure vulnerabilities to some degree, as well as vulnerable campus access routes. See the landslide location map in relation to the campus along with landslide severity zones identified.

Estimate of Potential Losses

There are no current models for estimating potential losses from a landslide directly impacting the campus.

Although the economic impact of landslide damage can exceed that of the direct repair costs, there are currently no applicable methods for estimating indirect costs related to Cal Poly San Luis Obispo.

Vulnerability Assessment Conclusions

Community exposure to landslides varies depending on their physical locations – whether in flat plains or on steep hillsides – and on their dependence on critical infrastructure located in landslide hazard zones.

Landslides could impact the campus in a variety of ways, primarily related to indirect impacts to transportation and utilities. Utility outages can impact health, particularly for vulnerable populations, and can cause interruptions in operations. Interruptions may

74 City of San Luis Obispo. Retrieved 2/9/21 from https://www.slocity.org/home/showdocument?id=60
impact student and employee’s ability to travel to campus and the delivery of classes and events.

**Identified Data Limitations**

The ability to predict future landslides at the Cal Poly San Luis Obispo campus is limited. However, the USGS estimates that climate change-induced shifts in weather will increase the frequency of post-wildfire landslides, which are expected to occur almost every year in California.

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**Power Outage**

**Description of the Hazard**

San Luis Obispo, California is a city and county along the Central Coast of California. San Luis Obispo County is approximately 190 miles north of San Luis Obispo County and 230 miles south of San Francisco. San Luis Obispo is located along one of the country’s largest highways, US Route 101. It should be noted that San Luis Obispo is a seismically active area; there are a number of nearby faults including the San Andreas Fault. The Nine Sisters are a string of hills that partially run through San Luis Obispo. They are geologically noteworthy for being volcanic plugs.

Most aspects of modern life, and almost all aspects of urban life, rely on the availability of reliable utilities, such as electricity, water, and natural gas. An interruption in the supply or distribution of these commodities can leave highly populated areas like San Luis Obispo without basic services, such as electricity or sanitation. These interruptions can be cascading effects from other hazard events, such as windstorms, floods, wildfires and earthquakes, or they can be caused by intentional disruptions of transmission lines.

A power outage event can interrupt day-to-day operations of the Cal Poly San Luis Obispo (SLO) campus, like in-person classes, impede or limit digital, telephonic or radio communications, create traffic jams around the busy avenues and boulevards surrounding the campus, close the student health center, and close restaurants around campus and outside the campus. Additionally, thousands of Cal Poly SLO student residents in on-campus housing would also be affected by a power outage on campus and in the area.

Additionally, a severe outage to the City of San Luis Obispo or to San Luis Obispo County would also directly affect the campus and the community.

Electric power disruptions and outages fall into two categories: intentional and unintentional.

The four types of **intentional** disruptions are:

- Planned: Some disruptions are intentional and can be scheduled based on maintenance or upgrading needs.
- Unscheduled: Some intentional disruptions must be done "on the spot" in response to an emergency.

- Demand-Side Management: Some customers (i.e., on the demand side) have entered into an agreement with their utility provider to curtail their demand for electricity during periods of peak system loads.

- Load Shedding: When the power system is under extreme stress due to heavy demand and/or failure of critical components, it is sometimes necessary to intentionally interrupt the service to selected customers to prevent the entire system from collapsing. These intentional interruptions result in rolling blackouts.

**Unintentional** or unplanned disruptions are outages that come with essentially no advance notice or warning. This type of disruption is the most problematic. The following are categories of unplanned disruptions:

- Accident by the utility, utility contractor, or others.
- Malfunction or equipment failure.
- Equipment overload (utility company or customer).
- Reduced capability (equipment that cannot operate within its design criteria).
- Tree contact other than from storms.
- Vandalism or intentional damage.
- Weather, including lightning, wind, earthquake, flood, and broken tree limbs taking down power lines.
- Wildfire that damages transmission lines.

**Location of the Hazard**

Although power outages can take place within a certain area, it has the potential to affect the entire planning area equally.

**Extent of the Hazard**

In order to anticipate outage conditions and reduce impacts, campus facility managers and others keep track of conditions and data provided by the media, municipal utilities and the California Independent System Operator (CAISO). CAISO is tasked with managing the power distribution grid that supplies most of California, except in areas served by municipal utilities and is thus the entity that coordinates statewide flow of electrical supply. CAISO uses a series of stage alerts to the media based on system conditions. The alerts are:

- Stage 1 - reserve margin falls below 7 percent.
- Stage 2 - reserve margin falls below 5 percent.
- Stage 3 - reserve margin falls below 1.5 percent.
Rotating blackouts become a possibility when Stage 3 is reached. Utility agencies aim to advise affected areas approximately 48 hours in advance of a potential PSPS event and will attempt notification again approximately 24 hours before power is shut off. Campus staff respond accordingly.

Given the prevalence of rolling blackouts and other power outages in California, the campus maintains safety precautions, situational awareness, access to emergency power generators and other protocols for managing campus power outages. Given that recorded outages have taken place on campus, the planning committee ranks the extent of the power outage hazard as Moderate.

History of the Hazard

Cal Poly San Luis Obispo reported regularly experiencing power outages in recent years due to Public Safety Power Shut-Offs. When the campus experiences a power outage, some contingent strategies are implemented (e.g., transitioning to virtual classes).

Potential Impacts of the Hazard

Instructors, campus residents, staff and administration rely on electricity for basic survival and operations. During a widespread power failure, it may take anywhere from several hours to days to restore operations if a significant event occurs. Electrical power may be the only cooling source for many individuals around the campus and its community, and long-term outages can potentially put people’s health and life at risk. Disruptions in the supply of heating fuel may put people and property at risk during extremely cold weather if it relies on electric generation or heating mechanisms instead of gas. Additionally, many medical devices, communications devices, and security rely on power to maintain their functions.

Climate Change and Energy Shortage

Climate change is expected to bring more frequent and intense natural disasters. These changes have created a variability at a rate that makes historical data a poor predictor of future climate. For example, the warmest years on record in California occurred in 2014, 2015, and 2016. The 2016 - 2017 year broke the record as the wettest ever recorded in the northern Sierra Nevada Mountains. Changes in temperatures, precipitation patterns, extreme events, and sea-level rise have the potential to decrease the efficiency of thermal power plants and substations, decrease the capacity of transmission lines, render hydropower less reliable, spur an increase in electricity demand, and put energy infrastructure at risk of flooding.

With climate warming, higher costs from increased demand for cooling in the summer are expected to outweigh the decreases in heating costs in the cooler seasons. Hotter temperatures in California will mean more energy (typically measured in “cooling-degree days”) needed to cool homes and businesses both during heat waves and on a daily basis, during the daytime peak of the diurnal temperature cycle. During future heat waves, historically cooler coastal cities (e.g., San Francisco and Los Angeles) are
projected to experience greater relative increases in temperature, such that areas that never before relied on air conditioning will experience new cooling demands.

Secondary impacts of energy shortages are most often felt by vulnerable populations. For example, those who rely on electric power for life-saving medical equipment, such as respirators, are extremely vulnerable to power outages. Also, during periods of extreme heat emergencies, the elderly and the very young are more vulnerable to the loss of cooling systems requiring power sources.

**Probability of Future Occurrence of the Hazard**

The probability of California experiencing a power outage can be difficult to quantify but is a hazard that occurs annually during the same seasonal periods of temperature variance throughout the calendar year. The City of San Luis Obispo and San Luis Obispo County experience such outages. As such, the probability ranking for the San Luis Obispo area is **Likely**. Since the Cal Poly SLO campus has recorded power outages, it is prudent to assign this same ranking for the campus.

Climate models suggest summer global temperatures are likely to increase while changes between temperature extremes would be more pronounced. As such, it is expected that power outages will occur more frequently in the future.

**Vulnerability to the Hazard**

Based on the data available, and in consideration of the increasing effects of climate change, the probability of future occurrences prompting intentional outages and creating unintentional power outages the hazard is high for the county in different areas but not specifically influencing the Cal State San Luis Obispo. Nonetheless, as discussed, campus leadership works to reduce vulnerabilities through consistent use of safety and operational protocols and emergency power sources to ensure it is able to mitigate an interruption to electrical power.

**Estimate of Potential Losses**

The data provided by Cal Poly San Luis Obispo does not report any value for potential losses due to power outage.

**Vulnerability Assessment Conclusions**

Elevators, entry ways, air filtration systems and lighting provide the campus community with the necessary infrastructure and systems to function and navigate through the campus and to maintain a safe campus environment and visibility during nighttime hours. The primary concern for campus leadership is that a loss of power can lead to potential hazards to students, faculty, and staff at Cal Poly San Luis Obispo. Vulnerable populations (especially students with physical disabilities) may be the most heavily affected by loss of power, as they rely on elevators, entry ways with automatic doors, and locks and lights; a power outage would impede a disabled student’s ability to travel and utilize the campus and its structures safely.
The use of communication devices, billing, records, and electrical tools may also become unusable due to a loss of electricity. Many records and billing items may have to revert to “by-hand” procedures and paper copies may have to be kept continuing operations. Additionally, classrooms may not be usable if lighting equipment is not functioning impacting a semester or quarter’s progress for the academic year.

Identified Data Limitations

Cal Poly San Luis Obispo did not report any monetary or life losses due to a power outage. Also, the campus did not report any incidents involving a power outage directly affecting the campus community and operations.
**Volcano (Associated Air Quality)**

**Description of the Hazard**

The US Geological Service defines volcanoes as “openings or vents where lava, tephra (small rocks), and steam erupt on to the Earth’s surface. Through a series of cracks within and beneath the volcano, the vent connects to one or more linked storage areas of molten or partially molten rock (magma). This connection to fresh magma allows the volcano to erupt over and over again in the same location”. 75

A volcanic eruption occurs when magma, lighter than surrounding rock, is driven upwards by its buoyancy and by pressure from the dissolved gases contained within it. Gases are released from magma as it reaches the surface and pressure decreases. Magma can be erupted in several ways and violent eruptions typically cause tiny pieces of tephra (ash) to be carried away by the wind. This ash is hard, does not dissolve in water, is extremely abrasive and mildly corrosive, and conducts electricity when wet.\(^2\)

The gases released in an eruption include carbon dioxide, sulfur dioxide, hydrogen sulfide, and hydrogen halides. Depending on their concentration, these are potentially hazardous to people, animals, agriculture, and property.

**Location of the Hazard**

There are eight volcanic areas located throughout California. Seven of these - Medicine Lake Volcano, Mount Shasta, Lassen Volcanic Center, Clear Lake Volcanic Field, Long Valley Volcanic Region, Coso Volcanic Field, and Salton Buttes – are considered active volcanoes. No portion of Cal Poly San Luis Obispo or San Luis Obispo County is located within a volcano hazard zone.

**Extent of the Hazard**

Volcanic hazards are most severe within a few miles of the volcano vent and the severity generally decreases with distance. Ash impact zones can range from tens to hundreds of miles from the vent source. The US Geological Survey has estimated zones surrounding active volcanoes wherein 2 inches or more of ashfall following an eruption is possible. While Cal Poly San Luis Obispo does not fall within an estimated ashfall zone, lighter dustings of ash outside of those areas may directly or indirectly impact the campus. As such, the planning committee ranks the extent of the hazard for the campus as **Low**.

The dashed lines in Figure 23-15 enclose areas where two inches or more of ashfall are possible. However, it should be noted that hazard maps are dynamic and updated periodically as research adds new information.

History of the Hazard
No historical eruption events in California have affected the campus. Over the last 1,000 years, there have been at least 12 eruptions in California.11 The most recent volcanic eruption in California occurred at Lassen Peak about 100 years ago, when a major explosion delivered windborne ash over 275 miles away.

Potential Impacts of the Hazard
The specific impacts vary widely and depend on which type of volcano erupts, the style of explosion, the volume of lava, the eruption duration, and the local water conditions. As

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Cal Poly San Luis Obispo is not proximal to an active volcano, only the potential impacts of ashfall and gases have been detailed. While both these hazards can be widespread, their most severe impacts are generally seen closer to the volcanic source.

Although ashfall is typically a nonlethal volcanic hazard, it is the most widespread and disruptive. Falling ash can damage crops, electronics, and machinery. It can also impact human health by irritating the respiratory tract, eyes, and skin. The particles may enter drinking water and structures and may cause structure failure if it is thick and heavy enough. Even a fine layer of ash can disrupt utilities. A portion of California’s major electric transmission lines, aerial telecommunication lifelines, transportation corridors, and water storage and conveyance lie within the state’s volcano hazard zones. Impacts to any of these can impact operations at Cal Poly San Luis Obispo.

The potential impacts of gases released during volcanic eruptions are as follows:

- Carbon dioxide typically becomes diluted very quickly and is not life threatening. However, it can become trapped in higher concentrations in low-lying areas and has the potential to be fatal.
- Sulfur dioxide can cause acid rain and air pollution downwind of a volcano.
- Hydrogen sulfide can cause irritation of the upper respiratory tract. At high concentrations it can cause unconsciousness and death.
- Hydrogen halides can coat ash particles and, once deposited, poison drinking water, agricultural crops, and grazing land.

**Probability of Future Occurrence of the Hazard**

The US Geological Survey, based on the record of volcanic activity in California, estimates that the probability of another small- to moderate-sized eruption in the next thirty years is about 16 percent. As such, the annual probability of future occurrence for the campus is ranked by the committee as *Unlikely*.

**Vulnerability to the Hazard**

Populations living near volcanoes are the most vulnerable to eruptions and lava flows. However, volcanic ash can travel and affect populations miles away. The location and thickness of ash in any given area is a function of the severity of the eruption and wind speed and direction. For Cal Poly San Luis Obispo, there is low vulnerability to the immediate impacts of volcanic eruptions due to the limited area affected and remote potential of an eruption. In the event of a widespread ashfall event, the elderly, infants, and populations with existing respiratory disease will be at higher risk.

**Estimate of Potential Losses**

Impacts to critical infrastructure, agriculture, and property from ashfall have the potential to cause widespread disruption, damage, and economic loss throughout the state. In the event of a widespread ashfall event, impacts will be immediate.

Current modeling is not precise enough to allow for an assessment of potential losses from ashfall to structures or infrastructure on or surrounding the campus.
Vulnerability Assessment Conclusions
Cal Poly San Luis Obispo is unlikely to experience the direct impacts of a volcanic event. While the campus may be indirectly impacted by ashfall elsewhere in the state, direct ashfall impacts are generally unlikely but possible in a widespread event. However, the likelihood of any volcanic eruption in the state impacting the campus is very low.

Identified Data Limitations
Not all active volcanoes in California have been zoned for hazards by the US Geological Survey. This, together with the infrequent occurrence of volcanic explosions and number of factors determining type and extent of impacts, make the quantification of potential loss difficult.

Wildfire

Description of the Hazard
While wildfires are a natural part of California’s ecosystem, wildfires in California represent a hazard that presents one of the greatest probabilities of destruction along with a demonstrated history of catastrophic fire events in recent years. The destructive fire seasons of 2017 to 2020 illustrated the destructive forces fire presents to communities across the state. Wildfires may result in the structural loss, infrastructure loss, dangerous air quality, environmental damages, economic impacts, injuries, and loss of life. In many communities throughout California, wildfire presents greatest risk to human life and property.

Wildfires have been defined as any free burning vegetation fire that initiates from an unplanned ignition, whether natural or human caused demanding fire suppression actions to contain. These fires are prone to become uncontrolled, spreading through vegetative fuels rapidly exposing people and structures to harm. Wildfires present a significant risk to communities across the state, as evidenced by increasing trends of structural losses from wildland fires. This risk is elevated in areas where development and community growth has intersected, also known as the wildland-urban interface (WUI). In the interface setting, development itself can provide additional fuel for large fires. Recent fires have also demonstrated the ability of fire to consume populated areas in extreme conditions.

California’s Mediterranean climate in combination with its geography and vast population create a combination of factors that promotes an optimal environment for large fire growth and consequences. As there is great diversity of geographic characteristics across the state, the risks and potential consequences of wildfire must be assessed locally. The physical location, weather patterns, local fuel types and volume, extent of the WUI, topography, and additional factors will factor differently from part of the state to another.

77 State of California Hazard Mitigation Plan, September 2018
The behavior of wildfires in California is significantly influenced by three distinct geographic factors. These factors will help shape the size, direction of spread, rate of combustion, fire intensity, and ability to pre-heat fuels. The physical factors contributing to wildfire behavior include:

- **Topography** – The rate in which wildfires spread increases with greater slopes in topography. The greater the slope will result in more pre-heating of fuel above the advancing fire. The direction that a slope faces will also influence fire behavior as south facing slopes receive greater solar radiation and thus drier vegetation that is more susceptible to combustion. Ridgetops often denote the end of fire spread as fire has greater difficulty spreading downhill.

- **Weather** – Weather factors substantially influence the behavior of wildfires. Wind, temperature, humidity, lightning, and lack of precipitation all contribute to a fire’s ability or inability to spread and intensify. California routinely experiences conditions in which these factors are in alignment to contribute to extreme fire behavior during the summer and fall seasons. High winds, low humidity, and high temperatures provide an environment promoting extreme fire activity.

- **Fuels** – Certain types of vegetation are increasingly prone to igniting and promote more intense burning. Areas with greater “fuel loading” (amount of fuel present in terms of weight of fuel per unit of area) increases the amount of fuel to fuel a fire. Greater volumes of dead or dry vegetation compared to live plants is a critical factor. Vegetation during drought conditions will experience decrease in moisture content increasing the conditions for combustion. Fuels close proximity to one another allows for rapid spread through contact or radiant exposures.

A risk assessment for wildfires should be implemented within a geospatial context focusing on the specific location features and incorporates the three components of the wildfire risk triangle – likelihood, intensity, and susceptibility.

**Location of the Hazard**

Substantial portions of the State of California are exceptionally vulnerable to wildfire activity or reside in a wildland-urban interface (WUI) area due to the vast open spaces, rangelands, forests, and other lands with high susceptibility to fire occurring throughout the state. Cal Poly San Luis Obispo is located at the base of the Santa Lucia Range. Areas considered to be within Fire Hazard Severity Zones defined by the Fire and Resource Assessment Program (FRAP) within the California Department of Forestry and Fire Protection (CalFire) occur to the west, east, and north of the campus. Additionally, these fire hazard zones exist in other areas throughout San Luis Obispo County. These areas of higher fire hazards occur extensively throughout the county. Each of these hazard zones include moderate to heavy vegetation and are bordered by residential development.

The Cal Poly San Luis Obispo campus is located in central San Luis Obispo County immediately north of the City of San Luis Obispo. The area immediately to the south of the campus is residential neighborhoods. The areas of higher fire hazard bordering the
San Luis Obispo County has multiple areas considered as fire hazard zones that present direct threats of burning potential in areas that are in proximity to those hazard areas.

78 California Department of Forestry and Fire Protection, Fire and Resource Assessment Program, Fire Hazard Severity Zone Viewer, https://egis.fire.ca.gov/FHSZ/
Fire Hazards Zones surrounding San Luis Obispo County demonstrate the broader community threat that wildfires present to the population. Fire hazard severity zones are found surrounding the populated areas of the county.

Figure 23-17: Fire Hazard Severity Zone Viewer, San Luis Obispo County

Extent of the Hazard

While the threat to fire directly affecting the campus is considerable, the direct effect of fire generated smoke is also likely to occur. fires are likely to occur in close proximity to the campus generating smoke that could envelop the campus in the right atmospheric conditions. Fires that are large enough to generate volumes of smoke to cover great distances have the potential to affect the air quality of the San Francisco Bay Area including the campus. This will especially be the case in weather conditions creating strong offshore winds. The potential for this impact has been demonstrated during the summers of 2018, 2019, and 2020 as fires burned across the state and spread smoke over vast distances. Fires burning well outside of the San Luis Obispo County region have the potential to distribute smoke onto the Cal Poly San Luis Obispo (SLO) campus.

Given that the area immediately surrounding the Cal Poly SLO campus is in proximity to fire hazard zones designated as High Fire Hazard Severity Zones (HFHSZ), and that the
County and surrounding hillsides are considered to be of high fire threat including Very High Fire Hazard Severity Zones (VHFHSZ), the planning committee ranks the extent of the wildfire hazard for the campus as **High**.

Moreover, as a large number of wildfires are ignited due to human caused factors, the ability to determine when or where a wildfire might occur is impossible. Only the conditions for a wildfire can be predicted with any accuracy.

The National Fire Danger Rating System (NFDRS) is the current system in use for rating and classifying the potential danger of fire. The NFDRS tracks the effects of previous weather events on both dead and live fuel loads and adjusts accordingly based on future or predicted weather conditions. These complex relationships and equations are computed, and the outputs are expressed in terms that users can quickly and easily understand. The current NFDRS is used by all federal and most state agencies to assess fire danger conditions.

The following table depicts the NFDRS, from the US Forest Service’s Wildland Fire Assessment System.

Table 23-24: National Fire Danger Rating System

<table>
<thead>
<tr>
<th>Rating</th>
<th>Basic Description</th>
<th>Detailed Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>CLASS 1: Low Danger (L)</strong></td>
<td>Fires not easily started</td>
<td>Fuels do not ignite readily from small firebrands. Fires in open or cured grassland may burn freely a few hours after rain, but wood fires spread slowly by creeping or smoldering and burn in irregular fingers. There is little danger of spotting.</td>
</tr>
<tr>
<td><strong>COLOR CODE:</strong> Green</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>CLASS 2: Moderate Danger (M)</strong></td>
<td>Fires start easily and spread at a moderate rate</td>
<td>Fires can start from most accidental causes. Fires in open cured grassland will burn briskly and spread rapidly on windy days. Woods fires spread slowly to moderately fast. The average fire is of moderate intensity, although heavy concentrations of fuel -- especially draped fuel -- may burn hot. Short-distance spotting may occur but is not persistent. Fires are not likely to become serious and control is relatively easy.</td>
</tr>
<tr>
<td><strong>COLOR CODE:</strong> Blue</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>CLASS 3: High Danger (H)</strong></td>
<td>Fires start easily and spread at a rapid rate</td>
<td>All fine dead fuels ignite readily, and fires start easily from most causes. Unattended brush and campfires are likely to escape. Fires spread rapidly and short-distance spotting is common.</td>
</tr>
<tr>
<td><strong>COLOR CODE:</strong> Yellow</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

High intensity burning may develop on slopes or in concentrations of fine fuel. Fires may become serious and their control difficult, unless they are hit hard and fast while small.

<table>
<thead>
<tr>
<th>CLASS 4: Very High Danger (VH)</th>
<th>Fires start very easily and spread at a very fast rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>COLOR CODE: Orange</td>
<td>Fires start easily from all causes and immediately after ignition, spread rapidly and increase quickly in intensity. Spot fires are a constant danger. Fires burning in light fuels may quickly develop high-intensity characteristics - such as long-distance spotting - and fire whirlwinds when they burn into heavier fuels. Direct attack at the head of such fires is rarely possible after they have been burning more than a few minutes.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>CLASS 5: Extreme (E)</th>
<th>Fire situation is explosive and can result in extensive property damage</th>
</tr>
</thead>
<tbody>
<tr>
<td>COLOR CODE: Red</td>
<td>Fires under extreme conditions start quickly, spread furiously, and burn intensely. All fires are potentially serious. Development into high intensity burning will usually be faster and occur from smaller fires than in the Very High Danger class (4). Direct attack is rarely possible and may be dangerous, except immediately after ignition. Fires that develop headway in heavy slash or in conifer stands may be unmanageable while the extreme burning condition lasts. Under these conditions, the only effective and safe control action is on the flanks, until the weather changes or the fuel supply lessens.</td>
</tr>
</tbody>
</table>

Due to the impacts of wildfires on public health, agencies across the nation have adopted the use of the Air Quality Index (AQI) to communicate and provide a consistent approach to air quality measurements and categorization. The AQI primarily focuses on the health effects caused by pollutants in the air such as smoke. The goal of the AQI is to provide advisories to assist the public in determining when to reduce exposures to inhalation of air pollution as pollution levels rise.
History of the Hazard

The State of California has a long history of chronic and destructive wildfires throughout the state. On average, 8,300 wildfires have caused burnt 928,245 acres across the state over the 20-year period between 2000 and 2020.80 San Luis Obispo County also has a long history of wildfire activity primarily in the foothills and mountains throughout the county. Wildfires occurring in San Luis Obispo County have resulted in thousands of acres burned and millions of dollars in damages.

The area immediately surrounding the Cal Poly San Luis Obispo campus is in proximity to fire hazard zones designated as High Fire Hazard Severity Zones (HFHSZ). Additionally, the County is surrounded by areas that are considered to be of high fire threat that would produce vast quantities of smoke and particulates into the air. The Cal Poly San Luis Obispo campus has experienced multiple days of poor air quality due to fires burning in Central California and neighboring counties. The 2017, 2018, and 2020 fire seasons in particular illustrated the increase in wildfire generated smoke saturating the air of communities throughout the state including the Central Coast. Cal Poly San Luis Obispo personnel reported the ongoing development of policies and procedures to address the response to poor air quality days.

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80 California Department of Forestry and Fire Protection, Stats and Events, https://www.fire.ca.gov/stats-events/
Table 23-25: Historic San Luis Obispo County Large-Scale Fires

<table>
<thead>
<tr>
<th>Date</th>
<th>Fire</th>
<th>Declaration</th>
<th>Damages</th>
</tr>
</thead>
<tbody>
<tr>
<td>7/1960</td>
<td>Weferling</td>
<td>NA</td>
<td>51,451 acres</td>
</tr>
<tr>
<td>9/1970</td>
<td>Buckeye</td>
<td>NA</td>
<td>42,307 acres</td>
</tr>
<tr>
<td>7/1985</td>
<td>Las Pilitas</td>
<td>DR-739-CA</td>
<td>84,271 acres, 10 structures</td>
</tr>
<tr>
<td>8/1994</td>
<td>Highway 41 Fire</td>
<td>NA</td>
<td>50,729 acres, 103 structures</td>
</tr>
<tr>
<td>8/1996</td>
<td>Highway 58 Fire</td>
<td>NA</td>
<td>106,969 acres, Numerous structures</td>
</tr>
<tr>
<td>8/1997</td>
<td>Logan</td>
<td>NA</td>
<td>49,490 acres</td>
</tr>
<tr>
<td>8/2016</td>
<td>Chimney</td>
<td>FM-5146-CA</td>
<td>46,344 acres, 70 structures</td>
</tr>
<tr>
<td>7/2017</td>
<td>Alamo</td>
<td>NA</td>
<td>28,834 acres, 14 structures</td>
</tr>
</tbody>
</table>

Fire has contributed significantly to San Luis Obispo County’s hazard and disaster history. Particular fires have shaped the way fire plays into preparedness, planning, response, recovery, and mitigation.

Potential Impacts of the Hazard

The location of the Cal Poly San Luis Obispo campus surrounded by areas designated as High or Very High Fire Hazard Severity Zones places a threat of flame, ember, and smoke exposure from wildfire to the campus. There is potential for fire to occur on three sides of the campus and in the surrounding hillsides composed of light to moderate fuels. The threat of these neighboring hillsides to campus structures is substantial.

Potential impacts to the campus community resulting from wildfires include:

- Injuries or loss of life
- Campus property destruction of damage
- Residential property destruction or damage
- Damage to residence halls located along borders of campus
- Commercial property destruction or damage
- Loss of property contents
- Infrastructure damage
- Damaged or disrupted transportation, lifelines, and supply routes
- Isolation from areas outside of San Luis Obispo
- Damaged or destroyed utilities

81 San Luis Obispo County Local Hazard Mitigation Plan, October 2019
- Damaged or destroyed critical facilities supporting campus emergency support needs
- Potential for community wide evacuation
- Loss of community economic base
- Employment losses
- Loss to ground supporting vegetation on hillsides resulting in erosion or landslides in future precipitation events
- Agricultural (crops and livestock) damages or destruction
- Threat to Leaning Pine Arboretum
- Evacuation of livestock
- Environmental damage
- Societal and community impacts
- Damage to organizations and facilities providing support services to vulnerable populations
- Greater evacuation challenges for those most vulnerable
- Psychological impacts of impacted populations
- Disruptions to education delivery to community

Potential impacts resulting from wildfire generated smoke include:
- Dangerous levels of air pollution
- Human Health Effects
  - Similar health impacts on pets
- Air conditioning systems overwhelmed
- Greater demands on air filtration systems
- Greater demands on healthcare systems
- Reduced outdoor work productivity
- Closures of academic sessions

Additionally, there remains a number of secondary impacts from wildfires that could affect the campus community. Utilities feeding areas of San Luis Obispo County including the campus may be damaged resulting in power outages. Fire related damage in the watersheds will likely cause future landslides, degradation to plants supporting
hillsides, and impact the hydroelectric power capabilities. Fires may present threats to areas of recreation, scenic value, and wildlife that are a part of the culture of the campus community. Finally, the campus may experience effects of evacuated individuals arriving on campus from other areas as a location of refuge.

Probability of Future Occurrence of the Hazard

Based on the wildfire threat potential in the area surrounding the Cal Poly San Luis Obispo campus and hillsides along the north and east side of the campus and surrounding the City of San Luis Obispo, including the immediate proximity to Fire Hazard Severity Zones listed as “Very High”, the density of residential and commercial development, and the historic occurrences of fires, the annual probability of wildfire related damage on campus is considered Possible.

Based on the wildfire threat potential in the area surrounding Central California including the hills and mountains throughout the region, the volume of areas in elevated Fire Hazard Severity Zones throughout the southern portions of the state, and the historic occurrences of smoke, the probability of wildfire generated smoke impacts to air quality is considered Likely.

Vulnerability to the Hazard

The Cal Poly San Luis Obispo campus is subject to direct impact from wildfire due to the campus location within a wildland-urban interface zone. The campus is identified to reside near a designated local High Fire Hazard Severity Zone. The campus is surrounded on by hillsides and open lands containing combustible vegetation. Additionally, vulnerabilities to the effects of wildfire would lie within the campus community who may reside or work in locations that are exposed to the Fire Hazard Severity Zones in other parts of the surrounding region. Wildfires occurring in other areas of the region may result in the displacement of large numbers of people. These effects may spill onto the campus in the form of evacuees or facility support to emergency resources.

Fire directly threatening the campus would likely take the form of vegetation fires along the hillsides and extending onto the campus or localized fires involving single structures or small areas. Smaller vegetation fires are possible surrounding the campus in the urban forest or fields surrounding the city. These incidents would likely have significant impact to the campus.

The primary basis of vulnerability is based on the population affected and the built environment exposed. In general, newer construction will be more fire resistant than older buildings as building and fire codes and construction technology have improved. Density of buildings and proximity of fuels to buildings or equipment at risk of combustion would additionally influence the fire’s ability to spread to structures. Structures with vegetation and other combustibles near the structure increases the ability of fire to spread to buildings.
Access to the north and south using US Highway 101 servicing access to Paso Robles, Monterey, or Santa Barbara could become cutoff during fire incidents. Routes to populated areas are limited primarily to US Highway 101 other routes are smaller roadways that would also likely be impacted by fire making them impassible. The university is limited by these routes for access to and from the campus from out of the immediate area. Access for supplies, equipment, and emergency services in addition to evacuation away from the campus would likely be forced to use alternative routes if available.

The greater concerns regarding vulnerabilities to wildfire are related to the smoke that fires in the area would produce. The past few summers have clearly demonstrated the reality of large wildfires producing enough smoke to fill the local areas even from substantial distances away. These recent fires have displayed how the effects of this smoke impact the general population and especially vulnerable populations. Cal Poly San Luis Obispo students, faculty, and staff both on campus and off campus face these same vulnerabilities related to smoke filled air.

Smoke generated from large wildfires pose a threat in terms of diminished air quality that would be exposed to the population within the area of smoke distribution. Individuals with existing health problems such as respiratory or cardiac illnesses are increasingly vulnerable to wildfire generated smoke. Staff who work in roles requiring outdoor activity will be increasingly exposed during days where the air quality index is considered unhealthy or worse. Student athletes participating in outdoor sports and engaging in aerobic activities are increasingly vulnerable to the effects of wildfire.

The vulnerability to members of the campus community in which wildfire generated smoke on the Cal Poly San Luis Obispo campus will vary depending on when the air quality was to reach unhealthy levels. The risk to the campus population will be lessened during periods when classes are not in session or during periods of breaks. Conversely, during the days and hours that classes are in session and staff are at their workplaces, the human vulnerability increases. However, in region-wide events this vulnerability may be shared with the homes and workplaces of members of the campus community and their families.

Vulnerable populations will likely face disproportionate health safety issues from smoke filled air, experience increased stresses, may require the need to remain away from the campus enclosed at home, and may find difficulty in accessing equipment or supplies to aid in a specific need.

**Estimate of Potential Losses**

Estimates of potential losses will be influenced by a variety of factors. Costs would also be likely to include mitigation or repairs of HVAC systems, sealing of doors and windows, and other methods of keeping smoke from entering buildings. Secondary costs would include lost academic days during campus closures, lost staff on campus productivity, and health and medical interventions for affected members of the campus community.
Based on estimate replacement costs of facilities and structures on campus, the maximum total replacement costs due to wildfire are $660,197,687. However due to the lack of a complete inventory of building and facility costs, the total replacement estimate is likely much higher.

Table 23-26: Wildfire Hazard Potential (WHP) Zone Estimated Losses

<table>
<thead>
<tr>
<th>WHP Zone</th>
<th>No of Buildings</th>
<th>Maximum Replacement Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Extreme</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Very High</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>High</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Moderate</td>
<td>25</td>
<td>Unknown</td>
</tr>
<tr>
<td>Low</td>
<td>13</td>
<td>$3,916,567</td>
</tr>
<tr>
<td>Very Low</td>
<td>0</td>
<td>$379,964,602</td>
</tr>
<tr>
<td>Non Burnable</td>
<td>75</td>
<td>$276,316,518</td>
</tr>
<tr>
<td>No Building Value Data Provided*</td>
<td>46</td>
<td>Unknown</td>
</tr>
</tbody>
</table>

*Buildings with no value defined are also included in the respective Zones they are found in.

Vulnerability Assessment Conclusions

The occurrence of wildfires has been a frequent event in San Luis Obispo County, including wildfire incidents that have threatened or caused damages near the Cal Poly San Luis Obispo campus. The location of the Cal Poly San Luis Obispo campus surrounded by open hillsides with light to moderate vegetative fuels along the entire northern and eastern edges presents a threat of fire to the campus community and campus assets. The foothills and mountains surrounding San Luis Obispo County host environments that are ideal for the development of wildfire activity. The consequences of fires in these areas would present primary and secondary consequences to the Cal Poly San Luis Obispo campus and expose vulnerabilities on the campus and to the campus community.

The topography of the valley surrounded by mountains allows for smoke filled air to linger in the valleys of San Luis Obispo County area with the potential for unhealthy air quality depending on wind conditions. Fires in the watersheds of the nearby mountains and tributaries may damage vegetation stabilizing hillsides and result in increased sediments to be discharged into the river system and reservoirs reducing their capacity and effectiveness. Communities located within or near the Wildland Urban Interface may be subject to damaging fires. These same communities may be home to members of the campus community. The potential for large-scale wildfires in the region further generates the added potential for a number of cascading effects such as disruptions to the local economy, utility failures, disruptions to providing for the needs of the community, and development of public health hazards. The potential for large-scale wildfires and resulting damage of homes and businesses has exponentially powerful impacts on particular
populations among the campus community including those with access or functional needs, international students, the homeless, and students residing in the residence halls.

Identified Data Limitations

Data limitations include missing campus structural replacement costs, and lack of both a complete inventory of building construction types and mitigation efforts to lessen the impact due to fire activity. HAZUS generated analysis is focused on the broader community level versus fine-tuning the analysis to the micro-level for facilities such as a university campus.

**Severe Weather (Wind, Tornado, Hail, and Lightning)**

Description of the Hazard

Severe weather can be described as a variety of weather or climate events that are beyond or near the ends of the range of observed weather patterns and behavior. These events can include high or extreme winds, storms, lightning, hail, tornadoes, heat waves, unusually cold temperatures, extreme rainfall, and flooding. According to the Intergovernmental Panel on Climate Change (IPCC), to be classified as severe (or extreme), the occurrence of each value of a climate or weather variable (e.g., wind, hail, lightning, tornado, etc.) must be “above (or below) a threshold value near the upper (or lower) ends of the range of observed values of the variable.”

Severe weather in California can be generated by local, regional, and/or global weather and climate influences. From the individual thunderstorm to the Santa Ana wind event to the strong El Niño, damaging weather elements that are produced by and accompany severe weather and climate phenomena (e.g., damaging winds, hail, lightning, and tornadoes) occur throughout California and the California State University (CSU) system.

**Global Scale Influences on Severe Weather in California: El Niño, La Niña, and ENSO**

The El Niño-Southern Oscillation (ENSO) is a recurring climate pattern involving changes in the temperature of waters in the central and eastern tropical Pacific Ocean. On periods ranging from about three (3) to seven (7) years, the surface waters across a large swath of the tropical Pacific Ocean warm or cool by anywhere from 1°C to 3°C, compared to...(continued in the next page)
normal. This oscillating warming and cooling pattern, referred to as the ENSO cycle, directly affects rainfall distribution in the tropics and can have a strong influence on weather across the United States and other parts of the world.

El Niño and La Niña are extreme phases of the ENSO cycle, with a third phase occurring between them called the Neutral phase. The El Niño phase is characterized by unusually warm ocean temperatures and weaker-than-normal east winds in the Equatorial Pacific, while the La Niña phase is characterized by unusually cold ocean temperatures and stronger-than-normal east winds in the Equatorial Pacific. Both extreme ENSO phases lead to significant differences from the average ocean temperatures, winds, surface pressure, and rainfall across parts of the tropical Pacific. The Neutral phase indicates that conditions are near their long-term average.

The extreme ENSO phases affect the frequency and intensity of weather events across the world, including in California. On average, areas across California experience exceptionally stormy winters with increased precipitation under El Niño conditions, but experience less stormy and drier winters under La Niña conditions. This variability in storminess and precipitation brought on by El Niño and La Niña events affects the both the frequency and intensity of severe weather conditions experienced by all CSU campuses, including California Polytechnic State University, San Luis Obispo (Cal Poly San Luis Obispo).

Regional Climate Influences on Severe Weather across California

Most of the weather in California is influenced by the wet-winter/ dry-summer Mediterranean climate pattern. In the summer months, Pacific storm tracks are deflected north due to the position of the Pacific High (i.e., a large-scale atmospheric circulation over the Northeast Pacific Ocean), preventing Pacific storms from reaching California. As a result, most summer storms are generated due to the incursion of moist air from the Gulf of Mexico or the Gulf of California, and occur as scattered, locally heavy showers in the desert and mountain regions of the state. In the winter months, the Pacific High decreases in intensity and moves south, permitting powerful Pacific storms to move into and across the state; these storms can produce extreme winds, heavy rains (including “atmospheric river” events), and widespread coastal and inland flooding. (Please see the Flood Hazard profile in this document for information on Floods.) As a result, storm

84 Retrieved on 07.18.2021 from https://www.weather.gov/mhx/ensowhat
86 Retrieved on 07.17.2021 from https://www.climate.gov/news-features/understanding-climate/el-ni%C3%B1o-and-la-ni%C3%B1a-frequently-asked-questions
87 Retrieved on 07.16.2021 from https://www.pmel.noaa.gov/elnino/what-is-el-nino
events accompanied by precipitation in California are far more frequent in the winter months than they are in the summer months.  

While the Mediterranean climate pattern influences the seasonal frequency, intensity, geographic spread, and type of some severe weather events CSU campuses experience (including Cal Poly San Luis Obispo), other severe weather phenomena may occur in California at any time of the year. For example, near the coast and over the Central Valley, there appears to be no defined seasonality to thunderstorms, and these storms are usually light and infrequent. Thunderstorms are more intense and more frequent in the intermediate and higher elevations of the Sierra Nevada, and occur with greater frequency during the summer months.

**Types of Storms in California**

The 2018 California State Hazard Mitigation Plan (SHMP) defines a storm as a violent atmospheric disturbance occurring over land and/or water that is distinguished by its strength, characteristics, and the scale of the resulting damage. The SHMP also lists the following types of storms that produce hazardous conditions and potential damage throughout the state of California. These storms affect (in varying degrees) all CSU campuses, including Cal Poly San Luis Obispo.

- **Thunderstorm**: A rain-bearing cloud that also produces lightning. Thunderstorms can produce some of nature’s most destructive and deadly weather including tornadoes, hail, strong winds, lightning and flooding. Thunderstorms are caused by an atmospheric imbalance from warm unstable air rising rapidly into the atmosphere. Lightning, which occurs during all thunderstorms, can strike anywhere. Thunderstorms can produce some of nature’s most destructive and deadly weather including tornadoes, hail, strong winds, lightning and flooding.  
  
*Severe thunderstorms* are more intense, violent, and dangerous thunderstorms. The National Oceanic and Atmospheric Administration (NOAA) defines a severe thunderstorm as any storm that produces one or more of the following elements: Damaging winds or speeds of 58 mph (50 knots) or greater, hail 1 inch in diameter or larger, and/or a tornado.

- **Hailstorm**: a type of storm that precipitates round chunks of ice. Hailstorms usually occur during regular thunderstorms.

- **Wind storm**: marked by high wind with little or no precipitation.

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89 Retrieved on 07.17.2021 from https://wrcc.dri.edu/Climate/narrative_ca.php
93 Retrieved on 07.15.2021 from https://www.weather.gov/safety/thunderstorm
- **Winter storm**: A storm that can produce a combination of freezing rain, sleet, heavy snow, and/or strong winds.

- **Coastal storm**: large wind-driven waves and/or storm surge that strike the coastal zone.

- **Ice storm**: Ice storms are one of the most dangerous forms of winter storms. When surface temperatures are below freezing, but a thick layer of above-freezing air remains aloft, rain can fall into the freezing layer and freeze upon impact into a glaze of ice. In general, 8 millimeters (0.31 inch) of accumulation is all that is required, especially in combination with breezy conditions, to start downing power lines as well as tree limbs. Ice storms also make unheated road surfaces too slick to drive on. Ice storms can vary in time range from hours to days and can cripple small towns and large urban centers alike.

- **Snowstorm**: A heavy fall of snow accumulating at a rate of more than 5 centimeters (2 inches) per hour that lasts several hours. Snowstorms, especially ones with a high liquid equivalent and breezy conditions, can down tree limbs, cut off power, and paralyze travel over a large region.94

### Severe Weather Hazard Elements: Wind Hazards, Hail, and Lightning

This hazard profile concentrates on the following types of severe weather hazards: **wind hazards** (including tornadoes), **hail**, and **lightning**. These hazards are produced by a variety of weather phenomena, including thunderstorms, coastal storms, winter storms, and topographically-enhanced downslope winds. While storm and downslope wind hazards are responsible for severe weather events across the CSU system, only the wind, tornado, hail, and lightning elements generated by these hazards are covered in this profile. (Storm-related hazards such as flooding and extreme temperatures are covered in other sections of this document.)

#### Wind Hazards

**Wind** is the horizontal movement of air past any given point. Wind begins with differences in air pressures; pressure that is higher at one point than another sets up a force, pushing the high towards the low pressure.95 Wind gusts are defined as “rapid fluctuations in the wind speed with a variation of 10 knots or more between peaks and lulls.” 96

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Wind hazards in California take several forms: High Wind, Strong Winds, Thunderstorm Winds, Mountain-Valley (Downslope) Winds, and Tornadoes. These hazards are encountered across California, and have the potential to cause harm to or loss of life and/or property throughout California and the CSU system (including Cal Poly San Luis Obispo).

**High Winds, Strong Winds, and Thunderstorm Winds**

The National Weather Service reports three (3) types of wind events that occur areas over land: High Winds, Strong Winds, and Thunderstorm Winds. Collectively, these reports are used to determine the frequency with which wind hazard events have affected areas across the U.S., including California.
High Winds

High winds are defined as sustained non-convective winds of 35 knots (40 mph) or greater lasting for 1 hour or longer, or gusts of 50 knots (58 mph) or greater for any duration (or otherwise locally/regionally defined). In some mountainous areas, the above numerical values are 43 knots (50 mph) and 65 knots (75 mph), respectively.

Strong Winds

Strong winds are defined as non-convective winds gusting less than 50 knots (58 mph), or sustained winds less than 35 knots (40 mph), resulting in a fatality, injury, or damage.97

Thunderstorm Winds

Thunderstorm winds are winds that arise from thunderstorm convection (occurring within 30 minutes of lightning being observed or detected), with speeds of at least 50 knots (58 mph). They can also be winds of any speed (non-severe thunderstorm winds below 50 knots (58 mph)) producing a fatality, injury, or damage.98

Please note: Straight-line wind is a term used to define any thunderstorm wind that is not associated with rotation. It is used mainly to differentiate from the rotational winds found in tornado-producing storms.99 However, it is not a term used in the NCEI Storm Events Database, and therefore cannot be used to determine severe weather history of or potential impacts to CSU campuses.

Tornadoes

A tornado is an extreme severe weather wind hazard. A tornado is a rapidly rotating column of air extending from a thunderstorm to the surface of the Earth.100 This column extends between cloud and the Earth’s surface. The damage from tornadoes comes from the strong winds they contain and the flying debris they create. It is generally believed that rotational wind speeds can be as high as 300 mph in the most violent tornadoes.101 On a local scale, tornadoes are the most violent and most destructive of all atmospheric phenomena.102


Santa Ana Winds. A type of wind hazard that is peculiar to Southern California is called a Santa Ana Wind. Santa Ana winds are strong, topographically-enhanced, extremely dry

100 Retrieved on 07.15.2021 from https://www.earthnetworks.com/tornado/
102 Retrieved on 07.15.2021 from https://www.weather.gov/bgm/severedefinitions
downslope winds that originate inland and affect coastal southern California and northern Baja California (Mexico).\textsuperscript{103} They occur when air from a region of high pressure over the dry, desert region of the southwestern U.S. flows westward towards low pressure located off the California coast. This creates dry winds that flow east to west through the mountain passages in Southern California. These winds have a strong seasonal component; they are most common during the cooler months of the year, occurring from September through May. Santa Ana winds typically feel warm (or even hot) because as the cool desert air moves down the side of the mountain, it is compressed, which causes the temperature of the air to rise. If strong enough, Santa Ana winds can cause major property damage, and may present difficulties for airborne and seagoing transportation. They also may increase wildfire risk because of the dryness of the winds and the speed at which they can spread a flame across the landscape.\textsuperscript{104} (Note: The Wildfire hazard is profiled elsewhere in this document.)

Figure below illustrates the mechanisms involved in the generation of Santa Ana winds across Southern California.

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\end{center}

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\begin{figure}
\end{figure}
\end{center}

\begin{center}
\begin{figure}
\end{figure}
\end{center}

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**Diablo Winds.** The Diablo wind is another type of topographically-enhanced downslope wind phenomenon that occurs in the North-Central areas of California. Diablo winds are offshore wind events that flow northeasterly over Northern California’s Coast Ranges, often creating high wind speeds downwind of major canyons and over ridges, and extreme fire danger for the San Francisco Bay Area. Diablo winds are driven by a surface pressure gradient that forms in response to an inverted pressure trough that develops over California.  

**Sundowner Winds.** Sundowner winds are significant and potentially damaging downslope wind and warming events that periodically occur along a short segment of the southern California coast in the vicinity of Santa Barbara, CA. The unique topography of this coastal region promotes the development of Sundowner wind events: over a length of about 100 km, the coastline is oriented approximately west–east, with the adjoining narrow coastal plain bounded by a steeply rising (to elevations greater than 1200 m) and


coast-parallel mountain range. Called Sundowner winds because they often begin in the late afternoon or early evening, their onset is typically associated with a rapid rise in temperature and decrease in relative humidity, and the winds tend to blow from the north from the Santa Ynez Mountains to the coast of Santa Barbara County, California. During the more intense Sundowner wind events, wind speeds can be of gale force 39-54 miles per hour) or higher, and can even reach hurricane force (≥ 74 miles per hour) in the most extreme cases. Temperatures over the coastal plain, and even at the coast itself, can rise significantly above 37.8°C (100°F). Seasonally, Sundowner winds peak in March, April, and May, with a minimum during summer and a secondary peak in winter that often corresponds with Santa Ana winds. In addition to causing a dramatic change from the more typical marine-influenced local weather conditions, Sundowner wind episodes have produced significant wind-related property and agricultural damage, as well as conditions of extreme fire danger.107 108 109

**Hail**

Hail is a form of precipitation consisting of solid ice that forms inside thunderstorm updrafts.110 It is roughly round in shape and at least 0.2’ in diameter. Hail develops in the upper atmosphere as ice crystals that are bounced about by high velocity updraft winds; the ice crystals accumulate frozen droplets and fall after developing enough weight. The size of hailstones varies and is a direct consequence of the severity and size of the storm that produces them – the higher the temperatures at the Earth’s surface, the greater the strength of the updrafts and the amount of time hailstones are suspended, and therefore the greater the size of the hailstone.111

**Lightning**

Lightning is an electrical discharge produced by a thunderstorm. Lightning rapidly heats the air in its immediate vicinity to about 50,000°F - about five times the temperature of the surface of the sun. This compresses the surrounding air and creates a supersonic shock wave, which decays to an acoustic wave that is heard as thunder.112


The discharge may occur within or between clouds, between the cloud and air, between a cloud and the ground, or between the ground and a cloud.113 Lightning that is produced from thunderstorms in which precipitation evaporates before reaching the ground is called “dry lightning.”

**Location of the Hazard**

Severe weather is a non-spatial hazard, and can occur anywhere in the CSU system, including on the Cal Poly San Luis Obispo campus. No one area of the campus – or of the surrounding community – is subject to experiencing severe weather more than any other area.

There is geographic variability among the different types of mountain and valley wind events (as a sub-category of the severe weather hazard). Santa Ana winds occur in Southern California, Diablo winds occur in North-Central California, and Sundowner winds occur almost exclusively in Santa Barbara County, California.

**Extent of the Hazard**

Severe weather hazards are non-spatial hazards that potentially affect all Cal Poly San Luis Obispo campus areas equally. However, the smallest geographic unit of measurement for almost all official severe weather event data is at the county level. Because the severe weather data used do not exist at the campus level, it is assumed that the same (or similar) severe weather risks to Cal Poly San Luis Obispo reflect those of the surrounding community and County. As a result, all assets and people at Cal Poly San Luis Obispo are at risk from the effects of severe weather and can expect to experience at least some (or the complete range of) endemic severe weather hazards. In consideration of the campus’ design, layout, and operations, the severe weather history and degree of severity in the San Luis Obispo area, and the history and degree of severity of each severe weather sub-type identified by the extent scales (below), the campus planning committee ranks the overall extent of the Severe Weather hazard as **MODERATE**. See each sub-hazard below for the planning committee’s sub-type extent ranking.

**Wind Hazard: Non-Rotational**

The Beaufort Scale described below, is an empirical measure that relates wind speed to observed conditions at sea or on land. Its full name is the Beaufort wind force scale.114 First developed in 1805, it is still used today to estimate wind strengths.

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114 Retrieved on 07.15.2021 from https://www.rmets.org/resource/beaufort-scale
## Table 23-27: Beaufort Wind Force Scale

<table>
<thead>
<tr>
<th>Force</th>
<th>Speed (mph)</th>
<th>Speed (knots)</th>
<th>Description</th>
<th>Specifications for use at sea</th>
<th>Specifications for use on land</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0-1</td>
<td>0-1</td>
<td>Calm</td>
<td>Sea like a mirror.</td>
<td>Calm; smoke rises vertically.</td>
</tr>
<tr>
<td>1</td>
<td>1-3</td>
<td>1-3</td>
<td>Light Air</td>
<td>Ripples with the appearance of scales are formed, but without foam crests.</td>
<td>Direction of wind shown by smoke drift, but not by wind vanes.</td>
</tr>
<tr>
<td>2</td>
<td>4-7</td>
<td>4-6</td>
<td>Light Breeze</td>
<td>Small wavelets, still short, but more pronounced. Crests have a glassy appearance and do not break.</td>
<td>Wind felt on face; leaves rustle; ordinary vanes moved by wind.</td>
</tr>
<tr>
<td>3</td>
<td>8-12</td>
<td>7-10</td>
<td>Gentle Breeze</td>
<td>Large wavelets. Crests begin to break. Foam of glassy appearance. Perhaps scattered white horses.</td>
<td>Leaves and small twigs in constant motion; wind extends light flag.</td>
</tr>
<tr>
<td>4</td>
<td>13-18</td>
<td>11-16</td>
<td>Moderate Breeze</td>
<td>Small waves, becoming larger; fairly frequent white horses.</td>
<td>Raises dust and loose paper; small branches are moved.</td>
</tr>
<tr>
<td>5</td>
<td>19-24</td>
<td>17-21</td>
<td>Fresh Breeze</td>
<td>Moderate waves, taking a more pronounced long form; many white horses are formed.</td>
<td>Small trees in leaf begin to sway; crested wavelets form on inland waters.</td>
</tr>
<tr>
<td>6</td>
<td>25-31</td>
<td>22-27</td>
<td>Strong Breeze</td>
<td>Large waves begin to form; the white foam crests are more extensive everywhere.</td>
<td>Large branches in motion; whistling heard in telegraph wires; umbrellas used with difficulty.</td>
</tr>
</tbody>
</table>

<p>| | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>7</td>
<td>32-38</td>
<td>28-33</td>
<td>Near Gale</td>
</tr>
<tr>
<td>8</td>
<td>39-46</td>
<td>34-40</td>
<td>Gale</td>
</tr>
<tr>
<td>9</td>
<td>47-54</td>
<td>41-47</td>
<td>Severe Gale</td>
</tr>
<tr>
<td>10</td>
<td>55-63</td>
<td>48-55</td>
<td>Storm</td>
</tr>
<tr>
<td>11</td>
<td>64-72</td>
<td>56-63</td>
<td>Violent Storm</td>
</tr>
</tbody>
</table>

### Near Gale
Sea heaps up and white foam from breaking waves begins to be blown in streaks along the direction of the wind.

Whole trees in motion; inconvenience felt when walking against the wind.

### Gale
Moderately high waves of greater length; edges of crests begin to break into spindrift. The foam is blown in well-marked streaks along the direction of the wind.

Breaks twigs off trees; generally impedes progress.

### Severe Gale
High waves. Dense streaks of foam along the direction of the wind. Crests of waves begin to topple, tumble and roll over. Spray may affect visibility

Slight structural damage occurs (chimney-pots and slates removed)

### Storm
Very high waves with long overhanging crests. The resulting foam, in great patches, is blown in dense white streaks along the direction of the wind. On the whole the surface of the sea takes on a white appearance. The tumbling of the sea becomes heavy and shock-like. Visibility affected.

Seldom experienced inland; trees uprooted; considerable structural damage occurs.

### Violent Storm
Exceptionally high waves (small and medium-size ships might be for a time lost to view behind the waves). The sea is completely covered with long white patches of foam lying along the direction of the wind. Everywhere the edges of the wave crests are blown into froth. Visibility affected.

Very rarely experienced; accompanied by widespread damage.
The air is filled with foam and spray. Sea completely white with driving spray; visibility very seriously affected.

Based on those extent ranking factors identified (above), the planning committee ranks the extent of non-rotational wind hazards as **MODERATE**.

**Extent: Tornado**

Tornadoes have their own severity/extent scale. Until 2007, tornadoes were measured and described according to the Fujita Scale.\(^{116}\)

In February 2007, use of the Fujita Scale was discontinued. In its place, the Enhanced Fujita (EF) Scale is used. The Enhanced Fujita scale considers how most structures are designed and is thought to be a much more accurate representation of the surface wind speeds in the most violent tornadoes. Like the original Fujita scale, the Enhanced Fujita scale is a set of wind estimates (not measurements) based on damage.

It is important to note the **date** that a tornado occurred. Tornadoes that occurred prior to February, 2007 are classified using the original Fujita scale and will not be converted to the Enhanced Fujita Scale.

Table below illustrates the Fujita Scale in use prior to February 2007.

**Table 23-28: Fujita Tornado Scale (Pre-February 2007)**\(^{117}\)

<table>
<thead>
<tr>
<th>F-Scale Number</th>
<th>Intensity Phrase</th>
<th>Wind Speed</th>
<th>Type of Damage</th>
</tr>
</thead>
<tbody>
<tr>
<td>F0</td>
<td>Gale tornado</td>
<td>40-72 mph</td>
<td>Some damage to chimneys; breaks branches off trees; pushes over shallow-rooted trees; damages sign boards.</td>
</tr>
<tr>
<td>F1</td>
<td>Moderate tornado</td>
<td>73-112 mph</td>
<td>The lower limit is the beginning of hurricane wind speed; peels surface off roofs; mobile homes pushed off foundations or overturned; moving autos pushed off the roads; attached garages may be destroyed.</td>
</tr>
</tbody>
</table>

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<table>
<thead>
<tr>
<th>F2</th>
<th>Significant tornado</th>
<th>113-157 mph</th>
<th>Considerable damage. Roofs torn off frame houses; mobile homes demolished; boxcars pushed over; large trees snapped or uprooted; light object missiles generated.</th>
</tr>
</thead>
<tbody>
<tr>
<td>F3</td>
<td>Severe tornado</td>
<td>158-206 mph</td>
<td>Roof and some walls torn off well-constructed houses; trains overturned; most trees in forest uprooted.</td>
</tr>
<tr>
<td>F4</td>
<td>Devastating tornado</td>
<td>207-260 mph</td>
<td>Well-constructed houses leveled; structures with weak foundations blown off some distance; cars thrown and large missiles generated.</td>
</tr>
<tr>
<td>F5</td>
<td>Incredible tornado</td>
<td>261-318 mph</td>
<td>Strong frame houses lifted off foundations and carried considerable distances to disintegrate; automobile sized missiles fly through the air in excess of 100 meters; trees debarked; steel reinforced concrete structures badly damaged.</td>
</tr>
<tr>
<td>F6</td>
<td>Inconceivable tornado</td>
<td>319-379 mph</td>
<td>These winds are very unlikely. The small area of damage they might produce would probably not be recognizable along with the mess produced by F4 and F5 wind that would surround the F6 winds. Missiles, such as cars and refrigerators would do serious secondary damage that could not be directly identified as F6 damage. If this level is ever achieved, evidence for it might only be found in some manner of ground swirl pattern, for it may never be identifiable through engineering studies.</td>
</tr>
</tbody>
</table>
Table below illustrates the Enhanced Fujita (EF) Scale, currently in use. Tornadoes that have occurred since February, 2007 are classified using the Enhanced Fujita Scale.

Table 23-29: Enhanced Fujita Scale (February 2007 and Later) \(^{118}\)

<table>
<thead>
<tr>
<th>Enhanced Fujita Category</th>
<th>Wind Speed</th>
<th>Potential Damage</th>
</tr>
</thead>
<tbody>
<tr>
<td>EF0</td>
<td>65-85 mph</td>
<td>Light damage. Peels surface off some roofs; some damage to gutters or siding; branches broken off trees; shallow-rooted trees pushed over.</td>
</tr>
<tr>
<td>EF1</td>
<td>86-110 mph</td>
<td>Moderate damage. Roofs severely stripped; mobile homes overturned or badly damaged; loss of exterior doors; windows and other glass broken.</td>
</tr>
<tr>
<td>EF2</td>
<td>111-135 mph</td>
<td>Considerable damage. Roofs torn off well-constructed houses; foundations of frame homes shifted; mobile homes completely destroyed; large trees snapped or uprooted; light-object missiles generated; cars lifted off ground.</td>
</tr>
<tr>
<td>EF3</td>
<td>136-165 mph</td>
<td>Severe damage. Entire stories of well-constructed houses destroyed; severe damage to large buildings such as shopping malls; trains overturned; trees debarked; heavy cars lifted off the ground and thrown; structures with weak foundations blown away some distance.</td>
</tr>
<tr>
<td>EF4</td>
<td>166-200 mph</td>
<td>Devastating damage. Well-constructed houses and whole frame houses completely leveled; cars thrown and small missiles generated.</td>
</tr>
<tr>
<td>EF5</td>
<td>&gt;200 mph</td>
<td>Incredible damage. Strong frame houses leveled off foundations and swept away; automobile-sized missiles fly through the air in excess of 100 m (107 yd); high-rise buildings have significant structural damage.</td>
</tr>
</tbody>
</table>

Based on the extent ranking factors identified (above), the planning committee ranks the extent of tornados as **LOW**.

**Extent: Hail**

The National Oceanic and Atmospheric Administration and the Tornado and Storm Research Organization (TORRO) have combined efforts to create the Hailstorm Intensity Scale. The following table provides details of this scale.

Table 23-30: Combined NOAA/TORRO Hailstorm Intensity Scale

<table>
<thead>
<tr>
<th>Size Code</th>
<th>Intensity Category</th>
<th>Typical Hail Diameter</th>
<th>Approximate Size</th>
<th>Typical Damage Impacts</th>
</tr>
</thead>
<tbody>
<tr>
<td>H0</td>
<td>Hard Hail</td>
<td>Up to 0.33”</td>
<td>Pea</td>
<td>No damage</td>
</tr>
<tr>
<td>H1</td>
<td>Potentially Damaging</td>
<td>0.33” – 0.60”</td>
<td>Marble or Mothball</td>
<td>Slight damage to plants and crops</td>
</tr>
<tr>
<td>H2</td>
<td>Potentially Damaging</td>
<td>0.60” – 0.80”</td>
<td>Dime or grape</td>
<td>Significant damage to fruit, crops, and vegetation</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>H3</th>
<th>Severe</th>
<th>0.80” – 1.20”</th>
<th>Nickel to Quarter</th>
<th>Severe damage to fruit and crops, damage to glass and plastic structures, paint and wood scored</th>
</tr>
</thead>
<tbody>
<tr>
<td>H4</td>
<td>Severe</td>
<td>1.20” – 1.60”</td>
<td>Half Dollar to Ping Pong Ball</td>
<td>Widespread glass damage, vehicle body damage</td>
</tr>
<tr>
<td>H5</td>
<td>Destructive</td>
<td>1.60” – 2.0”</td>
<td>Silver Dollar to Golf Ball</td>
<td>Wholesale destruction of glass, damage to tiled roofs, significant risk of injuries</td>
</tr>
<tr>
<td>H6</td>
<td>Destructive</td>
<td>2.0” – 2.4”</td>
<td>Lime or Egg</td>
<td>Aircraft body dented; brick walls pitted</td>
</tr>
<tr>
<td>H7</td>
<td>Very Destructive</td>
<td>2.4” – 3.0”</td>
<td>Tennis Ball</td>
<td>Severe roof damage, risk of serious injuries</td>
</tr>
<tr>
<td>H8</td>
<td>Very Destructive</td>
<td>3.0” – 3.5”</td>
<td>Baseball to Orange</td>
<td>Severe damage to aircraft body</td>
</tr>
</tbody>
</table>
Based on those extent ranking factors identified (above), the planning committee ranks the extent of the hail hazard as **LOW**.

**Extent: Lightning**

The National Weather Service (NWS) uses a Lightning Activity Level (LAL) scale to indicate the frequency and character of cloud-to-ground (C/G) lightning. The scale uses a range of 1 – 6, with 6 being the high end of the scale. Table below provides details of the LAL scale.

Table 23-31: Lightning Activity Level (LAL) Scale

<table>
<thead>
<tr>
<th>Rank</th>
<th>Cloud and Storm Development</th>
<th>Areal Coverage</th>
<th>Counts C/G per 5 Minutes</th>
<th>Counts C/G per 15 Minutes</th>
<th>Average C/G per Minute</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>No Thunderstorms</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>2</td>
<td>Cumulus clouds are common but only a few reaches the towering stage. A single thunderstorm must be confirmed in the rating area. The clouds mostly produce virga, but light rain will occasionally reach ground. Lightning is very infrequent.</td>
<td>&lt;15%</td>
<td>1-5</td>
<td>1-8</td>
<td>&lt;1</td>
</tr>
</tbody>
</table>
## Lightning Activity Level Scale

<table>
<thead>
<tr>
<th>Rank</th>
<th>Cloud and Storm Development</th>
<th>Areal Coverage</th>
<th>Counts C/G per 5 Minutes</th>
<th>Counts C/G per 15 Minutes</th>
<th>Average C/G per Minute</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>Cumulus clouds are common. Swelling and towering cumulus cover less than 2/10 of the sky. Thunderstorms are few, but 2 to 3 occur within the observation area. Light to moderate rain will reach the ground, and lightning is infrequent.</td>
<td>15% to 24%</td>
<td>6-10</td>
<td>9-15</td>
<td>1-2</td>
</tr>
<tr>
<td>4</td>
<td>Swelling cumulus and towering cumulus cover 2-3/10 of the sky. Thunderstorms are scattered but more than three must occur within the observation area. Moderate rain is commonly produced, and lightning is frequent.</td>
<td>25% to 50%</td>
<td>11-15</td>
<td>16-25</td>
<td>2-3</td>
</tr>
<tr>
<td>5</td>
<td>Towering cumulus and thunderstorms are numerous. They cover more than 3/10 and occasionally obscure the sky. Rain is moderate to heavy, and lightning is frequent and intense.</td>
<td>&gt;50%</td>
<td>&gt;15</td>
<td>&gt;25</td>
<td>&gt;3</td>
</tr>
<tr>
<td>6</td>
<td>Dry lightning outbreak. (LAL of 3 or greater with majority of storms producing little or no rainfall.)</td>
<td>&gt;15%</td>
<td>None</td>
<td>None</td>
<td>None</td>
</tr>
</tbody>
</table>

Based on those extent ranking factors identified (above), the planning committee ranks the extent of the lightning hazard as **LOW**.

**Extent: Thunderstorms that Generate Wind, Tornado, Hail, and Lightning Hazard Events**
Thunderstorms are not explicitly identified as a severe weather category for this hazard profile. However, they are responsible for most tornado, lightning, and hail hazard events – as well as a significant number of wind hazard events – across California and the CSU system. While individual thunderstorms affect relatively small areas, there are many instances in which thunderstorms can cluster together and/or travel in a line over long distances, producing significant damage over large geographic areas.

A thunderstorm is classified as “severe” when certain meteorological parameters within the thunderstorm are reached (i.e., damaging winds or speeds of 58 mph (50 knots) or greater, hail 1 inch in diameter or larger, and/or a tornado). However, there is currently no established, objective severity scale for thunderstorms.\(^\text{121} \text{122}\) That said, according to the Glossary of Meteorology published by the American Meteorological Society (AMS), a thunderstorm is reported as light, medium, or heavy according to following five (5) characteristics:

- the nature of the lightning and thunder;
- the type and intensity of the precipitation, if any;
- the speed and gustiness of the wind;
- the appearance of the clouds; and
- the effect upon surface temperature.\(^\text{123}\)

A thunderstorm may also be classified by the nature of the overall weather situation in which the thunderstorm is produced, including:

- **Airmass Thunderstorm**: A thunderstorm produced by local convection within an unstable air mass;\(^\text{124}\)
- **Frontal Thunderstorm**: An individual thunderstorm the initiation of which results from rising motion associated with a front, or a thunderstorm within a convective system generated and organized by frontal rising motion;\(^\text{125}\) or

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\(^{121}\) Retrieved on 07.15.2021 from https://www.noaa.gov/explainers/severe-storms

\(^{122}\) Retrieved on 07.15.2021 from https://www.weather.gov/safety/thunderstorm


- **Squall-line Thunderstorm**: An individual thunderstorm included within a squall line (i.e., a continuous or broken line of active deep moist convection frequently associated with thunder). 126 127

Based on the extent ranking factors identified (above) in relation to campus layout and operations, and past event low degree of severity, the planning committee ranks the extent of the thunderstorm hazard as **LOW**.

**History of the Hazard**

Severe weather hazards have been an annual occurrence in San Luis Obispo County and on the Cal Poly San Luis Obispo campus. Historical data for these hazards are presented below.

**Historical Storm Data Collection: NCEI Storm Events Database**

Historical information regarding severe weather hazards can be found using The National Centers for Environmental Information (NCEI) Storm Events Database. The Storm Events Database contains searchable, archived National Weather Service (NWS) storm data from January 1950 to April 2021, as entered by NOAA’s National Weather Service (NWS). Due to changes in the data collection and processing procedures over time, there are unique periods of record available depending on the event type.128 For example, from 1950 through 1954, only tornado events were recorded; from 1955 through 1995, only tornado, thunderstorm wind, and hail events were introduced into the database; from 1996 to present, 45 additional event types are recorded, including high wind, strong wind, and lightning events.129 To obtain the most accurate portrayal of severe weather event frequency, searches of the Storm Events Database are conducted using data collected since 01/01/1996. As a reminder, all official severe weather event data is at the county level. Severe weather data do not exist at the campus level. That said, it may be the case that the campus to some degree experiences the severe weather events reported for the surrounding community and County.

**Wind Hazards (excluding Tornadoes)**


Information obtained from the NCEI Storm Event Database website shows the number of events (or occurrences) of wind hazard events in San Luis Obispo County since 1996.\textsuperscript{130} Here, wind hazard events include all “High Wind,” “Strong Wind,” and “Thunderstorm Wind” storm reports.\textsuperscript{131}

- **High Wind**: at least 45 events, or approximately 1.78 events per year
- **Strong Wind**: at least 0 events, or 0 events per year
- **Thunderstorm Wind**: at least 12 events, or approximately 0.47 events per year
- **All Wind Hazard events** (excluding Tornadoes): at least 51 events, or approximately 2.01 events per year. (Note: This was determined by conducting a simultaneous search of the component wind hazards of high wind, strong wind and thunderstorm wind.)

Overall, in San Luis Obispo County, there have been at least 51 wind hazard events since 1996, excluding tornadoes. That translates to an approximate average historical frequency of occurrence of 2.01 wind hazard events per year.

Please note: Differences between the sums of individual component severe weather hazard event Database searches (i.e., 57 events) and simultaneous Database searches of all severe weather hazard events (i.e., 51 events) may be due to the following factors: (1) multiple event types are in the same record (e.g., "Thunderstorm Wind/Hail" or "Hail/Tornado;") and/or (2) severe weather hazard events such as “Thunderstorm Wind” or “Hail” that are reported for San Luis Obispo County have actually taken place hundreds of miles away, but are erroneously recorded as events that have occurred in the County.\textsuperscript{132} When such a discrepancy arises, the more conservative aggregate hazard wind event value (i.e., 51 events) is used to determine the historical frequency of occurrence for the severe weather hazard. The origin of this discrepancy is unknown at this time.

**Historical Wind Hazard Losses for San Luis Obispo County since 1996**

According to the NCEI Storm Events Database, the wind hazard events that San Luis Obispo County has experienced since 1996 have been costly. While there have been no deaths, injuries, or crop losses, property damage estimates have totaled approximately $4,000,000.

**Tornado Wind Hazards**

\textsuperscript{130} National Climatic Data Center. Storm Events Database. Retrieved 07.19.2021 from https://www.ncdc.noaa.gov/stormevents/

\textsuperscript{131} National Climatic Data Center. Storm Events Database. Retrieved 07.19.2021 from https://www.ncdc.noaa.gov/stormevents/

Information from the NCEI Storm Events Database indicates that since 1996, there have been 2 reported events of tornadoes in San Luis Obispo County, which translates to approximately 0.08 tornado events per year. The severity rating of both tornadoes was F0/EF0.

**Historical Tornado Hazard Losses for San Luis Obispo County since 1996**

According to the NCEI Storm Events Database, the tornado hazard events that San Luis Obispo County has experienced since 1996 have produced no deaths, injuries, property damage, or crop damage.133

**Hail**

Information from the NCEI Storm Events Database indicates that since 1996, there have been 5 reported events of hail in San Luis Obispo County, which translates to approximately 0.20 hail events per year. (Note: The NCEI Storm Event Database search results for hail indicate that there has been a total of six (6) reports of hail since 1996. However, one (1) entry is for a hail event in San Diego County, hundreds of miles away from San Luis Obispo County. The origin of this error is unknown at this time.)

**Historical Hail Hazard Losses for San Luis Obispo County since 1996**

According to the NCEI Storm Events Database, the hail hazard events that San Luis Obispo County has experienced since 1996 have produced no deaths, injuries, property damage, or crop damage. (Note: The San Diego County hail event that was included erroneously in the search results for hail hazard events in San Luis Obispo County accounted for all injuries (i.e., 5) and crop damage estimates (i.e., $300,000) presented in the search results.)

**Lightning**

Information from the NCEI Storm Events Database indicates that since 1996, there have been no reports of lightning hazard events in San Luis Obispo County.

**Historical Lightning Hazard Losses for San Luis Obispo County since 1996**

Because no lightning hazard events have been reported in San Luis Obispo County since 1996, there are no lightning-related deaths or injuries, or property or crop damages in the County.

**All Severe Weather Hazard Events Recorded by the NCEI Storm Events Database**

133 National Climatic Data Center. Storm Events Database. Retrieved 07.31.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Tornado&beginDate_mm=01&
Information obtained from the NCEI Storm Events Database indicates that there have been 58 occurrences of the severe weather hazard in San Luis Obispo County. This translates to 2.29 severe weather hazard occurrences per year.\textsuperscript{134}

Please note: Differences between the sums of individual component severe weather hazard event Database searches (i.e., 65 events) and simultaneous Database searches of all severe weather hazard events (i.e., 58 events) may be due to the following factors: (1) multiple event types are in the same record (e.g., "Thunderstorm Wind/Hail" or "Hail/Tornado;" and/or (2) severe weather hazard events such as “Thunderstorm Wind” or “Hail” that are reported for San Luis Obispo County have actually taken place hundreds of miles away, but are erroneously recorded as events that have occurred in the County.\textsuperscript{135} When such a discrepancy arises, the more conservative aggregate hazard wind event value (i.e., 58 events) is used to determine the historical frequency of occurrence for the severe weather hazard. The origin of this discrepancy is unknown at this time.

Historical, Aggregated Severe Hazard Losses for San Luis Obispo County since 1996

According to the NCEI Storm Events Database, the severe weather events that San Luis Obispo County has experienced since 1996 have been costly. While there have been no deaths, injuries, or crop damage, and property damage estimates have totaled approximately $4,000,000.\textsuperscript{136} \textit{It is important to note that for all San Luis Obispo County severe weather hazard events recorded on the Storm Events Database, all estimated property damages have been caused by wind hazard events alone.}

Wind Hazards Not Included in the NCEI Storm Events Database

\textit{Santa Ana Winds}

Santa Ana wind events occur at least twice per month from October through April. From 1948 to 2012, total of 2056 events on the 65-year record were recorded in the Southern California region, yielding an average of \textit{32 occurrences per year}. Typical Santa Ana wind events last 1–2 days and represent 27\% of the occurrences, with events lasting up to 6
days accounting for 90% of all occurrences. The remaining 10% are made up almost entirely of events lasting between 7 and 12 days.137 138

Figure below shows the mean monthly frequency per season of Santa Ana Wind events detected from 1948 to 2012. Extreme Santa Ana wind events are shown in dark red, and are defined as those events that are above the 90th percentile of all events on record.

Diablo Winds

Diablo wind events occur approximately 2.5 events per year. These events are most frequent during the fall and early winter seasons, with the highest frequency of events occurring in October. As a result, the highest risk of Diablo-wind-related damage is in the fall and early winter.

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The following figure shows the monthly frequency of Diablo winds (along with average live fuel moisture content). The Diablo Wind data are derived from a 17-year climatology of San Francisco Bay Area regional surface weather stations.\textsuperscript{141}

Figure 23-21: Monthly Frequency of Diablo Winds and Average Live Fuel Moisture Content (Dashed Line)\textsuperscript{142}

\textbf{Sundowner Winds}

Strong sundowner wind events occur approximately 2-3 times per year. These events can create sharp temperature rises, local gale force winds, and significant weather-related problems. Rare, “explosive” types of sundowner wind events occur about 6 times per century that present dangerous weather situations, generating extremely strong and hot winds that can reach gale force or higher speeds.\textsuperscript{143}

\textbf{Historical Frequency of All Severe Weather Hazards}

Table below shows the average historical frequency of severe weather hazard events for San Luis Obispo County since 1996.)

\begin{itemize}
\item \textsuperscript{141} Retrieved on 07.15.2021 from https://www.fireweather.org/diablo-winds
\item \textsuperscript{142} Retrieved on 07.13.2021 from https://www.fireweather.org/diablo-winds
\end{itemize}
Table 23-32: Severe Weather Hazard Event
Frequencies for San Luis Obispo County since 1996.

<table>
<thead>
<tr>
<th>Severe Weather Hazard Category</th>
<th>Average Number of Hazard Events Per Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wind (Includes High, Strong and Thunderstorm Winds ONLY)</td>
<td>2.01</td>
</tr>
<tr>
<td>Tornado</td>
<td>0.08</td>
</tr>
<tr>
<td>Hail</td>
<td>0.20</td>
</tr>
<tr>
<td>Lightning</td>
<td>0</td>
</tr>
<tr>
<td>Diablo Wind*</td>
<td>2.5</td>
</tr>
<tr>
<td>Santa Ana Wind</td>
<td>32</td>
</tr>
<tr>
<td>Sundowner Wind*</td>
<td>2 to 3</td>
</tr>
</tbody>
</table>

* Note: The Diablo and Sundowner wind hazards are not present in San Luis Obispo County. They are included here for information purposes only.

Potential Impacts of the Hazard

The significance (or priority) of a hazard’s potential impacts is based primarily on the frequency and resulting damage caused by the hazard, including deaths/injuries and property, crop, and economic damage. All assets and people within Cal Poly San Luis Obispo campus areas are at risk from the effects of severe weather hazards.

Wind Hazards (Including Tornadoes)

Wind hazard events have the potential to impact people, property, and operations on campuses across the CSU system. People caught in the open during an extreme wind event are exposed to high winds and debris, and could be injured or killed.

The habitability of buildings can be compromised (by damaging roofs, windows, or other weak points in the building envelope), leading to long-term operational issues for the campus. As with most university campuses, space is always at a premium at the Cal Poly San Luis Obispo campus, and the loss of any currently utilized space due to building or structural damage would likely disrupt operations and the University’s mission.
Extreme wind events can result in power failure, which would impact the operation of the campus. Fallen tree limbs and other potential transportation hazards may also cause disruption to the surrounding community and limit ingress/egress to the campus.

According to the 2019 San Luis Obispo County Multi-Jurisdictional Hazard Mitigation Plan, high wind hazards (including tornadoes) are “adverse weather” hazards that are considered to be of low significance, and therefore to have a minimal potential impact on the County and (by extension) the Cal Poly San Luis Obispo campus.\textsuperscript{144} However, thunderstorms – which are accompanied by high winds – are considered to be of medium significance, and therefore to have a moderate potential impact on the County and (by extension) the Cal Poly San Luis Obispo campus. (Please note: In the Plan, thunderstorms are grouped together with heavy rain, hail, lightning, dense fog, and freeze into one large “adverse weather” category.)

**Hail**

Hail typically impacts property by damaging structures, cars, and utilities as it falls. Dents in cars, broken glass, and holes in roofs are common impacts of hail. Injuries to people from hail are less common, though they can happen, as hail is a hard object falling in an unpredictable manner at a fairly high rate of speed.

According to the 2019 San Luis Obispo County Multi-Jurisdictional Hazard Mitigation Plan, hail hazards are “adverse weather” hazards that are considered to be of medium significance, and therefore have a moderate potential impact on the County and (by extension) the Cal Poly San Luis Obispo campus. (Please note: In the Plan, hail is grouped together with thunderstorms, heavy rain, lightning, dense fog, and freeze into one large “adverse weather” category.)

**Lightning**

Lightning strikes the United States about 20-25 million times a year.\textsuperscript{145} Although most lightning occurs in the summer months, people can be struck at any time of year. Since 1990, lightning has killed an average of 39 people each year in the United States, and hundreds more have been injured.\textsuperscript{146} Property losses due to lightning have been very costly across the U.S. For example, from 2005 through 2020, U.S. homeowner’s insurance claim payouts for lightning losses totaled approximately $15,334,600,000, or $958,412,500

\begin{footnotes}
\end{footnotes}
worth of payouts per year.\textsuperscript{147} (Commercial claim payouts for lightning losses for the U.S. were not available.)

According to the 2019 San Luis Obispo County Multi-Jurisdictional Hazard Mitigation Plan, lightning hazards are “adverse weather” hazards that are considered to be of medium significance, and therefore have a moderate potential impact on the County and (by extension) the Cal Poly San Luis Obispo campus.\textsuperscript{148} (Please note: In the Plan, lightning is grouped together in one large “adverse weather” category with thunderstorms, heavy rain, hail, dense fog, and freeze into one large “adverse weather” category.)

**Probability of Future Occurrence of the Hazard**

Areas throughout California, including all California State University (CSU) campuses, experience severe weather events every year, and future occurrences of such events are projected to increase in both their frequency and intensity. The 2019 San Luis Obispo County Multi-Jurisdictional Hazard Mitigation Plan states that there is between a 10% and 100% chance that all “adverse weather” hazards profiled here (including wind, tornado, hail and lightning) will occur in the future.\textsuperscript{149} However, according to the NCEI Storm Events Database, severe weather wind hazards have occurred in San Luis Obispo County significantly more than once annually – at an average occurrence of 2.01 times per year since 1996. While the severe weather hazard is a non-spatial hazard that affects all areas of the Cal Poly San Luis Obispo campus equally, the smallest geographic unit of measurement for almost all official severe weather event data is at the county level. Because the severe weather data used in this assessment do not exist at the campus level, it is assumed that the severe weather probabilities for the Cal Poly San Luis Obispo campus reflect those of the surrounding community and County identified in the Table below.

Based on the data available from both the 2019 San Luis Obispo County Multi-Jurisdictional Hazard Mitigation Plan and the NCEI Storm Events Database, the severe weather hazard is expected to occur on (or otherwise impact) the Cal Poly San Luis Obispo campus at least once on an annual basis. Therefore, the probability of future occurrence of the severe weather hazard for Cal Poly San Luis Obispo is **HIGHLY LIKELY**. See the table below for probabilities of future occurrence for component severe weather hazards for the County and the campus.

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\textsuperscript{147} Retrieved on 07.21.2021 from https://www.iii.org/table-archive/20504


Vulnerability to the Hazard

People, structures, and assets on the Cal Poly San Luis Obispo campus are all vulnerable to the impacts associated with severe weather. Infrastructure can be damaged or destroyed by hail, wind, tornadoes, thunderstorms, and lightning, which can result in service interruptions and outages. Structures can be damaged or destroyed by hail, wind, tornadoes, thunderstorms, and lightning. People can be injured or killed by lightning, flying debris, hail, or extreme wind events. The Cal Poly San Luis Obispo campus also has vehicles, as well as off-campus conference and recreational facilities, that are all vulnerable to a severe weather event.

Estimate of Potential Losses

Severe weather is a non-spatial hazard that affects the entire Cal Poly San Luis Obispo campus. Each of the hazards associated with severe weather can result in losses throughout the planning area.

Table 23-33: Severe Weather Hazard Probabilities of Future Occurrence for San Luis Obispo County and Cal Poly San Luis Obispo

<table>
<thead>
<tr>
<th>Severe Weather Hazard Category</th>
<th>Average Number of Hazard Events Per Year</th>
<th>Probability of Future Occurrence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wind (Includes High, Strong and Thunderstorm Winds ONLY)</td>
<td>2.01</td>
<td>Highly Likely</td>
</tr>
<tr>
<td>Tornado</td>
<td>0.08</td>
<td>Unlikely</td>
</tr>
<tr>
<td>Hail</td>
<td>0.20</td>
<td>Possible</td>
</tr>
<tr>
<td>Lightning</td>
<td>0</td>
<td>Unlikely</td>
</tr>
<tr>
<td>Diablo Wind**</td>
<td>2.5</td>
<td>Not Rated</td>
</tr>
<tr>
<td>Santa Ana Wind</td>
<td>32</td>
<td>Highly Likely</td>
</tr>
<tr>
<td>Sundowner Wind**</td>
<td>2 to 3</td>
<td>Not Rated</td>
</tr>
<tr>
<td>** Note: The Diablo and Sundowner wind hazards are not present in San Luis Obispo County, and therefore are not rated for probability of future occurrence. They are included here for information purposes only.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

23-137
All structures within the Cal Poly San Luis Obispo campus are at risk from severe weather. There are approximately 158 buildings on the campus that could be damaged by wind, hail, and/or lightning. If even a fraction of these assets were to be damaged, the resulting estimated losses would still be in the millions of dollars. The total replacement costs due to severe weather hazard are $660,197,687 for 113 of the buildings, and are unknown for the remaining 45 buildings. An analysis of projected dollar losses to campus buildings from severe weather as a percentage of building replacement costs is also not currently available, though CSU leadership may pursue such data in the future.

The population at the Cal Poly San Luis Obispo campus varies throughout the day. As of Fall, 2019, Cal Poly San Luis Obispo had 21,242 students and 2,871 faculty and staff. All are at risk from severe weather events, with 24,113 being directly vulnerable in this scenario.

**Vulnerability Assessment Conclusions**

Severe weather presents a variety of hazards to the Cal Poly San Luis Obispo campus. People, assets, infrastructure, and vehicles can all be damaged by this hazard, and losses can quickly begin to rise. In the aggregate, severe weather is a frequently occurring hazard (mostly in the form of wind hazard events) that presents a variety of risks to Cal Poly San Luis Obispo.

It is evident that the Cal Poly San Luis Obispo campus has vulnerabilities to and risks from severe weather hazard incidents, and that pre-event planning, communication, and mitigation efforts should be implemented. Public education and outreach regarding areas of shelter that could be used by campus populations during severe weather events is considered by campus leadership to be one viable mitigation option. The campus planning committee will continue to look for feasible and cost-effective options for the mitigation of severe weather risks going forward.

**Identified Data Limitations**

Numerous federal agencies maintain a variety of records regarding losses associated with hazards. Unfortunately, no single source is considered to offer a definitive accounting of all losses. The Federal Emergency Management Agency (FEMA) maintains records on federal expenditures associated with declared major disasters. The US Army Corps of Engineers (USACE) and the Natural Resources Conservation Service (NRCS) collect data on losses during the course of some of their ongoing projects and studies. Additionally, the National Oceanic and Atmospheric Administration’s (NOAA) National Centers for Environmental Information (NCEI) collects and maintains data about natural hazards in summary format, as well as occurrences, dates, injuries, deaths, and estimated

150 Retrieved on 07.19.2021 from https://www2.calstate.edu/csu-system/about-the-csu/facts-about-the-csu/enrollment/Pages/default.aspx

costs for individual storm events. Many of these databases and other data collection services, including the NCEI, have inherent data limitations when searching for information at a scale as small as a single campus.

The best available data and records have been used throughout this section. Where no data or records exist or could be located, that deficiency is noted.
23.4 Social Resilience Assessment

Overview

While every person is vulnerable to risk, individuals from diverse populations such as those with access and functional needs are disproportionately more vulnerable and may be at a higher risk to harm in a disaster event. In addition to physical vulnerabilities, the intersectionality between physical hazard risks and population social vulnerabilities must be considered to holistically address overall campus risk.

As inclusivity is a high priority for CSU, addressing campus risk and resilience must be done through the lens of inclusion and equity. Addressing social vulnerability is an increasingly critical requirement of state and national doctrines and described in Section 4.4 of the HVRA Base Plan. Every individual of the campus’s richly diverse population group needs to have the capacity, skills, and knowledge in order to understand, access, and participate in risk reduction and disaster response in ways that are meaningful to their own unique situation. In a campus community, having strong social support networks and active involvement in community disaster responses may negatively or positively impact these opportunities and reduce the resilience-building process. This section offers a glimpse into the CSU San Luis Obispo campus’s unique social construct, population demographics, strengths and concerns and presents a high-level assessment of the resilience, coping capacities and potential social vulnerabilities of students, staff and faculty. The research variables that were asked are often considered sensitive subjects, and few are traditionally included in emergency management hazard mitigation planning.

This social resilience assessment of college campuses is the first of its kind in the nation. The research methodology unfolded as the interviews with campuses progressed. The assessment data presented are not definitive or authoritative. The answers, analysis, and suggested trends are strictly indicators for potential social risk. They do not represent an accurate data capture as limitations on the data gathering process influenced an ability to provide accuracy. This assessment provides indications of increased risk, not accuracy of response or a true reflection of the situation of the campus. The information presented is to be considered in the context of the more detailed system-wide CSU social vulnerability assessment that is included in the baseline HVRA.
Campus-Identified Populations of Concern

During the campus interview, the following responses were provided when asked, “In considering the diverse population group(s) amongst student body, faculty and staff, which are of the most concern in your emergency management planning?”

Table 23-34: High level summary of campus populations of concern

<table>
<thead>
<tr>
<th>Question</th>
<th>Campus Response</th>
</tr>
</thead>
</table>
| Which population groups amongst the student body, faculty, and staff, are of the most concern for physical and social vulnerabilities in emergency management planning? | • LGBTQI populations  
• Students without financial aid  
• Populations experiencing homelessness  
• International students  
• Student exchange participants  
• Access and functional needs |
| Which population groups are most difficult to reach in an event?          | Students relying on social media for news and updates  
Economically disadvantaged populations without internet connections |
| Which population groups have little/limited support networks if impacted by an event? | N/A |

Resilience Variables Related to Campus Emergency Management

The interviewees were asked to reflect on a set of 12 variables for the campus populations of student, faculty and staff: homelessness (*housing insecurity*), food security, health and wellness, disability/access and functional needs (AFN), racial equity, digital equity, communications, international students, immigrants/immigration status issues (*undocumented, DACA, etc.*), LGBTQI (Lesbian Gay Bisexual Transgender Questioning (or queer) Intersex), and transportation dependency. They were also offered
an opportunity to add any other factor they wanted to include. The following two questions were asked:

- Is this factor a particular issue of concern for emergency management on your campus?
  
  Responses were summarized as **Very High, High, Medium, Low**

- Is this factor reflected in the emergency plans and processes for your campus?
  
  Responses were summarized as **Yes, No, In Progress, NA**

In order to provide a high-level qualitative response for the answers, the approach of averaging response was taken. If conflicting answers were expressed by the interviewees, the answer (code) was averaged out. A detailed explanation of the response averaging approach is included in the base HVRA.

Table 23-35: campus-specific emergency management issues of concern and inclusion in emergency management plans and processes.

<table>
<thead>
<tr>
<th>Issue of Concern</th>
<th>Plans &amp; Processes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Homelessness (Housing Insecurity)</td>
<td>Low</td>
</tr>
<tr>
<td>Food Security</td>
<td>Medium</td>
</tr>
<tr>
<td>Health &amp; Wellness</td>
<td>Very High</td>
</tr>
<tr>
<td>AFN</td>
<td>High</td>
</tr>
<tr>
<td>Racial Equity</td>
<td>High</td>
</tr>
<tr>
<td>Digital Equity</td>
<td>High</td>
</tr>
<tr>
<td>Comms.</td>
<td>Low</td>
</tr>
<tr>
<td>International Students</td>
<td>Medium</td>
</tr>
<tr>
<td>Immigrants / Immigration Status</td>
<td>Medium</td>
</tr>
<tr>
<td>LGBTQI</td>
<td>High</td>
</tr>
<tr>
<td>Transportation Dependency</td>
<td>High</td>
</tr>
</tbody>
</table>
Qualitative Narrative: Campus Overview of Potential Resilience Vulnerabilities

The following are interview notes of interest:

- Health and wellness is talked about in the EOC, with the emergency response team, and reflected in the plans.

- Access and functional needs accessibility on the website is in compliance though can improve. Quarterly updates are given to the EOC that lists individuals; AFN organization has a member that serves as a disability officer in the management section.

- Racial equity is a high issue of concern and is reflected in the plans.

- Communications is not considered an issue of concern except that student don’t tend to read emails.

- Visa regulations get changed for the international students and is a major concern.

- For international and immigrants/immigration status issues, are not reflected in the planning documents and referred to the study body as a whole, not “who is who.”

- Elements reflecting LGBTQI concerns are contributed to the emergency plans through designated liaisons, task forces and planning groups.

Campus High Hazards and Potentially Vulnerable Populations

This section provides a brief introduction to the link between socially vulnerable populations and a particular hazard type. While extensive research has been conducted on the impacts of hazards, not all linkages have been documented or published, and detail for finding them are beyond the scope of this assessment. It’s important to note, the intersectional nature of what makes an individual’s personal experience and resilience to an event is played out by unique factors for that individual or population. The nuanced social vulnerabilities often come from the social and physical environment in which a person is embedded.

In order to aid in further assessing campus resilience, below is a general description of the known impacts. From some hazards, the descriptions are robust, while others are only brief introductions.
Table 23-36: CSU San Luis Obispo *Highly Likely, Likely and Possible* Hazards

<table>
<thead>
<tr>
<th>Hazard</th>
<th>Future Occurrence Probability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Communicable Disease</td>
<td>Highly Likely</td>
</tr>
<tr>
<td>Drought</td>
<td>Highly Likely</td>
</tr>
<tr>
<td>Earthquake</td>
<td>Possible</td>
</tr>
<tr>
<td>Extreme Temperature</td>
<td>Possible (Heat only)</td>
</tr>
<tr>
<td>Flood</td>
<td>Possible</td>
</tr>
<tr>
<td>Landslide</td>
<td>Likely</td>
</tr>
<tr>
<td>Power Outage</td>
<td>Likely</td>
</tr>
<tr>
<td>Wildfire</td>
<td>Likely (Fire); Possible (Smoke)</td>
</tr>
</tbody>
</table>
**Drought**

The 2012-2016 drought had severe effects on two vulnerable sectors of our population: those in low-income brackets, and those, especially Native Americans, who rely on subsistence fishing for their livelihoods.\(^{152}\) Water bills increased throughout the state. Due to rising water prices, for the working poor, many have paid four to five percent of their income for water. Since many CSU students are commuters, and many living with families, future drought impacts may potentially affect a percentage of non-resident students. NASA’s modeling shows that future droughts are likely to last longer and be more intense, even leading to “megadroughts” in the western states.\(^{153}\) Fresh water supplies are predicted to be full of extremes, with both droughts and extreme precipitation events being more severe. The interrelationship between drought and other hazard conditions may lead to a set of secondary impacts. Drought conditions lead to water quality issues due to loss of drinking water, increased fire danger that leads to drought-induced fires and elevated AQI levels, as well as extreme heat or prolonged heat events.

**Earthquake**

Impacts on populations from earthquakes are complex, with long-term implications on social stability for all populations. In addition to the physical impact exposure during a no-notice earthquake event and the social and logistical challenges of a recovering community, an earthquake can have lasting impacts long afterwards due to post traumatic stress disorder (PTSD).

Socioeconomic vulnerabilities of populations at risk were analyzed in the hypothetical yet scientifically realistic earthquake sequence that is being used to better understand hazards for the San Francisco Bay region during and after a magnitude-7 earthquake (mainshock) on the Hayward Fault and its aftershocks. In this study, the at-risk populations located in areas of concentrated damage are anticipated to experience longer recovery trajectories, increased long term housing displacement, and transportation impacts due to dependencies on transit dependencies. When neighborhood schools close, families with school age children may move to other areas to keep their children in schools. Persons with access and functions needs are likely to be more dependent on access to functioning medical, social and personal health care services that would be overwhelmed by the event and therefore increasing their vulnerabilities. For the homeless populations, the loss of social community services and damages to shelters could add to protracted relocations. For the young and mobile populations who rent, the

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major disruption to housing, jobs and transit will also drive relocation. Widespread housing damage and preexisting housing market constraints will make it “extremely challenging” for the socially and economically vulnerable populations to find alternative housing near their home communities. Those who utilize interim and irregular housing for months and years after a disaster are more vulnerable to physical, social, and mental disorders, including suicide, substance abuse, and physical and verbal abuse. Aftershocks and post disaster conditions delay population return and increase outmigration.154

**Extreme Temps**

People susceptible to respiratory ailments (asthma, lower and upper respiratory disease) disproportionately suffer from the effects of fire, smoke, air pollutions, allergens, heat and PSPS. Those with limited income or without resources are affected disproportionately due to the inability to provide safe shelter, air conditioning, cooling, air purification, medical care, and quality foods, and are also least able to obtain information related to climate risks and adaptation strategies.

**Heat**

Heatstroke, cardiovascular disease, respiratory disease and cerebrovascular disease are related to extreme heat events. Increased number of heat waves creates heat-related physical stress on populations and is exacerbated in the metropolitan areas where greater amounts of heat-absorbing surfaces (e.g., asphalt and concrete) trap heat and emit higher temperatures throughout the night.

The heat also extends the geographic range and the distribution of disease-carrying insects and pests. Health professionals are concerned that California’s warming climate will allow species to acclimate. Such vectors include such pests as ticks that carry Lyme disease, and mosquitos that transmit Zika, dengue fever, West Nile, plague and tularemia. Some others, such as chikungunya, Chagas disease, and Rift Valley fever virus, are threats as well.

Some communities of color and some low-income, homeless, and immigrant populations are more exposed to heat waves, as these groups often reside in urban areas affected by heat island effects. In addition, these populations are likely to have limited adaptive capacity due to a lack of adequately insulated housing, inability to afford or to use air conditioning, inadequate access to public shelters such as cooling centers, and inadequate access to both routine and emergency health care. These social, economic,

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and health risk factors give rise to the observed increase in deaths and disease from extreme heat in some immigrant and impoverished communities.

Heat stroke, the most serious heat-related illness, occurs when the body is unable to control its temperature. Body temperature rises rapidly, the sweating mechanism fails, and the body cannot cool down. In extreme causes, heat stroke can cause confusion and unconsciousness, so the victim is unable to seek treatment without assistance.

There are several groups of people who are uniquely vulnerable to the effects of extreme heat, such as infants and children, older adults aged 65 and up, athletes and outdoor workers, low-income households, and individuals with certain chronic medical conditions.

When dealing with an extreme heat event, the most common impacts are those generally felt by the people living in the targeted area. For people in particular, heat can kill when the body is pushed beyond its limits. Most heat disorders occur because the victim has been overexposed to heat. As discussed, the major human risks associated with extreme heat include dehydration, sunburn, fatigue, heat exhaustion, heat stroke, and in severe cases, death.

Some portions of the population are more at risk to the effects of extreme heat. The very young, the elderly, and certain groups with chronic medical conditions (such as asthma or other pulmonary illnesses, heart disease, poor blood circulation, neurological illnesses, and obesity) are generally more vulnerable to the effects of extreme heat, and are more likely to suffer illness or death as a result.

This is especially true if exposure is extended for a period of time and preventative measures are not taken immediately. Distributional implications of impacts, and even less on distributional implications of adaptation actions.”

Flood

Risk from floods relates to community risk, exposure and infrastructural losses. The degree of vulnerability to these events and their impacts depends on human behavior and the traditional social factors such as situational awareness, prior knowledge of hazards, social capital and decision-making capabilities. The exposure of humans to floods continues to increase, driven by changes in hydrology and land use. The adverse impacts on socially vulnerable populations are amplified because a disproportionately high number live in flood-prone areas. Research has shown that places of social vulnerabilities are places characterized by housing and racial disparities, such as mobile home parks, structural fragility and poverty, and higher percentages of populations such

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as Black and Native Americans, and others with shared histories of discrimination, marginalization and exclusion. 156

Health impacts from flooding are well recognized due to the extensive history of flooding in California and around the nation. The impacts range from waterborne illnesses from contaminated waters, respiratory illnesses that impact the lungs, throat, and airways from airborne particles, mold on flooded buildings that can trigger asthma, allergies and other illnesses—all which are particularly impactful to older, younger and individuals with pre-existing health condition. Foodborne illnesses can increase if there are issues with power outages or sewer overflows. Individuals with increased mental health concerns can be impacted by the stress or anxiety from the impacts of the flood. Poor quality housing can increase vulnerability to many flood risks, including flood inundation, power outages, mold growth, rodent vectors, and serious health impacts. For those with limited finances, flood inundation and impacts to infrastructure or farmlands may lead to extensive income losses.

The poorest residents suffer disproportionately to flood situations, especially those who have been less able to fund homeowner’s insurance to protect against flood losses. Loss of life is not unusual in flooding situations, as is loss of property, livestock, pets, workplaces, and tourist industries. There is a strong interrelationship between water events and other hazards. Flooding, storms and water quality are related to each other. Drought conditions can exacerbate floods as the surface soils are hardened and not as ready to allow surface water absorption. Extreme heat events can cause snowmelt, inundating waterways and causing flood and water quality issues. Flooding and storm events can have impacts on public health, environmental health, agricultural health and economic system health. Mental health issues are reported for all people who have experience flood losses, including anxiety, fear, anger, anger, sadness and grief. 157 Additionally, waterborne disease outbreaks are reported weeks after the flood events. Mold contamination leads to indoor air issues. Damp indoor environments lead to increased prevalence of asthma, and also upper and lower respiratory symptoms. These issues may influence the diverse CSU populations, both on and off campus, in a number of ways long after a flood event, or the related hazards impacts, has concluded.

Landslides

Although infrastructural losses are of secondary importance to the risk to humans themselves, research investigating the vulnerability of people to landslides is rare. The many reasons for this lack of data are related to the fact that the collapse of occupied


buildings which makes it a function of structural vulnerability and therefore, indirect. The
degree of vulnerability to landslides by an individual considered at high risk, or even the
general populations, also depends on human behavior, including many of the traditional
social factors that are difficult to measure such as situational awareness, prior knowledge
of hazards, and decision-making capabilities.158

Landslides can result in primary lifeline failures through the loss of roads or power and
communication lines. Transportation routes are often expensive to clean up, and
prolonged obstruction can disrupt the movement of people and goods. Risk from
landslide relates to earthen and infrastructural losses. The degree of vulnerability to these
events and their impacts depends on human behavior and the traditional social factors
such as situational awareness, prior knowledge of hazards, social capital and decision-
making capabilities, as well as increased vulnerability due to social factors, such as racial
and economic disparities.

**Power Outage/Public Safety Power Shutdowns (PSPS)**

Loss of power creates economic hardship to a region experiencing regular PSPS events,
such as those experienced throughout the state over the recent years. Many businesses
close, including gas stations, grocery stores, and local retail establishments. These
impacts may deeply impact students dependent on support jobs, as well impacting family
members of campus staff and faculty. PSPS increases risks to the public due to inability
to use medical devices, spoilage of food and medicines, and disruption to infrastructure,
such as supply of clean water and electricity used to run home medical equipment, such
as lift chairs and ventilators.

**Wildfire**

Increased wildfire threat occurs especially in the end of fall, when conditions are driest,
but before the winter rains have come; an east-to-west wind gusts exacerbate fire risk.
Wildfire threats have the concomitant threat of Public Safety Power Shutoffs (PSPS). And,
in the case of an actual wildfire, danger exists both from fire and from the smoke. Recent
wildfires have demonstrated that some demographics are disproportionately affected.
Native Americans are six times more likely to be affected than white people. Blacks and
Hispanic people are 50 percent more vulnerable. These values take into account the
likelihood of a community being affected and the greater difficulty of that community to
recover. These statistics reflect the lack of access to resources to pay for insurance, to
rebuild and recover, to implement fire safety measures, and to access other resources.
Price gouging after a fire (such as documented in Sonoma County after the 2017 Tubbs

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29, 2021.
Fire) further exacerbates the disparity. Furthermore, the disabled and the elderly are at particular risk from extreme wildfire conditions, as they are often not as able to effectively evacuate. Of the 85 people who died in the Camp Fire in Butte in 2018, 62 of them were at least 65 years old.

Smoke from wildfires creates a significant public health threat. Especially vulnerable are individuals who have heart or lung issues, such heart disease, lung disease or asthma. Those most vulnerable include the medically fragile, elderly and children. Air Quality Indexes track the level of the following: particulate matter, surface levels of ozone, carbon monoxide, sulfur dioxide, and nitrogen dioxide. All of these can cause respiratory distress and harm lungs.

The California Department of Public Health reports the increased public health risks, and risk indicators that include: heat-related ED visits, populations living in wildfire areas, adults with multiple chronic conditions, populations living in poverty, race/ethnicity, outdoor workers, public transit access, air conditioner ownership and tree canopy.

Hazard Mitigation and Emergency Management Planning

The goal of this high-level assessment is to provide a starting point to encourage further exploring campus social risks and vulnerabilities, as well as to inform and to enhance holistic emergency management and hazard mitigation decision making, planning processes and future adaptive risk management strategies. By including the social resilience factors, mitigation investments may move beyond standardized planning and regulations, structure and infrastructure projects, and natural systems protections to embrace a more expanded, customized emergency operations plan and an education and outreach program unique to the campus.

A more robust social resilience inquiry is strongly encouraged to develop an accurate picture, based on methodical and scientific research-based data. Such an effort would be


envisioned through both nuanced discussions with a variety of campus stakeholders and the invitation of nontraditional stakeholders to join in a collaborative resilience partnership. Such a forward-leaning effort would be directly in keeping with CSU’s commitment to inclusion and equity in risk reduction.
Section 24

California State University, San Marcos

24.1 University Profile

University History

Since its founding in September of 1989, California State University San Marcos has focused on preparing future leaders, building great communities and solving critical issues. Located on a 306-acre hillside overlooking the city of San Marcos, CSUSM is the only public four-year comprehensive university serving North San Diego, Southwest Riverside and South Orange counties. CSU San Marcos opened in August of 1990 in rented office spaces with 448 juniors and seniors, a dozen faculty members and nine majors. In 1991, seven students were awarded the first Bachelor of Arts degrees in campus history. And, in fall 1992, the permanent campus opened following the completion of Craven Hall, Academic Hall and Science Hall I. CSU San Marcos has substantially grown since 2003 adding a building every year for the following decade.

CSU San Marcos offers 62 bachelor’s degrees, 15 master’s degrees, an Ed.D. program, and 13 teaching credentials. The university has four colleges: the College of Business Administration; the College of Science and Mathematics; the College of Humanities, Arts, Behavioral and Social Sciences; and the College of Education, Health and Human Services.

University Governance

The campus president is the chief executive officer of the university and maintains a close working relationship with the CSU’s systemwide office, reporting to the chancellor and participating in the system-wide Executive Council. The president manages campus operations and fundraising, sets campus priorities, and oversees the hiring and support of staff and faculty.

University Mission

“California State University San Marcos focuses on the student as an active participant in the learning process. As a Carnegie classified "community engaged" university, CSUSM students work closely with a faculty whose commitment to sustained excellence in teaching, research, and community partnership enhances student learning. The university offers rigorous undergraduate and graduate programs distinguished by exemplary teaching, innovative curricula, and the application of new technologies. CSUSM provides a range of services that respond to the needs of a student body with diverse backgrounds, expanding student access to an excellent and affordable education. As a public university, CSUSM grounds its mission in the public trust, alignment with regional needs, and sustained enrichment of the intellectual, civic, economic, and cultural life of our region and state.”
CSU San Marcos is dedicated to intellectual engagement, community, integrity, innovation and inclusiveness and focuses on these priorities to reach its strategic planning goals and mission.

University Location

CSU San Marcos is conveniently located in North San Diego County - only a short drive from the City of San Diego, Riverside County and Orange County.

University Population

CSU San Marcos exceeds a population of 16,000 students. Latino students make up 49% of the student population. White students are second in population at 27% In 2020, 47% of students received Pell Grants.

24.2 Interim Final Rule for Hazard Vulnerability and Risk Assessment

Requirement §201.6(c)(2): The plan shall include a risk assessment that provides the factual basis for activities proposed in the strategy to reduce losses from identified hazards. Local risk assessments must provide sufficient information to enable the jurisdiction to identify and prioritize appropriate mitigation actions to reduce losses from identified hazards.

Requirement §201.6(c)(2)(i): [The risk assessment shall include a] description of the type...location and extent of all natural hazards that can affect the jurisdiction. The plan shall include information on previous occurrences of hazard events and on the probability of future hazard events.

Requirement §201.6(c)(2)(ii): [The risk assessment shall include a] description of the jurisdiction’s vulnerability to the hazards described in paragraph (c)(2)(i) of this section. This description shall include an overall summary of each hazard and its impact on the community.

Requirement §201.6(c)(2)(ii): [The risk assessment] must also address National Flood Insurance Program (NFIP) insured structures that have been repetitively damaged floods.

Requirement §201.6(c)(2)(ii)(A): The plan should describe vulnerability in terms of the types and numbers of existing and future buildings, infrastructure, and critical facilities located in the identified hazard area.

Requirement §201.6(c)(2)(ii)(B): [The plan should describe vulnerability in terms of an] estimate of the potential dollar losses to vulnerable structures identified in paragraph (c)(2)(ii)(A) of this section and a description of the methodology used to prepare the estimate ..

Requirement §201.6(c)(2)(ii)(C): [The plan should describe vulnerability in terms of] providing a general description of land uses and development trends within the
community so that mitigation options can be considered in future land use decisions.

**Requirement §201.6(c)(2)(iii):** For multi-jurisdictional plans, the risk assessment must assess each jurisdiction’s risks where they vary from the risks facing the entire planning area.

### 24.3 Hazard Identification and Risk Assessment

**Overview of California State University, San Marcos History of Hazards**

Numerous federal agencies maintain a variety of records regarding losses associated with hazards. Unfortunately, no single source is considered to offer a definitive accounting of all losses. The Federal Emergency Management Agency (FEMA) maintains records on federal expenditures associated with declared major disasters. The US Army Corps of Engineers (USACE) and the Natural Resources Conservation Service (NRCS) collect data on losses during the course of some of their ongoing projects and studies. Additionally, the National Oceanic and Atmospheric Administration’s (NOAA) National Centers for Environmental Information (NCEI) database collects and maintains data about natural hazards in summary format. The data includes occurrences, dates, injuries, deaths, and estimated costs. Many of these databases and other data collection services, including the NCEI, have inherent data limitations when searching for information at a university scale.

The best available data and records were used throughout this assessment.

**Hazard Identification**

As part of the initial hazard identification process, the Campus Assessment Team considered potential hazards with the most chance to significantly affect the planning area. The hazards include those that have occurred in the past and may occur in the future. A variety of sources were used to develop the list of hazards considered including national, regional, and local sources such as emergency operations plans, FEMA’s How-To Series, websites, published documents, databases, and maps, as well as discussion among the Campus Assessment Team members.

In the initial phase of the planning process, the Campus Assessment Team considered 14 hazards and the risks they create for the University and its material assets, population, and operations. The hazards initially considered, and the determinations as to the treatment of those hazards, are shown in Table 24-1 (following).
### Table 24-1: Hazard Identification Determinations

<table>
<thead>
<tr>
<th>Hazard</th>
<th>Determination (Yes/No)</th>
<th>Reason for Determination</th>
<th>Future Occurrence Probability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Communicable Disease</td>
<td>Yes</td>
<td>Hazard of concern to campus</td>
<td>Highly Likely</td>
</tr>
<tr>
<td>Dam and Levee Failure</td>
<td>Yes</td>
<td>Hazard of concern to campus</td>
<td>Unlikely</td>
</tr>
<tr>
<td>Drought</td>
<td>Yes</td>
<td>Hazard of concern to campus</td>
<td>Highly Likely</td>
</tr>
<tr>
<td>Earthquake</td>
<td>Yes</td>
<td>Hazard of concern to campus</td>
<td>Possible</td>
</tr>
<tr>
<td>Erosion</td>
<td>Yes</td>
<td>Hazard of concern to campus</td>
<td>Likely</td>
</tr>
<tr>
<td>Extreme Temperature</td>
<td>Yes - Heat; No - Cold</td>
<td>Hazard of concern to campus</td>
<td>Highly Likely (Heat Only)</td>
</tr>
<tr>
<td>Flood</td>
<td>Yes</td>
<td>Hazard of concern to campus</td>
<td>Unlikely</td>
</tr>
<tr>
<td>Hazardous Materials</td>
<td>Yes</td>
<td>Hazard of concern to campus</td>
<td>Unlikely</td>
</tr>
<tr>
<td>Landslide</td>
<td>Yes</td>
<td>Hazard of concern to campus</td>
<td>Likely</td>
</tr>
<tr>
<td>Power Outage</td>
<td>Yes</td>
<td>Hazard of concern to campus</td>
<td>Likely</td>
</tr>
<tr>
<td>Sea Level Rise</td>
<td>No</td>
<td>Not a hazard of concern to campus</td>
<td>N/A</td>
</tr>
<tr>
<td>Tsunami</td>
<td>No</td>
<td>Not a hazard of concern to campus</td>
<td>N/A</td>
</tr>
<tr>
<td>Volcano</td>
<td>Yes</td>
<td>Hazard of concern to campus</td>
<td>Unlikely</td>
</tr>
<tr>
<td>Wildfire</td>
<td>Yes</td>
<td>Hazard of concern to campus</td>
<td>Possible (Fire); Possible (Smoke)</td>
</tr>
</tbody>
</table>

### Future Occurrence Probability

In order to determine the probability of future occurrences of each hazard profiled, the following scale was developed:

- Highly Likely - 76%-100% that the hazard would occur annually.
- Likely - 50%-75% that the hazard would occur annually.
- Possible - 11%-49% that the hazard would occur each annually.
- Unlikely - 0%-10% that the hazard would occur each annually.
Communicable Disease

Description of the Hazard

Communicable diseases are illnesses that occur due to infectious agents or their toxic products and are infectious due to their potential of transmission from one person or species to another by a replicating agent.¹ They may be transmitted from a reservoir to a susceptible host either directly as from an infected person or animal or indirectly through the agency of an intermediate plant or animal host, vector, or the inanimate environment. Communicable diseases are clinically evident illness resulting from the presence of pathogenic microbial agents, including pathogenic viruses, pathogenic bacteria, fungi, protozoa, multi-cellular parasites, and aberrant proteins known as prions.² The degree of spread of a communicable disease depends on both the ability of an organism to enter, survive and multiply in the host and the comparative ease with which the disease is transmitted to other hosts.³

Some ways in which communicable diseases spread are by:

- Travel through the air, such as tuberculosis, measles, or COVID-19;
- Physical contact with an infected person, such as through touch (staphylococcus), sexual intercourse (gonorrhea, HIV), fecal/oral transmission (hepatitis A), or droplets (influenza, TB, COVID-19);
- Contact with a contaminated surface or object (Norwalk virus), food (salmonella, E. coli), blood (HIV, hepatitis B), or water (cholera); and
- Bites from insects or animals capable of transmitting the disease (mosquito: malaria and yellow fever; flea: plague)⁴

Collectively, the twenty-three (23) campuses and Chancellor’s Office of the California State University (CSU) system have identified nine (9) communicable disease hazards that have had significant impacts on their respective student, faculty, and staff populations. Of these communicable diseases, COVID-19 is considered to be the most prominent and widespread agent across all CSU campuses. (See Table 24-2 below.)

¹ California Legislative Information. Health and Safety Code – HSC. Print. Retrieved 03.22.2021 from: https://leginfo.legislature.ca.gov/faces/codes_displaySection.xhtml?lawCode=HSC&sectionNum=120290.&text=(2)%20%E2%80%9CInfectious%20or%20communicable,has%20significant%20public%20health%20implications
Table 24-2: Communicable Diseases Identified CSU Campuses.

<table>
<thead>
<tr>
<th>Collective List of Communicable Diseases Identified by All CSU Campuses</th>
<th>Number of CSU Campuses (Including Chancellor’s Office) Identifying Communicable Disease Having Significant Impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>COVID-19 (SARS-CoV-2)</td>
<td>24</td>
</tr>
<tr>
<td>Meningitis</td>
<td>7</td>
</tr>
<tr>
<td>Measles</td>
<td>6</td>
</tr>
<tr>
<td>Influenza (Including H1N1/Swine Flu)</td>
<td>6</td>
</tr>
<tr>
<td>Tuberculosis</td>
<td>5</td>
</tr>
<tr>
<td>Norovirus</td>
<td>4</td>
</tr>
<tr>
<td>Mumps</td>
<td>2</td>
</tr>
<tr>
<td>E. Coli</td>
<td>2</td>
</tr>
<tr>
<td>Sexually Transmitted Diseases (STDs)</td>
<td>2</td>
</tr>
</tbody>
</table>

(Source: Interviews with CSU campus staff at CSU campuses and at CSU Chancellor’s Office.)

With the exception of COVID-19, there is variability among CSU campuses regarding which communicable diseases have had the greatest impact on individual campus communities. Table 24-3 shows the communicable disease hazards that have had the greatest impact on each CSU campus.

Table 24-3: Communicable Disease Hazards at CSU Campuses with Greatest Impact.

<table>
<thead>
<tr>
<th>CSU Campus</th>
<th>Identified Communicable Disease Hazards with the Greatest Impact on CSU Campus</th>
</tr>
</thead>
<tbody>
<tr>
<td>CSU Bakersfield</td>
<td>COVID-19, Meningitis</td>
</tr>
<tr>
<td>CSU Channel Islands</td>
<td>COVID-19, Measles</td>
</tr>
<tr>
<td>Chico State</td>
<td>COVID-19, Tuberculosis</td>
</tr>
<tr>
<td>CSU Dominguez Hills</td>
<td>COVID-19</td>
</tr>
<tr>
<td>Cal State East Bay</td>
<td>COVID-19, Meningitis</td>
</tr>
<tr>
<td>Fresno State</td>
<td>COVID-19, Meningitis, Tuberculosis</td>
</tr>
<tr>
<td>Cal State Fullerton</td>
<td>COVID-19, Influenza</td>
</tr>
<tr>
<td>Humboldt State</td>
<td>COVID-19, Measles, Norovirus, Influenza, STDs</td>
</tr>
<tr>
<td>Cal State Long Beach</td>
<td>COVID-19</td>
</tr>
<tr>
<td>Cal State LA</td>
<td>COVID-19, E. coli, Measles</td>
</tr>
<tr>
<td>Institution</td>
<td>Disease(s)</td>
</tr>
<tr>
<td>-----------------------------</td>
<td>-----------------------------------------------</td>
</tr>
<tr>
<td>Cal Maritime</td>
<td>COVID-19</td>
</tr>
<tr>
<td>CSU Monterey Bay</td>
<td>COVID-19</td>
</tr>
<tr>
<td>CSUN (Northridge)</td>
<td>COVID-19, Measles</td>
</tr>
<tr>
<td>Cal Poly Pomona</td>
<td>COVID-19, Influenza (Swine Flu - H1N1)</td>
</tr>
<tr>
<td>Sacramento State</td>
<td>COVID-19</td>
</tr>
<tr>
<td>Cal State San Bernardino</td>
<td>COVID-19, Tuberculosis</td>
</tr>
<tr>
<td>San Diego State</td>
<td>COVID-19, Meningitis, Mumps</td>
</tr>
<tr>
<td>San Francisco State</td>
<td>COVID-19</td>
</tr>
<tr>
<td>San José State</td>
<td>COVID-19, H1N1</td>
</tr>
<tr>
<td>Cal Poly San Luis Obispo</td>
<td>COVID-19, Meningitis, Norovirus</td>
</tr>
<tr>
<td><strong>CSU San Marcos</strong></td>
<td><strong>COVID-19</strong></td>
</tr>
<tr>
<td>Sonoma State</td>
<td>COVID-19, H1N1, Norovirus</td>
</tr>
<tr>
<td>Stanislaus State</td>
<td>COVID-19, Tuberculosis</td>
</tr>
<tr>
<td>Office of the Chancellor</td>
<td>COVID-19</td>
</tr>
<tr>
<td><strong>CSU System-Wide</strong></td>
<td><strong>COVID-19, Meningitis, Measles, Tuberculosis, Influenza-Swine Flu-H1N1, Mumps, Norovirus, E. coli, STDs</strong></td>
</tr>
</tbody>
</table>

(Source: Interviews with CSU campus staff at CSU campuses and at CSU Chancellor’s Office.)

**Descriptions of Identified Communicable Disease Hazards at CSU San Marcos**

CSU San Marcos has identified one (1) communicable disease hazard that has had the greatest impact on campus – COVID-19. The following is a brief description of the communicable disease hazard at CSU San Marcos.

**COVID-19 (SARS-CoV-2)**

Coronaviruses are a family of viruses that can cause illnesses such as the common cold, severe acute respiratory syndrome (SARS) and Middle East respiratory syndrome (MERS). In 2019, a new coronavirus was identified as the cause of a disease outbreak that originated in China. This virus is now known as the **severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2)**. The disease it causes is called Coronavirus Disease 2019 (COVID-19). In March 2020, the World Health Organization (WHO) declared the COVID-19 outbreak a pandemic.

Signs and symptoms of coronavirus disease 2019 (i.e., COVID-19) may appear two to 14 days after exposure. Common signs and symptoms can include fever, cough, and tiredness. Early symptoms of COVID-19 may also include a loss of taste or smell.
The virus that causes COVID-19 spreads easily among people, and more continues to be discovered over time about how it spreads. Data has shown that the COVID-19 virus spreads mainly from person to person among those in close contact (within about 6 feet, or 2 meters). The virus is transmitted by respiratory droplets being released when someone with the virus coughs, sneezes, breathes, sings or talks. These droplets can be inhaled or land in the mouth, nose or eyes of a person nearby. In some situations, the COVID-19 virus can spread by a person being exposed to small droplets or aerosols that stay in the air for several minutes or hours (i.e., airborne transmission). It’s not yet known how common it is for the virus to spread this way. The COVID-19 virus can also spread if a person touches a surface or object with the virus on it and then touches his or her mouth, nose or eyes; however, this is not considered to be a main way it spreads.

The severity of COVID-19 symptoms can range from very mild to severe. Some people may have only a few symptoms, and some people may have no symptoms at all. However, some people may experience worsened symptoms, such as worsened shortness of breath and pneumonia. People who are older have a higher risk of serious illness from COVID-19, and the risk increases with age. People who have existing medical conditions also may have a higher risk of serious illness from COVID-19. In some cases, the disease can cause severe medical complications and may even lead to death.  

Location of the Hazard

Communicable diseases have the potential to affect the entire CSU San Marcos (CSUSM) planning area equally. As a result, the communicable disease hazard can be found both at the main CSUSM campus is located San Marcos, CA (San Diego County), and at the CSUSM satellite campus in Temecula, CA (Riverside County). Because of the ubiquitous nature of many communicable diseases students, faculty, staff at (and visitors to) both CSUSM locations are at risk of exposure to the communicable disease hazard.  

CSU Student Housing Locations and Populations

Although CSU-campus-owned student housing opportunities have been severely limited due to the COVID-19 pandemic, this situation is temporary. Eventually, students will be allowed back on campus at full capacity, and many of these students will be living in campus-owned housing. When this occurs, over 53,000 students (i.e., just over 11% of the CSU total enrollment) will be at increased risk of exposure to communicable disease hazards, owing to the “close-quarters” living arrangements in student housing. Table 24-4 shows the number of students that were living in CSU-campus-owned housing in Fall,

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7 California State University. About CSU. Retrieved 4.29.2021 from: https://www2.calstate.edu/csu-system/about-the-csu
2019, prior to the CVID-19 pandemic. For CSU San Marcos, approximately 11% of its 14,519 enrolled students (or 1,597 students) reside in student housing.  

**Extent of the Hazard**

Various communicable diseases are categorized by the Center for Disease Control and Prevention (CDC) by levels of containment called Biosafety Levels (or BSLs). The higher the BSL, the greater the level of containment and level of effort necessary to prevent transmission of the disease, and therefore the greater the hazard. Biosafety Levels prescribe procedures and levels of containment for a particular microorganism or material (including research involving recombinant or synthetic nucleic acid molecules) and procedures associated with that containment. BSLs also consider primary barriers (e.g., biosafety cabinets), secondary barriers, facility design, air handling, laboratory security, etc. BSLs are graded from 1 to 4; as the BSL increases so does the relative risk of the agent/procedures as well the stringency of procedures and facility design.

Figure 24-1 describes the different BSLs, and provides examples of communicable diseases that would typically fall in to these classifications, as well as the typical protections that would be necessary to prevent transmission of each of the diseases.

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8 California State University. *Enrollment*. Retrieved 04.30.2021 from: [https://www2.calstate.edu/csu-system/about-the-csu/facts-about-the-csu/enrollment/Pages/default.aspx](https://www2.calstate.edu/csu-system/about-the-csu/facts-about-the-csu/enrollment/Pages/default.aspx)

9 California State University. *CSU Campus Match*. Retrieved 04.30.2021 from: [https://www2.calstate.edu/attend/campuses/campus-match/Pages/campus-match.aspx](https://www2.calstate.edu/attend/campuses/campus-match/Pages/campus-match.aspx)
The Extent of CSU San Marcos Communicable Disease Hazards Except COVID-19:

Besides COVID-19, there was no information provided on other communicable disease hazards on campus.

The Extent of CSU San Marcos COVID-19 Communicable Disease Hazard:

As a microorganism, the SARS-CoV-2 (COVID-19) virus requires a high level of containment. It is therefore classified at BSL-3. 11

CSU-campus-specific COVID-19 case data for CSU San Marcos can be found in the History of the Hazard section below.

History of the Hazard

Over an approximately one-year period, from mid-March, 2020 to March 23, 2021, there were a reported 113 cases of COVID-19 at CSU San Marcos. Most communicable disease data are maintained by at the state and at the county levels, and are not generally available at the municipal or campus levels, unless (a) the CSU campus falls under the jurisdiction of a city-level health department, or (b) a geographically specific outbreak occurs on campus or in the local community. The exception to this is the current COVID-19 pandemic, where both campus and County-level case data have been collected. As a


result, it is important to provide COVID-19 case statistics for both CSU campuses and the counties where CSU campus assets are located.

Tables 24-5- and 24-6 show campus-level and County-level COVID-19 Case data for CSU San Marcos. These case data are updated on at least a weekly basis. (Please note that the COVID-19 case numbers here may not reflect the most recent updates.)

Table 24-4: Campus-level COVID-19 Case data for CSU San Marcos (as of 03.17.2021).12

<table>
<thead>
<tr>
<th>Case Location</th>
<th>Students</th>
<th>Employees</th>
<th>Vendors</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>On Campus</td>
<td>40</td>
<td>44</td>
<td>4</td>
<td>88</td>
</tr>
<tr>
<td>Off-Site Campus Program</td>
<td>19</td>
<td>6</td>
<td>N/A</td>
<td>25</td>
</tr>
<tr>
<td>Total Cumulative Cases</td>
<td>59</td>
<td>50</td>
<td>4</td>
<td>113</td>
</tr>
</tbody>
</table>

(Note: The numbers above include only those cases known to CSUSM, and are not inclusive of any positive cases impacting campus community members personally off-campus. Also, these case data are updated on at least a weekly basis, but may not reflect the most recent updates.)

Table 24-5: County-level COVID-19 Case data for CSU San Marcos.13

<table>
<thead>
<tr>
<th>County</th>
<th>Cases</th>
<th>Deaths</th>
</tr>
</thead>
<tbody>
<tr>
<td>San Diego</td>
<td>267,728</td>
<td>3,494</td>
</tr>
<tr>
<td>Riverside</td>
<td>292,967</td>
<td>4,117</td>
</tr>
</tbody>
</table>

Potential Impacts of the Hazard

Communicable disease outbreaks and pandemics potentially have (and will continue to have) direct impact on life, health, and safety across the CSU system, including the CSU San Marcos campus. The extent of this impact is contingent on the type of infection or contagion, the severity of the outbreak, and the speed at which it is transmitted. Property and infrastructure integrity may be affected if large portions of the campus population contract communicable diseases at the same time and are therefore unable to perform maintenance, operations, and educational tasks. This would be particularly disruptive if

those impacted are first responders or other essential personnel. Long-term outbreaks affecting large numbers of CSU San Marcos students could result in cancelled classes, delayed matriculation, or other disruptions to the CSU System’s mission. This has already occurred with the current COVID-19 pandemic, and could occur again with more virulent strains of communicable diseases, including COVID-19.

Communicable disease hazards found across the CSU system (including CSU San Marcos) vary both by level of containment (BSL) (described previously) and by level of individual/public health risk, or Risk Group (RG) level. While BSLs describe the procedures and required levels of containment in a laboratory setting, Risk Groups (RGs) reflect the potential effects of disease exposure on humans or animals. Like BSLs, RGs range from Level 1 (RG1) to Level 4 (RG4), with Level 1 (RG1) posing minimal risk to healthy individuals and public health and Level 4 (RG4) posing a very serious or extreme risks to individuals and public. BSLs generally correlate with Risk Group (RG) Levels (e.g., a RG2 agent is worked with at BSL-2), but there are exceptions (e.g., production volumes, high-risk procedures, etc.).

The World Health Organization’s (WHO) Laboratory Biosafety Manual, 3rd ed., NIH Guidelines, categorizes Risk Groups (RGs) in the following way:

Table 24-6: WHO Risk Group Categorization

<table>
<thead>
<tr>
<th>Risk Group (RG)</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>RG1</td>
<td>Rarely associated with disease in healthy adult humans or animals and pose no-to-little public health risk (e.g., Saccharomyces cerevisiae, E. coli K-12 strain derivatives often used for recombinant/molecular biology, many environmental organisms)</td>
</tr>
<tr>
<td>RG2</td>
<td>Associated with mild to moderate disease for which preventative measures or post exposure treatments are often available; public health impact is limited (e.g., Streptococcus pyogenes, Salmonella, hepatitis B virus)</td>
</tr>
<tr>
<td>RG3</td>
<td>Associated with serious to lethal human disease for which preventative vaccines or post-exposure therapies may be scarce. Public health impact is limited-to-moderate (e.g., Mycobacterium tuberculosis, hantaviruses, West Nile virus, SARS)</td>
</tr>
<tr>
<td>RG4</td>
<td>Associated with serious to lethal human disease for which preventative vaccines or post exposure therapies are not</td>
</tr>
</tbody>
</table>

usually available. Public health impact is high (e.g., Ebola virus, Marburg virus, smallpox virus, etc.)

Table 24-8 describes the four (4) Risk Group Levels (RGs), and provides examples of communicable diseases that would typically fall into these classifications, and the typical protections that would be necessary to prevent transmission of the disease. It is important to note that all but two (2) communicable disease hazards identified by CSU campuses fall under either the lower-risk RG1 or RG2 categories. COVID-19 and tuberculosis are the two (2) communicable diseases fall under the higher-risk RG3 category. However, with the advent of the recently-developed COVID-19 vaccine, and with the expectation of an increasingly robust vaccine supply, it is possible that the RG level for COVID-19 could be lowered in the future, thereby reducing both the extent and the potential impact of COVID-19.

Table 24-7: Risk Group Levels (RGs) with Example Diseases and Recommended Precautions

<table>
<thead>
<tr>
<th>Level</th>
<th>Examples</th>
<th>Typical Protection to Prevent Transmission</th>
</tr>
</thead>
<tbody>
<tr>
<td>RG 1</td>
<td>E. Coli</td>
<td>Precautions are minimal, most likely involving gloves and some sort of facial protection. Usually, contaminated materials are left in open (but separately indicated) waste receptacles. Decontamination procedures for this level are similar in most respects to modern precautions against everyday viruses (i.e.: washing one’s hands with anti-bacterial soap, washing all exposed surfaces of the lab with disinfectants, etc.).</td>
</tr>
<tr>
<td>RG 2</td>
<td>Chicken Pox</td>
<td>These bacteria and viruses cause mild disease in humans or are difficult to contract via aerosol. Routine diagnostic work with clinical specimens can be done safely at BSL-2, using BSL-2 practices and procedures.</td>
</tr>
<tr>
<td></td>
<td>Hepatitis A, B, C</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Lyme disease</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Salmonella</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Mumps</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Measles</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Malaria</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Scrapie</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Dengue Fever</td>
<td></td>
</tr>
<tr>
<td></td>
<td>HIV</td>
<td></td>
</tr>
</tbody>
</table>

| RG 3 | Anthrax  
West Nile Virus  
SARS Virus (Including COVID-19)  
Tuberculosis  
Typhus  
Yellow Fever  
Hantaviruses  
Avian Flu |
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>These bacteria and viruses cause severe to fatal disease in human, but vaccines or other treatments do exist to combat them. Laboratory personnel have specific training in handling pathogenic and potentially lethal agents and are supervised by competent scientists who are experienced in working with these agents. This is considered a neutral or warm zone.</td>
<td></td>
</tr>
</tbody>
</table>

| RG 4 | H5N1 (Bird Flu)  
Dengue Hemorrhagic Fever  
Marburg Virus  
Ebola Virus  
Smallpox  
Lassa Fever  
Crimean-Congo Hemorrhagic Fever  
Other Hemorrhagic Diseases |
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>These viruses and bacteria cause severe to fatal disease in humans, for which vaccines or other treatments are not available. When dealing with biological hazards at this level the use of a Hazmat suit and a self-contained oxygen supply is mandatory. The entrance and exit of a BSL-4 lab will contain multiple showers, a vacuum room, an ultraviolet light room, autonomous detection system, and other safety precautions designed to destroy all traces of the biohazard. Multiple airlocks are employed and are electronically secured to prevent both doors opening at the same time. All air and water service going to and coming from a BSL-4 lab will undergo similar decontamination procedures to eliminate the possibility of an accidental release.</td>
<td></td>
</tr>
</tbody>
</table>

**Probability of Future Occurrence of the Hazard**

There are significant data limitations regarding non-COVID-19 communicable disease cases, as the information thereof is outdated, anecdotal, and/or inadequate. As a result, it is not feasible to provide quantitative probabilities of future occurrence for non-COVID-19 communicable disease hazards. However, based on the limited data, it is feasible to present qualitative probabilities of future occurrence based on ranges of communicable disease frequency. Table 5-12 shows a probability scale of future occurrence for the nine (9) communicable disease hazards profiled in this assessment. This scale is divided into four (4) levels of probability:
Table 24-8: Likelihood of Future Hazard Occurrence

<table>
<thead>
<tr>
<th>Likelihood</th>
<th>Parameters for Determining Likelihood</th>
</tr>
</thead>
<tbody>
<tr>
<td>Highly Likely</td>
<td>76 – 100% probability that hazard will occur annually (high to very high frequency)</td>
</tr>
<tr>
<td>Likely</td>
<td>50 – 75% probability that hazard will occur annually (moderate to high frequency)</td>
</tr>
<tr>
<td>Possible</td>
<td>11 – 49% probability that hazard will occur annually (low to moderate frequency)</td>
</tr>
<tr>
<td>Unlikely</td>
<td>0 – 10% probability that hazard will occur annually (very low to low frequency)</td>
</tr>
</tbody>
</table>

Due to significant data limitations surrounding non-COVID communicable diseases, the probability of future occurrence of CSU-system-wide communicable disease is measured by the proportion of campuses that have identified a particular communicable disease as having an impact on the campus community. In this measure, the more frequent a communicable disease is seen as impactful CSU-wide, the greater the probability of future occurrence.

Note: Each communicable disease’s probability of future occurrence ranking CSU-system-wide reflects the ranking at the individual CSU campus level unless noted otherwise.

Table 24-9: Probability of Future Occurrence of Communicable Disease Hazard for CSU System

<table>
<thead>
<tr>
<th>Collective List of Communicable Diseases Identified by All CSU Campuses</th>
<th>Number of CSU Campuses (Including Chancellor’s Office) Identifying Communicable Disease Having Significant Impact</th>
<th>Proportion of CSU Campuses Identifying Communicable Disease as Having Significant Impact System-Wide</th>
<th>CSU System-Wide Probability Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>COVID-19 (SARS-CoV-2)</td>
<td>24</td>
<td>1.00</td>
<td>Highly Likely</td>
</tr>
<tr>
<td>Meningitis</td>
<td>7</td>
<td>0.29</td>
<td>Possible</td>
</tr>
<tr>
<td>Measles</td>
<td>6</td>
<td>0.25</td>
<td>Possible</td>
</tr>
<tr>
<td>Influenza (Including H1N1/Swine Flu)</td>
<td>6</td>
<td>0.25</td>
<td>Possible</td>
</tr>
<tr>
<td>Tuberculosis</td>
<td>5</td>
<td>0.21</td>
<td>Possible</td>
</tr>
<tr>
<td>Norovirus</td>
<td>4</td>
<td>0.17</td>
<td>Possible</td>
</tr>
<tr>
<td>Mumps</td>
<td>2</td>
<td>0.08</td>
<td>Unlikely</td>
</tr>
<tr>
<td>E. Coli</td>
<td>2</td>
<td>0.08</td>
<td>Unlikely</td>
</tr>
</tbody>
</table>
Sexually Transmitted Diseases (STDs) | 2 | 0.08 | Unlikely

(Source: Interviews with staff at CSU campuses and at the CSU Chancellor’s Office.)

Vulnerability to the Hazard

Vulnerability to a communicable diseases hazard resides in the population of a given area – both human and animal – not in the infrastructure or physical assets. While CSU assets and infrastructure could be impacted indirectly by the communicable disease hazard, these impacts would be secondary to the impact that the communicable disease hazard would have on students, faculty, staff, and visitors at the CSU San Marcos campus.

CSU campus settings are geographically diverse, with locations ranging from small towns to medium-sized cities to densely populated urban areas. Hundreds of thousands of people work, study, and/or pass through CSU campuses on any given day. As of Fall 2019, the CSU -San Marcos System had 14,519 students and additional faculty and staff. Each of these persons is vulnerable to communicable disease, particularly if it is a pathogen that individual has not been immunized against, or for which no immunization exists. Prolonged outbreaks could result in a loss of services, failure of infrastructure (from lack of operators or maintenance), and closure of facilities. This exact scenario has played out to some degree in the current COVID-19 pandemic on the San Marcos campus. 17,18

Estimate of Potential Losses

COVID-19 Pandemic Health Impact on CSU Campuses and Surrounding Communities

The most prescient metric for estimating losses from COVID-19 is loss of life. The nationwide campus-related COVID-19 death rate of 0.02% remains well below the average COVID-19 death rate in the U.S. However, due to data limitations, there is no information on CSU-campus-specific deaths by COVID-19 or by any other communicable diseases. In fact, COVID-19 is the only communicable disease for which case reports have been readily available for CSU campuses.

At some point in the future, CSU campuses will return to full capacity. Without adequate surveillance regarding campus access and student and employee interaction, CSU campuses (including CSU San Marcos) are at risk of developing an extreme incidence of COVID-19, and may become “super-spreaders” for adjacent communities. 19 The emergence of more virulent COVID-19 variants would only add to the potential for high negative impacts on life safety, operations, and service delivery across the CSU system.

17 The California State University. Enrollment. Retrieved 05.03.2021 from: https://www2.calstate.edu/csu-system/about-the-csu/facts-about-the-csu/enrollment/Pages/default.aspx
18 The California State University. Employee Head Count by Campus. Retrieved 05.03.2021 from: https://www2.calstate.edu/csu-system/faculty-staff/employee-profile/csu-workforce/Pages/employee-headcount-by-campus.aspx
(Other communicable diseases would also re-emerge, but with low to moderate negative impacts on life safety, operations, and service delivery.)

Economic Impact of COVID-19 Pandemic on CSU Financial Health

During the first few months of the COVID-19 pandemic in 2020, the CSU system suffered tremendous negative fiscal impacts. From March through July of 2020 alone, over $146 million worth of revenue losses were sustained across the CSU system due to refunds to students for parking, housing and dining service fees during Spring Semester, 2020. (See Figure 24-2 below for the economic impact to the CSU – San Marcos campus). Several CSU campuses saw refund losses surpass $10 million. (See Figure 24-2.)

Figure 24-2: CSU COVID-19 Cost Tracking Showing Revenue Refund Losses and Increased Costs

During Spring Semester, 2020, campus shutdowns, the shift to remote learning, shrinking revenue from sources like dorm fees and student bookstores, and changes in enrollment patterns across the system unrelated to COVID-19 all hit the California State University system simultaneously with well over a $300 million loss from reduced revenues and from new costs.

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Mitigative Relief from Federal Assistance

The $1.5 billion in total federal assistance sent to the CSU system will help relieve the losses of revenues from services like dorms, parking and dining services during a year of mainly empty campuses. (See Table 24-11.) However, because of staggering COVID-related revenue losses, the CSU system is planning for three (3) years of fiscal duress.

Table 24-10: Total Federal Assistance to CSU for COVID-19 Related Losses, 2020 – 2021\textsuperscript{21,22,23}

<table>
<thead>
<tr>
<th>Institution</th>
<th>December 2020 Stimulus</th>
<th>CARES Act</th>
<th>APLU Projection of HEERF Total ARP Act Funding Allocation</th>
<th>Total Estimated Federal COVID Relief Funding</th>
</tr>
</thead>
<tbody>
<tr>
<td>California Polytechnic State University</td>
<td>$20,752,799</td>
<td>$14,725,000</td>
<td>$37,000,928</td>
<td>$72,478,727</td>
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<tr>
<td>California State Polytechnic University, Pomona</td>
<td>$48,614,353</td>
<td>$31,102,000</td>
<td>$86,044,649</td>
<td>$165,761,002</td>
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<tr>
<td>California State University Channel Islands</td>
<td>$14,288,099</td>
<td>$8,512,000</td>
<td>$24,915,170</td>
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<tr>
<td>California State University Maritime Academy</td>
<td>$1,381,700</td>
<td>$1,204,000</td>
<td>$2,472,622</td>
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<tr>
<td>California State University - Sacramento</td>
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<td>$35,643,000</td>
<td>$104,900,133</td>
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<td>California State University, Bakersfield</td>
<td>$22,855,632</td>
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<td>$75,624,197</td>
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</tbody>
</table>


<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>California State University, Chico</td>
<td>$31,603,856</td>
<td>$20,019,000</td>
<td>$55,754,538</td>
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<td>California State University, Dominguez Hills</td>
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<td>California State University, Fresno</td>
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<td>California State University, Fullerton</td>
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<td>$41,088,000</td>
<td>$120,859,884</td>
<td>$229,684,833</td>
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<td>California State University, Long Beach</td>
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<td>$41,202,000</td>
<td>$119,508,329</td>
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<td>California State University, Los Angeles</td>
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<td>California State University, Monterey Bay</td>
<td>$13,455,716</td>
<td>$8,705,000</td>
<td>$23,922,768</td>
<td>$46,083,484</td>
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<tr>
<td>California State University, Northridge</td>
<td>$74,004,088</td>
<td>$47,458,000</td>
<td>$131,021,450</td>
<td>$252,483,538</td>
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<tr>
<td>California State University, San Bernardino</td>
<td>$42,438,131</td>
<td>$27,924,000</td>
<td>$74,982,459</td>
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<td><strong>California State University, San Marcos</strong></td>
<td><strong>$26,602,684</strong></td>
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<td><strong>$46,496,808</strong></td>
<td><strong>$88,641,492</strong></td>
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<td>$30,000,000</td>
<td>$83,075,470</td>
<td>$160,479,879</td>
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</tbody>
</table>
Vulnerability Assessment Conclusions

Before the COVID-19 pandemic, populations at all CSU campuses and CSU-affiliated facilities were substantial. Collectively, as of Fall 2019, CSU campuses had 480,541 students and 53,763 faculty and staff. All were at risk from the communicable disease events, with 534,304 people being directly vulnerable. The COVID-19 pandemic has caused campus population numbers to plummet to a small fraction of full capacity.

At some point in the future, campus population numbers will return to their pre-pandemic levels, and students, faculty, and staff will again be vulnerable to the communicable disease hazard. *If just 10% of the total CSU population were to become ill with a highly infective communicable disease like influenza or another strain of SARS, this would mean that approximately 53,430 people would be sick at the same time.* This scenario would likely overwhelm available on-campus medical services and could even overwhelm portions of the larger community’s medical resources – especially if there were large numbers of infected people with immune system compromises or other underlying health problems.

See Table 24-12 below for the “10% outbreak scenario” projections for the CSU – San Marcos campus and for the entire CSU system.

![Table 24-11: Scenario of Communicable Disease Hazard Affecting 10% of the CSU Population](image-url)

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24 The California State University. Enrollment. Retrieved 05.04.2021 from: [https://www2.calstate.edu/csu-system/about-the-csu/facts-about-the-csu/enrollment/Pages/default.aspx](https://www2.calstate.edu/csu-system/about-the-csu/facts-about-the-csu/enrollment/Pages/default.aspx)

25 The California State University. Employee Head Count by Campus. Retrieved 05.04.2021 from: [https://www2.calstate.edu/csu-system/faculty-staff(employee-profile)/csu-workforce/Pages/employee-headcount-by-campus.aspx](https://www2.calstate.edu/csu-system/faculty-staff(employee-profile)/csu-workforce/Pages/employee-headcount-by-campus.aspx)
<table>
<thead>
<tr>
<th>Institution</th>
<th>Total Enrollment</th>
<th>Undergraduate Students</th>
<th>Graduate Students</th>
<th>Total Students</th>
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<td>Chico State</td>
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<td>1,969</td>
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<td>1,899</td>
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<tr>
<td>CSU Dominguez Hills</td>
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<td>1,761</td>
<td>18,788</td>
<td>1,879</td>
</tr>
<tr>
<td>Cal State East Bay</td>
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<td>1,764</td>
<td>16,469</td>
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<td>2,667</td>
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<td>815</td>
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<tr>
<td>Cal State Long Beach</td>
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<td>4,004</td>
<td>42,078</td>
<td>4,208</td>
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<td>2,821</td>
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<td>2,918</td>
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<tr>
<td>Cal Maritime</td>
<td>911</td>
<td>329</td>
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<td>CSU Monterey Bay</td>
<td>7,123</td>
<td>1,059</td>
<td>8,182</td>
<td>818</td>
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<td>CSUN (Northridge)</td>
<td>38,391</td>
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<td>Cal Poly Pomona</td>
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<td>San Diego State</td>
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<td>Cal Poly San Luis Obispo</td>
<td>21,242</td>
<td>2,871</td>
<td>24,113</td>
<td>2,411</td>
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<tr>
<td><strong>CSU San Marcos</strong></td>
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<td><strong>1,687</strong></td>
<td><strong>16,206</strong></td>
<td><strong>1,621</strong></td>
</tr>
<tr>
<td>Sonoma State</td>
<td>8,649</td>
<td>1,338</td>
<td>9,987</td>
<td>999</td>
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<td>Stanislaus State</td>
<td>10,614</td>
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<td>1,189</td>
</tr>
<tr>
<td>Office of the Chancellor</td>
<td>0</td>
<td>673</td>
<td>673</td>
<td>67</td>
</tr>
<tr>
<td><strong>CSU System-Wide</strong></td>
<td><strong>480,541</strong></td>
<td><strong>53,763</strong></td>
<td><strong>534,304</strong></td>
<td><strong>53,430</strong></td>
</tr>
</tbody>
</table>

*Note: Enrollment figures do not include non-specific CSU campus International Programs (455 students) or CALStateTEACH Program (933 students).*

While the case numbers of COVID-19 have been significantly lower (about 1% of the total CSU population) than those in the 10% scenario, the degree of virulence and resultant morbidity and mortality caused by COVID-19 have led to widespread campus shutdowns, educational disruption, and economic harm to the CSU system, including CSU - San...
Marcos. In short, the real-time COVID-19 communicable disease outbreak scenario has proven far more devastating than the 10% simulated scenario.

**Identified Data Limitations**

There is a wealth of technical information available for communicable disease. However, there is also limited non-COVID-19 communicable disease data available regarding risk or vulnerability of specific populations throughout the CSU. Much of the data that does exist is protected by privacy policies, and therefore cannot be obtained for more specific populations. As a result, performing a detailed quantitative assessment for this hazard is difficult.

Data that could be collected prior to the next update in order to improve this methodology includes:

- Data regarding infection rates at the campus level and for specific populations;
- Data regarding communicable disease case numbers and outcomes, by CSU campus;
- Data regarding projected population changes;
- Data regarding absenteeism; and
- Data regarding increased operating costs as a result of absenteeism (i.e., temporary shifting of duties resulting in business interruption).
**Dam and Levee Failure**

Description of the Hazard

A dam failure represents the structural collapse of a dam that stores water in a reservoir behind the dam. These failures are typically the result of structural age, damage to the structure caused by earthquake or flooding, inadequate discharge or spillway capacity, inadequate maintenance, improper construction materials, or extreme inflow of water into the reservoir. Prolonged precipitation may result in overtopping of the dam resulting in structural compromise. The tremendous energy generated by a sudden breach of the dam will have significant downstream effects. Flood damage resulting from dam failures potentially will result in economic losses, environmental damage, destruction of agriculture, and human casualties. This type of incident is extremely dangerous as it can occur rapidly, with no warning resulting in an inability to effectively evacuate threatened communities.

A levee failure is similar to dam failures as the result will be a breach causing flooding on the dry side of the levee. Levees are embankments whose primary purpose is to furnish flood protection from seasonal high water or divert the flow of water. Most levees in California are intended to withstand peak water levels generated by heavy precipitation or rapid snowmelt in a watershed. Other levees are designed to withstand fluctuating water levels on a continuous basis such as those in the California Delta exposed to tidal influences. Levees routinely extend for lengthy distances immediately protecting communities. Levees can be found throughout the state but are most prominent in the Sacramento and San Joaquin Valleys.

Levee failures can vary from overtopping to small uncontrolled discharge to catastrophic failure. Areas downstream of the failure will be subject to inundation dependent on the volume of water released. These levee failures are also typically the result of structural age, damage to the structure caused by earthquake or flooding, slumping, seepage underneath the levee, high velocity flows eroding the levee, inadequate capacity, inadequate maintenance, improper construction materials, or extreme inflow of water into the system. Flood damage resulting from levee failures potentially will result in economic losses, environmental damage, destruction of agriculture, and human casualties.

A Dam or levee failure flooding will vary depending on a number of factors including the extent of the collapse or breach, the volume of water behind the structure, and the nature of the exposed downstream features. This unpredictable flooding presents a threat to life and property in addition to critical infrastructure. Lifelines and supply routes will likely be damaged or made impassible by flood erosion or standing water. Water quality and health concerns would likely be cascading effects of dam or levee failures.

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Location of the Hazard

San Diego County is home to a variety of flood control facilities and levee systems mostly along the base of the various mountains and hills throughout the county. Levees have been constructed along flood control channels in the County but not in proximity to CSU San Marcos. The CSU San Marcos campus is in proximity to one relatively small dam a mile south of the campus. The campus is not in proximity to rivers or flood control channels lined with levees.

Figure 24-3: Dams and Levees near San Marcos

There are a number of dam facilities scattered throughout the hills east and south of San Marcos. These facilities do not have a direct impact on the campus but may provide hazards to transportation routes in and out of the campus and may affect areas in which members of the campus community reside. The CSU San Marcos campus lies outside of dam inundation zones for these facilities.
Figure 24-4: San Marcos Dam Breach Inundation Map

[Map of San Marcos Dam Breach Inundation with CSU: San Marcos Inundation highlighted.]

27 California Department of Water Resources, Dam Breach Inundation Map Publisher, https://fmds.water.ca.gov/webgis/?appid=dam_prototype_v2
Extent of the Hazard

Dams are classified according to the hazard that they pose to life and property in the event of failure, rather than the likelihood of that failure.
• High hazard potential dams may result in loss of human life, and will likely result in economic, environmental, or lifeline losses.
• Significant hazard potential dams are not expected to result in loss of life, but are expected to cause economic, environmental, and lifeline losses.
• Low hazard potential dams are not expected to result in loss of life, and there is a low expectation of economic, environmental, or lifeline losses. What losses do occur are generally limited to the dam owner.

Dams classified as high hazard are required to have Emergency Action Plans (EAP). EAPS are formal documents that identify potential emergency conditions at the dam and specify preplanned actions to be followed in case of failure. An EAP is required for all high hazard dams and is recommended for all significant hazard dams.

Table 24-12: San Diego County Dams in Proximity to CSU San Marcos

<table>
<thead>
<tr>
<th>River</th>
<th>Dam</th>
<th>Storage</th>
<th>Hazard Severity</th>
</tr>
</thead>
<tbody>
<tr>
<td>San Marcos</td>
<td>San Marcos</td>
<td>4,818af</td>
<td>High Hazard</td>
</tr>
</tbody>
</table>

The CSU San Marcos campus lies outside of the inundation zone of the dams listed above. In the event of a catastrophic failure of the identified dams, the CSU San Marcos campus is expected to remain out of an area affected by water inundation. The inundation area is expected to spread water to the west towards Lake San Marcos. There are multiple secondary transportation corridors and residential neighborhoods that lie within the dam inundation zones that could compromise transportation routes and areas the campus community reside or work. Based on these factors, the planning committee ranks the extent of the hazard as Low.

**Extent – Levee Failure**

Levees are used along numerous flood control channels and other waterways including portions of the San Marcos Creek. The CSU San Marcos campus lies outside of the levee flood protected area. Transportation routes accessing the campus cross into levee protected zones. In the event any of these channels were flowing at elevated levels and a failure of a levee were to occur, the community surrounding the campus would likely experience flood related damages. While the campus would not experience direct impacts, this specific hazard could alter the ability of the campus to maintain operations as damages would be extensive. Depending on the location of a breach, the campus community could be heavily affected with the loss of life and homes, access to campus would be limited, and student financial capacity to support ongoing education being diminished. However, it should be noted that levees undergo regulated monitoring, maintenance and inspections. Based on these factors, the planning committee ranks the extent of the hazard for the campus as Low.

History of the Hazard

There are no records of dam or levee failures in areas that present a threat to the CSU San Marcos campus. San Diego County has experienced the following dam failures:

Table 24-13: San Diego County Dam Failures

<table>
<thead>
<tr>
<th>Date</th>
<th>Dam</th>
<th>Release</th>
<th>Damage</th>
</tr>
</thead>
<tbody>
<tr>
<td>1/27/1916</td>
<td>Lower Otay</td>
<td>770af</td>
<td>Extensive, Infrastructure, 11 fatalities</td>
</tr>
<tr>
<td>1/30/1916</td>
<td>Sweetwater</td>
<td>Unknown</td>
<td>Extensive; Infrastructure</td>
</tr>
</tbody>
</table>

Potential Impacts of the Hazard

**Dam Failure Impacts**

Water that is released due to a dam that has failed generates tremendous energy and force causing a flood that will be catastrophic to life and property. Water levels from the failed dam could be significantly higher than those experienced in worst case scenario flood events. Areas closer to the failed dam will be more likely to experience complete devastation while other areas within the inundation zone will see varying levels of flood waters. The extent of the impacts of a failed dam would vary based on a number of factors such as the volume of water released, the base flow of the river, the time of the failure, the amount of warning provided, and the distance from the dam. Potential impacts resulting from a dam failure include:

- Loss of life
- Property destruction or damage
- Loss of property contents
- Infrastructure damage
- Flooded or destroyed lifelines/supply routes
- Damaged or destroyed utilities
- Loss of community economic base
- Employment losses
- Agricultural (crops and livestock) damages or destruction
- Environmental damage
- Floods generating threats to public health
- Flood generated debris

**Levee Failure Impacts**

A levee failure may result in substantial amounts of water to enter into developed areas protected by the levee. The force and volume of water that is generated by a levee failure may cause extensive structural damage in close proximity to the breach and effects of flooding spreading well beyond the point of the failure. The extent of the impacts would
vary based on a number of factors such as the volume of water released, the time of the failure, the amount of warning provided, the location of the breach, elevation, and distance from the breach. Potential impacts resulting from a levee failure include:

- Loss of life
- Property destruction or damage
- Loss of property contents
- Infrastructure damage
- Public health hazards resulting from mold, mildew, and disease due to flood water
- Flooded or destroyed lifelines/supply routes
- Damaged or destroyed utilities
- Loss of community economic base
- Employment losses
- Agricultural (crops and livestock) damages or destruction
- Environmental damage
- Prolonged periods of necessary dewatering

Probability of Future Occurrence of the Hazard

San Diego County is determined to be at risk from dam and levee failure in many parts of the county. The location of the CSU San Marcos campus is one mile to the north and lower in elevation to the San Marcos Dam / South Reservoir demonstrating that the potential exists for future dam or levee related issues. However, the dam inundation zone for the South Reservoir turns to the north east and away from the campus. The campus is ¾ of a mile from the boundary of the dam inundation zone. There are no identified levees in proximity to the campus and thus the campus is outside of any levee protected zone. There are no official recurrence intervals that have been calculated for dam or levee failures. Based on historical experience and occurrences, the likelihood of this hazard is low.

The CSU San Marcos, Temecula campus is ¼ mile away from the dam inundation zone for the Diamond Valley Lake that is 13 miles northeast of the campus and 2 miles from the dam inundation zone for the Skinner Reservoir. The campus is 1/8 of a mile from the Vail Lake Dam inundation zone. There are no identified levees in proximity to the Temecula campus and thus the campus is outside of any levee protected zone.

The probability of future occurrence for both dam and levee failures is Unlikely. 

Vulnerability to the Hazard

Given high priority monitoring and maintenance practices in place, a catastrophic dam or levee failure is highly unlikely. As such, vulnerability is tied to the consistency of these practices, and, therefore, is not considered to be truly vulnerable on a daily basis. However, in the unlikely event of a catastrophic failure, the effects of flooding from compromised dams and levees would not directly impact the campus but would most likely affect members of the campus community only in terms of disruption to regional
transportation networks and services and the amount of time to respond to the needs of the campus community prior to inundation will be limited.

Any breach along a levee is impossible to predict where a failure may occur. It is likely that response action will not be fully implemented until the incident situational intelligence provides adequate information as to compromised locations. These variables place all those working and living within the dam inundation and flood protection zones in vulnerable locations.

The distributed placement of levees, most near development may expose significant vulnerabilities to other areas of the region even if the campus is unaffected. There is potential the campus community will be affected as a breach may cause flooding and damages to the homes of students, faculty, and staff or to access/supply routes, utilities, or other critical services. The potential for flood damaged structures being left uninhabitable including campus residence halls will result in the vulnerability of numerous displaced individuals and households. The lack of flood insurance will cause additional extreme financial burdens on those affected.

Vulnerability to a dam or levee failure on the CSU San Marcos campus will vary depending on when the failure was to occur. The risk to the campus population will be lessened during periods when classes are not in session or during periods of breaks. Conversely, during the days and hours that classes are in session and staff are at their workplaces, the human vulnerability increases. However, in region-wide events this vulnerability may be shared with the homes and workplaces of members of the campus community and their families.

Certain campus populations will experience greater challenges to a post-flood / failure environment. Vulnerable populations will likely need to navigate through flood generated debris, face extreme health safety issues from flood waters, experience extreme stresses of a disaster, an inability to communicate to or gain access to support networks, and find difficulty in accessing equipment or supplies to aid in a specific need.

Estimate of Potential Losses

Estimates of potential losses will be influenced by a variety of factors. The volume and force of the water will determine the scale of damages affecting campus infrastructure, equipment, and other impacted features. The proximity to the failure and elevation above flood waters will affect the level of damage and individuals exposed. The time of the academic year, the day of week, and hour in which the failure was to occur will influence the number of people on campus and potential casualties. Losses will be generated by the physical damages, the loss of revenue, loss of academic research, loss of building contents, and community wide economic reductions.

Based on estimate replacement costs of facilities and structures on campus, the total replacement costs due to dam or levee failure are $217,777,651. However, it is unlikely for a dam or levee failure event to cause catastrophic destruction at CSU San Marcos.
Vulnerability Assessment Conclusions

While the occurrence of dam and levee failures have not been historically relevant near the CSU San Marcos campus, the potential for hazards related to the region’s levees and dams still exist. However, the presence of earthquake faults in proximity to the existing dam and levee structures presents a valid danger to downstream locations in the event of an earthquake. In the unlikely event of a high priority dam’s total failure, the consequences would be catastrophic to downstream communities. The potential for dam or levee failure further generates the added potential for a number of cascading effects such as disruptions to the local economy, utility failures, disruptions to providing for the needs of the community, and development of public health hazards. These effects would be exacerbated by effects of seasonal flooding, ongoing heavy precipitation, or excessive run-off from the watershed contributing to the river system. The potential for widespread flooding and damage of structures due to the force of water has exponentially powerful impacts on particular populations among the campus community including those with access or functional needs, international students, the homeless, and students residing in the residence halls.

Identified Data Limitations

Data limitations include missing campus structural replacement costs, and an incomplete inventory of both building construction features and mitigation efforts to lessen the impact due to flood inundation.
**Drought**

Description of the Hazard

Drought is defined as a condition where moisture levels fall significantly below normal for an extended period of time over a large area that adversely affects plants, animal life, and humans. Drought is a gradual phenomenon. Although droughts are sometimes characterized as emergencies, they differ from typical emergency events. Most natural disasters, such as floods or forest fires, occur relatively rapidly and afford little time for preparing for disaster response. Droughts occur slowly, over a multi-year period, and it is often not obvious or easy to quantify when a drought begins and ends.

Throughout California, one dry year does not normally constitute a drought. California’s extensive system of water supply infrastructure (reservoirs, groundwater basins, and conveyance assets) mitigates the effect of short-term dry periods for most water users. Defining when a drought begins is a function of drought impacts to water users. Drought in one location may not constitute a drought for all water users, as some users in relative proximity may have a different water supply. For example, individual water suppliers may use a combination of sources such as rainfall/runoff, water in storage, or expected supply from a water wholesaler to define their water supply conditions.

Drought can be characterized as one or more of the four following types:

- **Meteorological drought** is defined on the basis of the degree of dryness (in comparison to some “normal” or average amount) and the duration of the dry period. A meteorological drought must be considered as region-specific since the atmospheric conditions that result in deficiencies of precipitation are highly variable from region to region.

- **Hydrological drought** is associated with the effects of periods of precipitation (including snowfall) shortfalls on surface or subsurface water supply (e.g., streamflow, reservoir and lake levels, ground water). The frequency and severity of hydrological drought is often defined on a watershed or river basin scale. Although all droughts originate with a deficiency of precipitation, hydrologists are more concerned with how this deficiency plays out through the hydrologic system. Hydrological droughts are usually out of phase with or lag the occurrence of meteorological and agricultural droughts. It takes longer for precipitation deficiencies to show up in components of the hydrological system such as soil moisture, streamflow, and ground water and reservoir levels. As a result, these impacts are out of phase with impacts in other economic sectors.

- **Agricultural drought** focus is on soil moisture deficiencies, differences between actual and potential evaporation, reduced ground water or reservoir levels, and so forth. Plant water demand depends on prevailing weather conditions, biological characteristics of the specific plant, its stage of growth, and the physical and biological properties of the soil.
• **Socioeconomic drought** refers to when physical water shortage begins to affect health, well-being, and quality of life of people, or when the drought starts to affect the supply and demand of an economic product that relies on water.

The drought issue in California is further compounded by water rights. The central challenge is how to prioritize water usage among a broad variety of contexts. It is for this reason that water is a commodity possessed and utilized under a variety of legal doctrines. As such, many competing sets of interests create a dynamic prioritization process between, for example, farming and federally protected fish habitats and water supply for municipal/public use (including usage for CSU –San Marcos) versus water usage for wildfire abatement or natural resource protection.

**Location of the Hazard**

Drought conditions have been identified throughout San Diego County where the campus is located. Drought is not a location-specific hazard and affects the entire planning area equally. Drought location is not isolated to the campus footprint but occurs as a geographic sub-set of drought conditions occurring at larger scales. From 2000-2020, drought conditions existed continuously in the state, with 80-100% of the state impacted for 12 of the last 20 years. 29

**Extent of the Hazard**

Given the historical occurrence of severe drought impacts throughout San Diego County (including the planning area) and across the state and the potential future impact exacerbated by climate change, the CSU Planning Committee recognizes that drought will continue to pose a high degree of risk, potentially impacting crops, livestock, water resources, the natural environment at large, buildings and infrastructure (from land subsidence), and local economies. In addition, although drought affects the entire planning equally, the potential impacts may be variable and specific to each campus/jurisdiction, depending on contextual factors such as the degree of assets and activities, historically impacted by drought within each jurisdiction. In addition, land subsidence has occurred and will continue in areas where the groundwater basin has been subject to overdraft and long-term recharge is inadequate to maintain the water table elevation, leaving underground voids. Subsidence levels have been measured up to 30-feet with subsidence bowls covering hundreds of square miles. As such, drought-related subsidence may result in serious structural damage to buildings, roads, irrigation ditches, underground utilities, and pipelines. These effects though rare, are issues of concern for the campus over the long term.[1]

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The U.S. Drought Monitor developed tables of impacts reported during past droughts in California in order to depict the extent of drought risk for each level of drought on the U.S. These possible extent conditions for California complement the general impacts column of the U.S. Drought Monitor Classification Scheme.

Table 24-14: Impacts of Drought Levels as Determined by US Drought Monitor

<table>
<thead>
<tr>
<th>Category</th>
<th>Impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>D0</td>
<td>Soil is dry; irrigation delivery begins early</td>
</tr>
<tr>
<td></td>
<td>Dryland crop germination is stunted</td>
</tr>
<tr>
<td></td>
<td>Active fire season begins</td>
</tr>
<tr>
<td></td>
<td>Winter resort visitation is low; snowpack is minimal</td>
</tr>
<tr>
<td>D1</td>
<td>Dryland pasture growth is stunted; producers give supplemental feed to cattle</td>
</tr>
<tr>
<td></td>
<td>Landscaping and gardens need irrigation earlier; wildlife patterns begin to change</td>
</tr>
<tr>
<td></td>
<td>Stock ponds and creeks are lower than usual</td>
</tr>
<tr>
<td>D2</td>
<td>Grazing land is inadequate</td>
</tr>
<tr>
<td></td>
<td>Producers increase water efficiency methods and drought-resistant crops</td>
</tr>
<tr>
<td></td>
<td>Fire season is longer, with high burn intensity, dry fuels, and large fire spatial extent; more fire crews are on staff</td>
</tr>
<tr>
<td></td>
<td>Wine country tourism increases; lake- and river-based tourism declines; boat ramps close</td>
</tr>
<tr>
<td></td>
<td>Trees are stressed; plants increase reproductive mechanisms; wildlife diseases increase</td>
</tr>
<tr>
<td></td>
<td>Water temperature increases; programs to divert water to protect fish begin</td>
</tr>
<tr>
<td></td>
<td>River flows decrease; reservoir levels are low and banks are exposed</td>
</tr>
<tr>
<td>D3</td>
<td>Livestock need expensive supplemental feed, cattle and horses are sold; little pasture remains, producers find it difficult to maintain organic meat requirements</td>
</tr>
<tr>
<td></td>
<td>Fruit trees bud early; producers begin irrigating in the winter</td>
</tr>
<tr>
<td></td>
<td>Federal water is not adequate to meet irrigation contracts; extracting supplemental groundwater is expensive</td>
</tr>
<tr>
<td></td>
<td>Dairy operations close</td>
</tr>
<tr>
<td></td>
<td>Marijuana growers illegally tap water out of rivers</td>
</tr>
</tbody>
</table>

30 United States Drought Monitor. *Drought Classification*. Retrieved 05.04.2021 from: [https://droughtmonitor.unl.edu/About/AbouttheData/DroughtClassification.aspx](https://droughtmonitor.unl.edu/About/AbouttheData/DroughtClassification.aspx)
Fire season lasts year-round; fires occur in typically wet parts of state; burn bans are implemented

Ski and rafting business is low, mountain communities suffer

Orchard removal and well drilling company business increase; panning for gold increases

Low river levels impede fish migration and cause lower survival rates

Wildlife encroach on developed areas; little native food and water is available for bears, which hibernate less

Water sanitation is a concern, reservoir levels drop significantly, surface water is nearly dry, flows are very low; water theft occurs

Wells and aquifer levels decrease; homeowners drill new wells

Water conservation rebate programs increase; water use restrictions are implemented; water transfers increase

Water is inadequate for agriculture, wildlife, and urban needs; reservoirs are extremely low; hydropower is restricted

Fields are left fallow; orchards are removed; vegetable yields are low; honey harvest is small

Fire season is very costly; number of fires and area burned are extensive

Many recreational activities are affected

Fish rescue and relocation begins; pine beetle infestation occurs; forest mortality is high; wetlands dry up; survival of native plants and animals is low; fewer wildflowers bloom; wildlife death is widespread; algae blooms appear

Policy change; agriculture unemployment is high, food aid is needed

Poor air quality affects health; greenhouse gas emissions increase as hydropower production decreases; West Nile Virus outbreaks rise

Water shortages are widespread; surface water is depleted; federal irrigation water deliveries are extremely low; junior water rights are curtailed; water prices are extremely high; wells are dry, more and deeper wells are drilled; water quality is poor;

History of the Hazard

Although previous occurrence of drought is not identified specifically for the campus, drought has been so prevalent in California that its presence is almost ubiquitous and continuous, including the CSU - San Marcos footprint.
According to the National Drought Mitigation Center, over 3,500 reports and publications covering 370 drought-related events took place across the state (many of which were statewide events) between 2000-2020. In addition, the National Center for Environmental Information (NCEI) reports more than 500 events statewide during this same time period. These events produced a comprehensive range of impacts to water supply, regulations and allocations to businesses and municipalities, budgets and resources for firefighting, water law and policy, and physical impacts to built and natural environments. As such, data records of previous occurrences can be viewed as separate time and event demarcations for a hazard almost continuously in effect across the state with cascading impact potential. 31

Best available data does not identify a timeline of historical occurrences specific to the campus, but the water table at the campus farm is receding, indicating the recent occurrence of drought on campus.

According to the Department of Water Resources, droughts exceeding three years are relatively common in Southern California, but relatively rare in Northern California - the region is the geographic source of much of the state’s developed water supply. The 1929-34 drought established the criteria commonly used in designing storage capacity and yield of large Northern California reservoirs. 32

According to the US Drought Monitor’s time series data, from 2000-2021 (with the exception of a 2–3-month period in 2000 and 2011), some degree of drought conditions have been continuously in effect somewhere in California. In fact, 80% - 100% of the state has been subjected to drought conditions for 12 of the last 20 years, with the most severe drought being the 100% state-wide event from 2012-2017. 33

Figure 24-6: Periods of Drought in State of California, 2001 – 2021 34

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Given the ubiquitous nature of the drought risk in California, the following drought event was selected as an exemplar due to its broad and significant impacts on the state and on the CSU - San Marcos campus planning area:

**2012 – 2017** – Drought produced severe impacts to water wells throughout the state of California, with a high number of wells running dry. Land subsidence due to increased groundwater pumping also occurred in numerous areas of the state such as the San Joaquin and Central Valleys. Crop damage was widespread as well. Water allotments were drastically reduced in many towns and water agencies, with extremely high costs for procuring water. In addition, job loss occurred with many families requiring food supply assistance, and water supply assistance provided to home-owners with dry wells. According to a report released by UC Davis Center for Watershed Sciences, the 2012-2017 period of the California drought cost the state's agriculture industry about $1 billion in lost revenue, with a total statewide economic cost of the drought calculated to be $2.2 billion. The report says, ‘it is responsible for the greatest water loss ever seen in California agriculture - about one third less than normal”. The report calls the groundwater situation in California "a slow-moving train wreck." Spring snowpack at Donner Summit reached record low levels in 2014, exceeded in 2015 by a remarkable April 1 snow-water-equivalent value of only 5% of average. Decreased precipitation since contributed to near-record low levels in the Shasta Reservoir. The ongoing drought has contributed to declines in crop values across the state. For example, crops including cotton, corn silage and barley (the field crop category) fell by 42 percent.  

### Potential Impacts of the Hazard

Drought impacts are wide-reaching and may be economic, environmental, and/or societal. This assessment of its impact recognizes that historic occurrences of drought throughout the planning area are a sub-set of larger and inter-connected local and regional droughts, and that the (related) historic impacts provide a sound basis for understanding potential (future) impacts.

The most significant impact associated with drought across the CSU - San Marcos campus planning area is the historic and potential reduction in water availability for the municipal area tied to each campus. Other impacts include crop loss and damage to trees and other natural resources (See Tree Mortality below). The footprint of CSU - San Marcos to some extent includes these vulnerable resources based on the campus landscape (trees) and the presence (and footprint size) of agricultural research crops and field stations.

As a secondary impact of drought, wildfire is directly attributable to dry atmospheric conditions. Wildfires almost always coincide with drought in California, though not limited to such. However, the wildfire hazard is analyzed separately in this plan. (See wildfire hazard).

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35 National Oceanic and Atmospheric Administration National Centers for Environmental Information. *State Climate Summaries: California.* Retrieved 05.04.2021 from: [https://statesummaries.ncics.org/chapter/ca/](https://statesummaries.ncics.org/chapter/ca/)

In reviewing the occurrences of drought for CSU - San Marcos and San Marcos, CA, the US Drought Monitor and the National Drought Mitigation Center report that tens of millions of trees died during the (2014-2017) state-wide drought disaster. Though data sources do not provide data for tree mortality specific to CSU - San Marcos, the broad geographic extent of the impact makes it likely that tree mortality occurred to some degree on the campuses. Due to the lasting and ongoing effects of drought on the landscape, trees will continue to be impacted within the municipalities, counties and regions wherein lies the CSU campus system as long as drought conditions continue.

Given the absence of data, in order for the CSU Committee to assess the impact of tree mortality, it is useful to view it as a risk sub-set to the probability, location, extent, severity and duration of the drought hazard within each campus-located municipality, county and region. Regarding potential impacts, standing dead trees could fall, posing a risk to people, buildings, power lines, roads and other infrastructure. In addition, drought-impacted trees become susceptible to diseases and insect infestations (bark beetle) further adding to the risk of tree mortality and related potential impacts. No data are currently available for tree mortality on campus; however, the CSU Planning Team will pursue data on this issue in the future.

As a potential tertiary impact, prolonged and repeated drought conditions over time can produce land subsidence and the risk of damage to building foundations and infrastructure on campus resulting from ground instability and collapse. Land subsidence is defined as the vertical sinking of the land over manmade or natural underground voids. Subsidence is often the direct result of groundwater over-extraction in response to drought conditions, as well as oil and gas extraction. Weight can accelerate the process of subsidence resulting from surface development and infrastructure such as roads and buildings, vibrations from construction blasting and heavy truck or train traffic. For example, the State Water Project’s 444-mile-long California Aqueduct has required repairs such as the raising of canal linings, bridges, and water control structures on the Aqueduct – in the Central Valley a five-mile reach of the Eastside Bypass was impacted by subsidence, and the Department of Water Resources estimated that it may cost in the range of $250 million to acquire flowage easements and levee improvements to restore the design capacity of the subsided area.

At present, drought related damage to campus buildings and infrastructure at CSU - San Marcos has not been reported, but the potential for such impacts is possible. With regard to overall potential impact, water supply/availability for CSU - San Marcos is ultimately tied to broader inter-dependent, and more intensive modes of water use at local and regional scales such as agriculture and ranching, wildfire protection, larger metropolitan/municipal usage, manufacturing and commerce, tourism, recreation, and wildlife preservation. During drought periods, the State of California’s regulated water allocations are modified and often reduced, which can result in reduced water availability.

for all usage contexts, including CSU - San Marcos. A reduction of electric power generation and water quality deterioration are also potential impact factors.

Table 24-15: Summary of Drought Impacts on Water Resources

<table>
<thead>
<tr>
<th>Resource</th>
<th>Type of Impact</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sea Level</td>
<td>Direct</td>
<td>Sea level is rising and will likely impact coastal areas</td>
</tr>
<tr>
<td>Soil Moisture</td>
<td>Direct</td>
<td>Prolonged dry seasons can lead to decreases in soil moisture; drier vegetation</td>
</tr>
<tr>
<td>Vegetation</td>
<td>Indirect</td>
<td>Longer and more intense fire season with increased extent of area burned</td>
</tr>
<tr>
<td>Stream Conditions</td>
<td>Direct</td>
<td>Increases in water temperature; potential effects on fish</td>
</tr>
<tr>
<td>Snowpack</td>
<td>Indirect</td>
<td>Increases in temperature will lead to decreases in snowpack</td>
</tr>
<tr>
<td>Runoff</td>
<td>Direct</td>
<td>Warmer temperatures are likely to lead to a shift in peak runoff from spring to winter and a likely decrease in summer base flow</td>
</tr>
<tr>
<td>Hydropower</td>
<td>Indirect</td>
<td>Decreased summer flows resulting from earlier snowmelt and a shift in peak runoff could affect hydropower generation during summer months</td>
</tr>
<tr>
<td>Precipitation</td>
<td>Direct</td>
<td>Warmer winter temperatures will result in a greater percentage of precipitation falling as rain rather than as snow</td>
</tr>
<tr>
<td>Groundwater</td>
<td>Indirect</td>
<td>Reduction in snowpack and extended periods of drought are likely to increase dependency on groundwater</td>
</tr>
</tbody>
</table>

Probability of Future Occurrence of the Hazard

**Highly Likely** — The US Drought Monitor’s time series data (2000-2020) indicates that some degree of drought has nearly a 100% probability of occurrence somewhere in the state in any given year. Given that CSU - San Marcos lies within a drought impacted region, it is prudent to extend this likelihood of occurrence to the planning area.

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Vulnerability to the Hazard

In California, rising temperatures are projected to increase the average lowest elevation at which snow falls, reducing water storage in the snowpack, particularly at those lower mountain elevations which are now on the margins of reliable snowpack accumulation. Higher spring temperatures will also result in earlier melting of the snowpack. The shift in snow melt to earlier in the season is critical for California’s water supply because flood control rules require that water be allowed to flow downstream and that water cannot be stored in reservoirs for use in the dry season. As such, state-level drought risk factors that have led to drought’s state-wide severity and extent, and potential impacts also create drought vulnerabilities at the level of the CSU - San Marcos campus.

Moreover, climate change will likely adversely impact the vulnerability of watersheds and ecosystems in their ability to deliver important ecosystem services. These changes may limit the natural capacity of healthy forests to capture water and regulate stream flows. Sierra Nevada mountain winters and springs are warming, and on average, precipitation as snowfall relative to rain is decreasing. A warming climate with reduced snowpack will result in earlier snowmelt and will subsequently reduce downstream water availability during summer and early fall.

As such, the state and the CSU - San Marcos planning area stakeholders potentially have less capacity to address future drought risks due to projected temperature increases and shortages in water; ground-water withdrawals have been occurring at a deficit rate of 1 – 2 million acre feet per year, where the impacts of drought include decreased availability of water for agriculture and environmental uses. In forested and other vegetated areas, prolonged drought decreases the moisture content of forest fuels and increases the risk of high severity wildfires.

It should be pointed out that California is the single most productive agricultural state and its agricultural industry relies heavily on reservoir water supplied by snowmelt and rainfall runoff. Yearly variations in snowpack depths have implications for water availability as snowmelt from the winter snowpack feeds a network of reservoirs. Spring snowpack at Donner Summit reached record low levels in 2014, exceeded in 2015 by a remarkable April 1 snow-water-equivalent value of only 5% of average. Decreased precipitation since 2011 has contributed to near-record low levels in the Shasta Reservoir.

Vulnerability of Populations

The historical and potential impacts of drought on California’s population include agricultural sector job loss, secondary economic losses to local businesses and public recreational resources, increased cost to local and state government for large-scale water acquisition and delivery, and water rationing and water wells running dry for individuals and families. As drought is often accompanied by prolonged periods of extreme heat,
negative health impacts such as dehydration can also occur, where children and elderly are most susceptible. Air quality often declines in times of drought which can affect those with respiratory ailments. These same vulnerability measures apply to the students, faculty and staff of the CSU – San Marcos campus.

**Property Vulnerability**

The historical and potential impacts of drought on property include crop loss, injury and death of livestock and pets, and damage to infrastructure, homes and other buildings resulting from the secondary drought impact of land subsidence. The related drought impacts of tree mortality and land subsidence pose risks to vulnerable critical infrastructure and property. These same vulnerability measures apply to the properties of the CSU - San Marcos campus.

**Natural Environment Vulnerability**

The historical and potential impacts of drought on the natural environment are widespread throughout public and private lands within the state, including tree mortality, impacts to all flora and fauna, and destabilization (subsidence) of land along streams and rivers, and within watersheds.

The core issue shaping the impact of drought throughout California is water supply and demand. Several factors play into the issue including groundwater basins, surface water run-off, public and agricultural demand, and surface water storage water sheds. A USGS led analysis was first conducted in 2010 through the Forest and Rangeland Assessment and ongoing through the USGS Forest and Rangeland Ecosystem Science Center to identify threats and assets where water supply would benefit from environmental management designed to protect or enhance water resources, the key effort which, in part, both defines and mitigates the severity of drought risk and vulnerabilities.

With regard to overall threat and asset findings shaping the potential severity of drought, the watersheds in the Sierra region contribute most greatly to the state’s water supply, but are under threat from climate change, wildfire and development. In addition, groundwater basins in the San Joaquin Valley and Sacramento Valley bioregions are an abundant resource that is heavily threatened by over pumping.

**Critical Facilities Vulnerabilities**

Drought impacts to state and CSU - San Marcos’s critical facilities include water shortfalls for facility operations and critical functions, and potential structural destabilization and damage resulting from land subsidence.

**Estimate of Potential Losses**

An estimate of potential losses from drought has not been calculated for the campus or the CSU system as a whole. However. drought related losses to the City of San Marcos and the surrounding region such as crop loss and cost increases for water resources have
re-occurred over time. Please consult city and county level government, and/or state agricultural agencies for data on the financial impacts from drought.

Vulnerability Assessment Conclusions

The CSU Planning Committee understands that the high degree of vulnerability posed by drought will be exacerbated by greater climate variation in the future and therefore greater variation and uncertainty regarding the availability of water supplies which are already under tremendous stress. In response to such vulnerability, state legislation passed in 2014 requires local governments to regulate pumping and recharge to better manage groundwater supplies, and groundwater-dependent regions are required to halt overdraft and bring basins into sustainable levels of pumping and recharge by the early 2040s. That said, the Committee will continue to work with local, regional and state partners and stakeholders to explore solutions for mitigating the drought hazard on its campuses by accessing the best available data and resources on climate change and its relationship to drought.

Identified Data Limitations

Data is limited concerning campus-related agricultural assets as well as data on campus tree mortality.
Earthquake

Description of the Hazard

An earthquake is a sudden motion or shaking caused by the release of pressure accumulated along the edge of tectonic plates covering the earth. These huge plates are constantly moving and move ever so slowly under, over, or by passing one another. This movement is gradual however the plates may lock together accumulating enormous amounts of energy. When this energy builds, stress develops, and the adjoining plates will eventually break free and result in ground shaking – an earthquake.

Large earthquakes may result in fissuring, ground settlement, and/or vertical or horizontal displacement. Earthquakes occur without warning and can result in extensive damages and human casualties. Damages associated to earthquake generated ground shaking is normally confined to a narrow area along fault trend from the earthquake epicenter. However, seismic waves may generate ground shaking resulting in damages in areas outside of the fault trend.

Fault Rupture – The rupture of faults is the differential movement of the two sides of the earth’s plates at the point of the fault. Horizontal or vertical displacement may be significant and occur over great distances. The movement and energy that occurs along a fault is released in waves resulting in ground shaking. The intensity of ground shaking varies based on the magnitude of the earthquake, the proximity to the earthquake epicenter, the composition of the ground sediment or rock the waves travel through, and the depth of the earthquake.

Liquefaction – In addition to the primary fault rupture that occurs right along a fault during an earthquake, the ground many miles away can also fail during intense shaking. As seismic waves travel through saturated granular soil; the soil begins to liquefy and act as a fluid. Soil strength and stability is lost causing the effects of ground shaking to intensify and for ground deformation to occur. These water saturated soils when shaken quickly lose the ability to support buildings, bridges, utilities, and other structures. Areas susceptible to liquefaction include places where sandy sediments have been deposited by rivers along their course or by wave action along beaches. The greater the magnitude of an earthquake and longer duration of strong ground shaking will result in an enhanced potential for liquefaction to occur. Settlement can cause damage when the amount settlement varies significantly across the length of a structure. Lateral spreading occurs when liquefaction occurs on gently sloping ground and the liquefied material at depth allows the area to slide, often toward a vertical discontinuity or “free face” such as a creek or stream channel. Liquefaction can occur in susceptible soils below bodies of water, and settlement and lateral spreading can damage structures built on or adjacent to these areas. Transportation bridges across water bodies, wharves, piers and other structures at ports and harbors, and underwater utility lines can be severely damaged by this hidden hazard.

Subsidence - Changes in the local environment that cause subsidence or sinkholes are called triggering mechanisms. Water is the primary factor that affects the local
environment and causes subsidence. Water level decline, changes in groundwater flow, increased loading, and deterioration (such as abandoned mines) are all triggering mechanisms. Water level decline may occur naturally, or it may be the result of human action. Factors that lead to water decline are pumping (from wells), localized drainage (for construction activities), dewatering, or drought. Changes in groundwater flow can result from an increase in the velocity of groundwater movement, and increase in the frequency of water table fluctuations, and changes in discharge (either increase or decrease). Increased loading can cause pressure in the soil, leading to the failure of underground cavities and space, such as caves. Vibrations from earthquakes, heavy machinery, and blasting may result in structural collapse, followed by surface resettlement.

Location of the Hazard

The State of California is particularly vulnerable to earthquake activity due to California’s location residing between two large tectonic plates. CSU San Marcos is located in northern San Diego County bordering Escondido. In general, fault systems surround and traverse through San Diego County including the area of CSU San Marcos. Throughout the valleys the ground is saturated with sediment eroded from the mountains and foothills via multiple stream and river channels and resulting in liquefaction zones scattered across the region.

The Pacific Plate and the North American Plate come together at the San Andreas Fault 80-85 miles east of the CSU San Marcos campus. In addition to the San Andreas Fault, San Diego County is home to or near additional fault systems with the potential to generate strong ground shaking. The Elsinore Fault extends across the northern portions of the county in a southeast to northwest direction. The Newport-Inglewood Fault is another southeast to northwest fault 13 miles west of the campus paralleling the coastline. The San Jacinto Fault extends from the Salton Sea to the Cajon Pass approximately 40-45 miles northeast of the campus. There are numerous additional faults in the area on all sides of the campus.
The CSU San Marcos campus does not reside within areas designated to be liquefaction zones. However, substantial areas of the community surrounding the campus reside within the liquefaction zones including access routes into and out of the campus. These zones mostly follow the creek channels. This includes Interstate 15, State Route 78, and South Twin Oaks Valley Road. The liquefaction zone generally follows the path of the San Marcos Creek.

Extent of the Hazard

The extent or severity of earthquake damage is expressed in terms of magnitude, intensity, and duration. The amount of energy released during an earthquake is normally conveyed as a magnitude measured from a seismogram. Magnitude is expressed in numbers and decimals representing the physical size of the earthquake. The strength and effect of the shaking on the surface of the earth is classified as the intensity. Intensity is further defined from the effects the earthquake has on people, structures, and the natural environment. The intensity of an earthquake in terms of measuring magnitude and
evaluating its effects is generally expressed using the Modified Mercalli (MM) Intensity Scale. Duration is the length of time the earthquake’s energy is released.

The Richter magnitude scale was developed in 1935 by Charles F. Richter of the California Institute of Technology as a mathematical device to compare the size of earthquakes. The Richter Scale is the best-known scale for measuring the magnitude of earthquakes. The magnitude value is proportional to the logarithm of the amplitude of the strongest wave during an earthquake. A recording of 7, for example, indicates a disturbance with ground motion 10 times as large as a recording of 6. The energy released by an earthquake increases by a factor of 31 for every unit increase in the Richter scale.

Table 24-16: Earthquake Intensity and Frequency Comparisons

<table>
<thead>
<tr>
<th>Magnitude</th>
<th>Mercalli Intensity</th>
<th>Potential Damage</th>
<th>Global Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 2.0</td>
<td>I</td>
<td>None</td>
<td>Continually</td>
</tr>
<tr>
<td>2.0 - 2.9</td>
<td>I to II</td>
<td>None</td>
<td>&gt; 1M per year</td>
</tr>
<tr>
<td>3.0 - 3.9</td>
<td>II to IV</td>
<td>None</td>
<td>&gt; 100,000 per year</td>
</tr>
<tr>
<td>4.0 - 4.9</td>
<td>IV to VII</td>
<td>Light</td>
<td>10K to 15 K per year</td>
</tr>
<tr>
<td>5.0 - 5.9</td>
<td>VI to VII</td>
<td>Moderate</td>
<td>1K to 1,500 per year</td>
</tr>
<tr>
<td>6.0 - 6.9</td>
<td>VII to X</td>
<td>Heavy</td>
<td>100 to 150 per year</td>
</tr>
<tr>
<td>7.0 - 7.9</td>
<td>VII &lt;</td>
<td>Very Heavy</td>
<td>10 - 20 per year</td>
</tr>
<tr>
<td>8.0 - 8.9</td>
<td>VII &lt;</td>
<td>None</td>
<td>1 per year</td>
</tr>
<tr>
<td>&gt; 9.0</td>
<td>VII &lt;</td>
<td>None</td>
<td>1 per 10-50 years</td>
</tr>
</tbody>
</table>

The Modified Mercalli Intensity Scale provides descriptive values of earthquake intensity that may provide greater meaning to the broader population as the description of intensity refers to the effects actually experienced. This scale uses an arbitrary ranking based on observed earthquake effects. The scale is composed of increasing levels of intensity ranging from shaking that is not recognizable to intense shaking resulting in catastrophic damages and casualties. The Modified Mercalli Intensity Scale is demonstrated below:
Table 20-17: Modified Mercalli Intensity Scale\textsuperscript{41}

<table>
<thead>
<tr>
<th>Intensity</th>
<th>Shaking</th>
<th>Description / Damage</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Not felt</td>
<td>Not felt except by a very few under especially favorable conditions.</td>
</tr>
<tr>
<td>II</td>
<td>Weak</td>
<td>Felt only by a few persons at rest, especially on upper floors of buildings.</td>
</tr>
<tr>
<td>III</td>
<td>Weak</td>
<td>Felt quite noticeably by persons indoors, especially on upper floors of buildings. Many people do not recognize it as an earthquake. Standing motor cars may rock slightly. Vibrations similar to the passing of a truck. Duration estimated.</td>
</tr>
<tr>
<td>IV</td>
<td>Light</td>
<td>Felt indoors by many, outdoors by few during the day. At night, some awakened. Dishes, windows, doors disturbed; walls make cracking sound. Sensation like heavy truck striking building. Standing motor cars rocked noticeably.</td>
</tr>
<tr>
<td>V</td>
<td>Moderate</td>
<td>Felt by nearly everyone; many awakened. Some dishes, windows broken. Unstable objects overturned. Pendulum clocks may stop.</td>
</tr>
<tr>
<td>VI</td>
<td>Strong</td>
<td>Felt by all, many frightened. Some heavy furniture moved; a few instances of fallen plaster. Damage slight.</td>
</tr>
<tr>
<td>VII</td>
<td>Very strong</td>
<td>Damage negligible in buildings of good design and construction; slight to moderate in well-built ordinary structures; considerable damage in poorly built or badly designed structures; some chimneys broken.</td>
</tr>
<tr>
<td>VIII</td>
<td>Severe</td>
<td>Damage slight in specially designed structures; considerable damage in ordinary substantial buildings with partial collapse. Damage great in poorly built structures. Fall of chimneys, factory stacks, columns, monuments, walls. Heavy furniture overturned.</td>
</tr>
</tbody>
</table>

\[\begin{array}{|c|c|}
\hline
\text{IX} & \text{Violent} \\
\hline
\text{Damage considerable in specially designed structures; well-designed frame structures thrown out of plumb. Damage great in substantial buildings, with partial collapse. Buildings shifted off foundations.} \\
\hline
\text{X} & \text{Extreme} \\
\hline
\text{Some well-built wooden structures destroyed; most masonry and frame structures destroyed with foundations. Rails bent.} \\
\hline
\end{array}\]

The graph below illustrates the increasing intensity of energy that is released and as the measured magnitude increases. While each whole number increases in magnitude represents a tenfold increase in the measured amplitude, it represents an increasing rate of 32 times more energy released in the same increase in magnitude. As the magnitude of an earthquake is measured higher, the intensity of the earthquake worsens progressively from one category to the next.

Figure 24-8: Earthquake Magnitude and Equivalent Energy Release$^{42}$

\[\text{Figure 24-8: Earthquake Magnitude and Equivalent Energy Release}\]

\[\begin{array}{c}
\text{Energy Release (equivalent kilograms of explosive)} \\
\hline
\text{55,000,000,000,000} & 55,000,000,000 \\
\text{1,800,000,000,000,000} & 1,800,000,000,000 \\
\text{55,000,000,000} & 55,000,000,000 \\
\text{1,800,000,000} & 1,800,000,000 \\
\text{55,000} & 55,000 \\
\text{58} & 58 \\
\hline
\end{array}\]

\[\text{Number of Earthquakes per Year (worldwide)}\]

\[\text{Earthquakes Energy Equivalents}\]

\[\begin{array}{c}
\text{Chile (1960)} \\
\text{Alaska (1964)} \\
\text{New Madrid, MO (1812)} \\
\text{San Francisco, CA (1906)} \\
\text{Charleston, SC (1886)} \\
\text{Loma Prieta, CA (1989)} \\
\text{Kobe, Japan (1995)} \\
\text{Northridge (1994)} \\
\text{Krakata Eruption} \\
\text{World's Largest Nuclear Test (USSR)} \\
\text{Mount St. Helens Eruption} \\
\text{Hiroshima Atomic Bomb} \\
\text{Average Tornado} \\
\text{Large Lightning Bolt} \\
\text{Oklahoma City Bombing} \\
\text{Moderate Lightning Bolt} \\
\hline
\end{array}\]

Although earthquake history, damages and shaking potential in the San Diego County area are fairly extensive, the campus does not reside in a liquefaction zone. Nevertheless, the impacts of a major earthquake would be felt beyond the campus and have long reaching effects. The risk of casualties and damages would likely extend to the homes and workplaces of members of the campus community including students, staff, and faculty. As such, the planning committee ranks the extent of the earthquake hazard as Moderate.

History of the Hazard

The State of California has a long history of chronic and destructive earthquakes throughout the state. On average, earthquakes strong enough to result in structural damages occur three to four times a year in California, while earthquakes Magnitude 6.0 to 6.9 occur once every two to three years. San Diego County also has a long history of earthquake activity. The entire area of San Diego County is at risk to seismic activity and has a history of significant earthquakes resulting in damages.

Table 24-18: Historic Earthquakes Near San Marcos, CA

<table>
<thead>
<tr>
<th>Date</th>
<th>Location</th>
<th>Magnitude</th>
<th>Damages</th>
</tr>
</thead>
<tbody>
<tr>
<td>5/27/1862</td>
<td>Rose Canyon</td>
<td>±6.0</td>
<td>Minor</td>
</tr>
<tr>
<td>2/23/1892</td>
<td>Laguna Salada (Mexico)</td>
<td>7.0</td>
<td>Minor, Structural</td>
</tr>
<tr>
<td>5/15/1910</td>
<td>Elsinore</td>
<td>6.0</td>
<td>Minor</td>
</tr>
<tr>
<td>6/22/1915</td>
<td>Imperial Valley</td>
<td>6.3</td>
<td>Moderate, 6 fatalities</td>
</tr>
<tr>
<td>5/18/1940</td>
<td>Imperial Valley</td>
<td>6.9</td>
<td>Extensive, 8 fatalities</td>
</tr>
<tr>
<td>4/8/1968</td>
<td>Borrego Mountain</td>
<td>6.5</td>
<td>Structural, Utilities</td>
</tr>
<tr>
<td>10/15/1979</td>
<td>Imperial Valley</td>
<td>6.4</td>
<td>Extensive structural, 91 injuries</td>
</tr>
<tr>
<td>7/13/1986</td>
<td>Coronado Bank Fault</td>
<td>5.3</td>
<td>Moderate, 1 fatality</td>
</tr>
<tr>
<td>6/15/2004</td>
<td>San Diego Trough</td>
<td>5.7</td>
<td>Minor</td>
</tr>
<tr>
<td>4/4/2010</td>
<td>Baja California (Mexico)</td>
<td>7.2</td>
<td></td>
</tr>
<tr>
<td>8/26/2012</td>
<td>Brawley</td>
<td>5.4</td>
<td>Minor</td>
</tr>
<tr>
<td>6/10/2016</td>
<td>Borrego Springs</td>
<td>5.2</td>
<td>Minor</td>
</tr>
</tbody>
</table>

The May 18, 1940 Imperial Valley Earthquake became the largest seismic event in the Imperial Valley at the time. The Imperial Valley Earthquake resulted in 8 people being killed, multiple injuries, and $6 million in damages. The earthquake caused extensive damage to structures, the transportation infrastructure, utility systems, irrigation systems, and critical facilities. The Imperial Fault displayed a surface rupture extending of at least 25 miles. The earthquake was felt as far away as Los Angeles and Tucson.

43 San Diego County Mulit-Jurisdictional Hazard Mitigation Plan, October, 2017
The April 8, 1968 Borrego Mountain Earthquake shook a large part of southern California. The earthquake caused extensive damage across southern California. The earthquake resulted in extensive infrastructure damages, power lines being severed, roadway damages, and structural damages. Ground displacement was found along the Superstition Hills Fault miles from the epicenter. The earthquake was felt as far away as Yosemite Valley, Fresno, and Las Vegas.

**Potential Impacts of the Hazard**

The shaking of the ground from earthquakes can result in building collapse, bridge failure, utility disruptions and other structural collapse. Large earthquakes can additionally cause natural gas lines to break resulting in structure fires. The proximity to the unstable soils to the north of the campus along San Marcos Creek presents a potential for liquefaction creating greater ground instability during seismic events. A major earthquake in the San Diego area would likely result in region-wide social disruptions in addition to structural damages. The region-wide structural damages may disrupt lifelines and supply chain routes limiting the campus from effective evacuation routes and receiving necessary supplies or equipment.

Most injuries resulting from earthquakes are from collapsing walls, flying glass, or other objects moved by ground shaking. The lack of warning allows individuals minimal time to react and find areas of safety. A moderate earthquake occurring near San Marcos could cause injuries or fatalities to members of the campus community or support networks the campus relies on. These earthquake effects might be aggravated by collateral incidents such as fire, flooding, hazardous material spills, dam/levee compromises, and other cascading events. A catastrophic earthquake near San Marcos could result in extensive casualties, expansive structural damages, panic, widespread utility outages, communication failures, and secondary emergencies such as fire. A catastrophic earthquake would certainly affect the broader San Diego County region limiting immediate assistance that the campus may normally expect.

Local impacts to CSU San Marcos campus caused by an earthquake could include:

- Damage and secondary fires to industrial buildings to the west of campus
- Potential hazardous material releases on and off campus
- Infrastructure damage to freeway system
- Structural damage to bridges
- Landslides to hills surrounding San Marcos
- Potential liquefaction damage to areas near the San Marcos Creek and Twin Oaks Valley Channel
- Potential isolation among on-campus residents
- Structural damage to flood control and drainage systems
- Damage to the South Lake Reservoir Dam
- Structural damage to campus academic and support buildings
- Structural damage to parking structure
- Structural damage to residence halls resulting in displaced student populations
- Potential isolation among on-campus residents
- Structural damage to nearby residences and apartment complexes
- Community members arriving on campus for refuge from damaged homes
- Damaged university communications, computer systems, and networks
- Considerable stress and fear among community
- Closure or reduction of service to campus operations
- Reduction of campus revenue

Probability of Future Occurrence of the Hazard

The Working Group on California Earthquake Probabilities (WGCEP), a collaboration between the United States Geological Survey (USGS), the Southern California Earthquake Center (SCEC), and the California Geological Survey (CGS) develops Uniform California Earthquake Forecasts (UCERFs) using the best currently available science and technology. The UCERF version 3 provides a three-dimensional view of the likelihood a region in California will experience a Magnitude 6.7 or greater earthquake in the next 30 years. The likelihood for the San Diego County fault systems surrounding San Marcos is included in the following table.

Table 24-20: Major Potentially Active Faults in Proximity to CSU San Marcos

<table>
<thead>
<tr>
<th>Fault Zone</th>
<th>Recurrence</th>
<th>Maximum Magnitude</th>
<th>UCERF3 Likelihood</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coronado Bank</td>
<td>Historic: Holocene</td>
<td>6.0 to 7.7</td>
<td>2-3%</td>
</tr>
<tr>
<td>Earthquake Valley</td>
<td>Historic: Holocene</td>
<td>6.0 to 7.0</td>
<td>2-3%</td>
</tr>
<tr>
<td>Elsinore</td>
<td>Historic: 250 years</td>
<td>6.0 to 7.2</td>
<td>1-2%</td>
</tr>
<tr>
<td>Newport-Inglewood</td>
<td>Historic: Unknown</td>
<td>6.0 to 7.4</td>
<td>1%</td>
</tr>
<tr>
<td>Rose Canyon</td>
<td>Historic: Quaternary</td>
<td>6.0 to 7.2</td>
<td>1-2%</td>
</tr>
<tr>
<td>San Andreas</td>
<td>Varies: 100-300 years</td>
<td>6.8 to 8.0</td>
<td>18-20%</td>
</tr>
<tr>
<td>San Jacinto</td>
<td>Varies: 100-300 years</td>
<td>6.5 to 7.5</td>
<td>4-5%</td>
</tr>
</tbody>
</table>

Based on the earthquake shaking potential in the San Diego County region, the proximity to the above listed fault systems, the probability of seismic ground shaking generating damage is considered Possible.

44 San Diego County Multi-Jurisdictional Hazard Mitigation Plan, October 2017
45 Southern California Earthquake Center, Earthquake Information, [https://scedc.caltech.edu/earthquake/faults.html](https://scedc.caltech.edu/earthquake/faults.html)
Vulnerability to the Hazard

A considerable challenge regarding earthquakes is they generally occur without warning. The fault systems surrounding the region all cross major transportation routes potentially reducing the availability of access and the supply chain. The geographic location of CSU San Marcos places the campus in a suburban community near residential, commercial, and industrial areas that is moderately populated. Earthquake effects experienced in the neighboring local community will likely spill over onto the campus.

The known fault systems generating the threat to San Marcos generally surround the city but do not cross into the city including near the CSU San Marcos campus. However, the proximity and potential for large earthquake development from these surrounding systems expose significant vulnerabilities. The potential for earthquake damaged structures being left uninhabitable including campus residence halls will result in numerous displaced individuals and households. The lack of earthquake insurance will cause extreme financial burdens on those affected. Campus buildings and equipment would be vulnerable to damages from building, seismic shaking, secondary fires, and secondary building floods from broken pipes.

Elements of the vulnerability to a major earthquake on the CSU San Marcos campus will vary depending on when the earthquake were to strike. The risk to the campus population will be lessened during periods when classes are not in session or during periods of breaks. Conversely, during the days and hours that classes are in session and staff are at their workplaces, the human vulnerability increases. Generally, people are safer when at home in wood frame structures as earthquakes tend to generate less structural damage to wood construction than in commercial or industrial facilities. The greater number of people on campus at the time of an earthquake will result in more people being exposed to effects from damaged campus facilities or equipment and require greater evacuation assistance. However, in region-wide events this vulnerability may simply shift to the homes and workplaces of members of the campus community and their families.

The risk to the campus population will be lessened during periods when classes are not in session or during periods of breaks. Conversely, during the days and hours that classes are in session and staff are at their workplaces, the human vulnerability increases. Generally, people are safer when at home in wood frame structures as earthquakes tend to generate less structural damage to wood construction than in commercial or industrial facilities. The greater number of people on campus at the time of an earthquake will result in more people being exposed to effects from damaged campus facilities or equipment and require greater evacuation assistance. However, in region-wide events this vulnerability may simply shift to the homes and workplaces of members of the campus community and their families.

The aftermath of a major earthquake will likely result in widespread search and rescue operations for trapped and injured individuals. The demand on emergency services will be great, potentially requiring the campus community to be prepared for these scenarios and initiate response actions as needed. There will be needs for emergency medical care, shelter, water, and food for individuals who have been displaced by the earthquake. In
earthquakes causing significant damages, there may be a necessity to provide assistance with identification and support to local agencies in mass fatality management.

There may be a need to evacuate members of the campus community from the campus and to other locations that are deemed to be safer locations. Certain campus populations will experience greater challenges to a post-earthquake environment. Vulnerable populations including those that rely on specific services, require electrical power, homeless students, experience disabilities, non-English speakers, those whose age make evacuating difficult, and others will be most affected. These individuals will likely need to navigate through earthquake generated debris, extreme stresses of a disaster, an inability to communicate to or gain access to support networks and find difficulty in accessing equipment or supplies to aid in a specific need.

**Estimate of Potential Losses**

Estimates of potential losses will be influenced by a variety of factors. The intensity of the earthquake will determine what scale of damages affecting campus infrastructure, equipment, and other impacted features. Losses will be generated by the physical damages, the loss of revenue, loss of academic research, loss of building contents, and community wide economic reductions.

Based on estimate replacement costs of facilities and structures on campus, the maximum total replacement costs due to earthquake are $217,777,651.

Table 24-19: HAZUS Peak Ground Acceleration Zone (PGA) Estimated Losses

<table>
<thead>
<tr>
<th>PGA Zone Designation</th>
<th>Intensity</th>
<th>No of Buildings</th>
<th>Maximum Replacement Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Extreme</td>
<td>X+</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Violent</td>
<td>IX</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Severe</td>
<td>VIII</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Very Strong</td>
<td>VII</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Strong</td>
<td>VI</td>
<td>25</td>
<td>$217,777,651</td>
</tr>
<tr>
<td>Moderate</td>
<td>V</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Light</td>
<td>IV</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Weak</td>
<td>II-III</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Not Felt</td>
<td>I</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>NA</td>
<td>NA</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>No Building Value Data Provided*</td>
<td>NA</td>
<td>10</td>
<td>Unknown</td>
</tr>
</tbody>
</table>

*Buildings with no value defined are also included in the respective Zones they are found in.

**Vulnerability Assessment Conclusions**

It is difficult to predict the severity of casualties, property, and cascading impacts generated by future seismic events affecting the greater San Diego County region and the CSU San Marcos campus. Each of the earthquake generated effects will vary widely based
on the intensity of the earthquake, location of the epicenter, proximity to people and
development, time of day and year, the soil composition under the impacted structures,
building construction, among others. In any case, the potential for a major earthquake
exists affecting the campus and causing extensive challenges to the CSU San Marcos
campus and community.

In the event that a major earthquake were to strike along the many fault systems
surrounding San Marcos, the effects could be significant to the campus community and
campus operations. The widespread impacts generated by a major earthquake would
extend the effects of casualties, damages, and other impacts to the broader San Diego
County region creating large-scale regionwide needs for critical assistance and a heavy
demand on limited emergency resources. The threat and impacts presented to the campus
will be shared with the campus community from their homes and places of work. The
campus will likely be required to address critical needs independently during early phases
of the disaster.

The campus population is additionally vulnerable to the effects of major ground shaking
that are far reaching. The psychological and social impacts a major earthquake will give
rise to will potentially harm individuals and cause tremendous fear. The willingness to
return indoors may be hampered especially as after-shocks continue. These effects are
magnified for populations having specific vulnerabilities or access limitations.

Identified Data Limitations

Data limitations include missing campus structural replacement costs, and lack of a
complete inventory of building construction types to include status of earthquake
retrofitting. HAZUS generated analysis is focused on the broader community level versus
fine-tuning the analysis to the micro-level for facilities such as a university campus.

Erosion

Description of the Hazard

The US Geological Survey (USGS) defines erosion as “the process whereby materials of
the earth’s crust are loosened, dissolved, or worn away and simultaneously moved from
one place to another.” Erosion may occur in areas of streams and rivers, along bluffs,
around immovable objects (such as buildings or bridge abutments), or as a cascading
result of other natural hazards, such as earthquakes or wildfires. When erosion occurs
along bodies of water, the removal of material causes the shore to move further landward.

Forces such as sea level rise and changes in sediment supply impact erosion gradually
and can be difficult to recognize. In contrast, the impacts of short-term events, such as

storms and flooding, can be severe and are immediately recognizable. Along the Pacific coast, rain, wind, and waves can induce significant short-term erosion.

Location of the Hazard

Erosion is a relatively non-spatial hazard that can occur in any location with conducive soil structure and a source of movement such as water or wind. As such, for the purpose of this campus-level analysis, the erosion hazard poses a consistent risk across the terrain of the CSU San Marcos campus with erosion-prone characteristics. An area’s potential for erosion is determined by several factors, including rainfall, topography, soil characteristics, and vegetative cover. Streambank and bluff erosion can occur near any riverine area. Areas on campus with little to no vegetation have been identified which resulted from a 2014 fire in the area. These areas are susceptible to erosion.

Extent of the Hazard

While there is no published scale of severity or extent for this geologic hazard on the CSU San Marcos campus, erosion is likely to occur if conditions are favorable. Such conditions are favorable in areas on campus with little to no vegetation, and are being monitored. As such, the planning committee ranks the extent of the hazard as Moderate.

History of the Hazard

After a 2014 fire in the area, there was concern regarding erosion hazards due to the lack of vegetation. However, there are no recorded incidents of erosion on the CSU San Marcos campus.

Potential Impacts of the Hazard

Erosion causes instability in soil. During high-intensity rain events, for example, eroded areas will continue to erode, resulting in additional loss of soil and ground stability in the area. This removal of sediment can result in damage to infrastructure, public health, and safety. On campus, areas of erosion can create pedestrian and transportation hazards, and structures may become unsafe if erosion is not controlled.

Probability of Future Occurrence of the Hazard

Erosion is an on-going and dynamic process that occurs regularly. As climate change induces more frequent and intense weather events, such as wildfires and flooding, erosion may generally become more widespread or severe. These events can cause erosion or exacerbate areas already experiencing erosion. As a result, and in consideration of the Salida current and potential extent of erosion on campus, the probability of at least a limited degree of erosion in the future is High.

Vulnerability to the Hazard

Topography, soil structure, land use, and precipitation are all factors of erosion. CSU San Marcos infrastructure and buildings located on steep slopes, in areas with little vegetation, or in areas with conducive soil types are more vulnerable to erosion. In addition to areas
on campus with little vegetation, CSU leadership would consider performing an analysis to identify such at-risk buildings, infrastructure, slopes and soil types in the future.

In the wider San Marcos community, erosion vulnerabilities include agricultural sector job loss, degradation of riverine ecosystems, and loss of water quality.

Estimate of Potential Losses

The historic and potential impacts of erosion on property statewide include reduced agricultural productivity, lower surface water quality, and damaged drainage networks.

Current modeling is not precise enough to allow for an assessment of potential losses to buildings and infrastructure on campus.

Vulnerability Assessment Conclusions

While the ability to predict future erosion on the CSU San Marcos campus is limited, the core issues shaping erosion vulnerability on campus are flora and landscaping. If left unchecked, erosion can cause significant damage to campus infrastructure and the surrounding environment.

Identified Data Limitations

The complex interactions between soil erosion factors make predictive modeling, determination of hazard areas, and quantification of loss difficult. Localized data on this hazard is also limited, resulting in more generalized findings.

**Extreme Temperatures (Includes Extreme Cold and Extreme Heat)**

Heat

Description of the Hazard

What is considered an excessively hot temperature varies according to the normal climate for that region. However, when temperatures are extremely high, people are at higher risk for heat-related illnesses, such as dehydration, heat exhaustion, heat stroke, and in severe cases, death.48

Hazards from extreme heat are made worse when high temperatures are accompanied by high levels of humidity, which is defined as the amount of moisture in the air.49 As the temperature climbs, the air is able to hold more moisture. High humidity prevents the human body from cooling down naturally, which leads people to perceive that the

temperatures “feel” hotter. The combination of temperature and humidity is known as the heat index.

Heat stroke, the most serious heat-related illness, occurs when the body is unable to control its temperature. Body temperature rises rapidly, the sweating mechanism fails, and the body cannot cool down.\textsuperscript{50} In extreme causes, heat stroke can cause confusion and unconsciousness, so the victim is unable to seek treatment without assistance.

There are several groups of people who are uniquely vulnerable to the effects of extreme heat, such as infants and children, older adults aged 65 and up, athletes and outdoor workers, low-income households, and individuals with certain chronic medical conditions.\textsuperscript{51}

Location of the Hazard

Extreme heat events are a non-spatial hazard and may occur throughout the CSU San Marcos campus.

Extent of the Hazard

Extreme heat has a wide range of extent and severity markers and characteristics. Monthly average maximum temperatures in June through October range approximately from the high 70s to the high 80s in San Marcos. That said, multiple extreme heat events have occurred with 12 events in just the last two years. In addition, the 2006 heat wave with temperatures reaching 119 degrees stands as a marker for how severe the hazard may become in the future. Based on these factors, the planning committee ranks the extent of the hazard for the campus as Moderate to High.

The National Weather Service issues a Heat Advisory when the heat index value is expected to reach 100° – 104° F within the next 12 to 24 hours. Excessive Heat Warnings are issued when there is an anticipated heat index of 105° F or greater that will last for two (2) or more hours. Excessive Heat Warnings are issued by the county when any location in the county is expected to reach that criteria.\textsuperscript{52} In anticipation of an Excessive Heat Warning, an Excessive Heat Watch may be issued 1 to 2 days in advance, when the Heat Warning criteria is 50 – 79% likely to occur.

Figure 24-9 (following) depicts the National Weather Service’s methodology for determining the heat index, using the % humidity and the actual temperature.


\textsuperscript{52} National Weather Service. \textit{Heat}. Retrieved 01.22.21 from: https://www.weather.gov/bgm/heat
Figure 24-9: Methodology for Determining Heat Index

As the heat index rises, so does the potential danger to people and animals. Table xx (following) shows the health hazards associated with extreme heat.

Table 24-20: Health Risks Associated with Heat Index

<table>
<thead>
<tr>
<th>Category</th>
<th>Heat Index</th>
<th>Health Hazards</th>
</tr>
</thead>
<tbody>
<tr>
<td>Extreme Danger</td>
<td>130° F or higher</td>
<td>Heat stroke / sunstroke is likely with continued exposure.</td>
</tr>
<tr>
<td>Danger</td>
<td>105° – 129° F</td>
<td>Sunstroke, heat cramps, and/or heat exhaustion is likely with prolonged exposure and/or physical activity.</td>
</tr>
<tr>
<td>Extreme Caution</td>
<td>90° – 104° F</td>
<td>Sunstroke, heat cramps, and/or heat exhaustion is possible with prolonged exposure and/or physical activity.</td>
</tr>
<tr>
<td>Caution</td>
<td>80° – 89° F</td>
<td>Fatigue is possible with prolonged exposure and/or physical activity.</td>
</tr>
</tbody>
</table>

History of the Hazard

Based on data gathered from the National Centers for Environmental Information (NCEI) Storm Events Database, there have been multiple excessive heat events in the City of San Marcos and in San Diego County, with a dozen events occurring just in 2019 and 2020. The extended period of excessive heat across Southern California in the summer of 2006 is particularly notable. Heat index values in the region reached as high as 119° F. This heat wave led to the development and adoption of San Diego County’s Excessive Heat Preparedness and Response Plan, which was just recently updated and reissued in a consumer version in August 2020. 54

Potential Impacts of the Hazard

CSU San Marcos may experience impacts from extreme heat due to cancelled classes or postponed outdoor events in order to protect students, faculty, and staff from the weather. In addition to the threat extreme heat poses to humans, high temperatures also pose a threat to utility production, which in turn threaten facilities and operations that rely on utilities. As temperatures rise, more people stay indoors, increasing the demand for air conditioning, fans, and other electronics. This puts a strain on the electrical grid, which can cause temporary outages. These outages can impact operations throughout campus, resulting in interruptions and delays in service. Outages may also negatively impact research efforts on campus, as the inability to maintain a steady, constant temperature may impact research specimens and experimental results.

Probability of Future Occurrence of the Hazard

There have been multiple extreme heat events in San Diego County that have affected the City of San Marcos, including three in the past year. It is Highly Likely that the hazard will occur annually.

Vulnerability to the Hazard

When dealing with an extreme heat event, the most common impacts are those generally felt by the people living in the targeted area. For people in particular, heat can kill when the body is pushed beyond its limits. Most heat disorders occur because the victim has been overexposed to heat. As discussed, the major human risks associated with extreme heat include dehydration, sunburn, fatigue, heat exhaustion, heat stroke, and in severe cases, death.

Some portions of the population are more at risk to the effects of extreme heat. The very young, the elderly, and certain groups with chronic medical conditions (such as asthma or other pulmonary illnesses, heart disease, poor blood circulation, neurological illnesses, and obesity) are generally more vulnerable to the effects of extreme heat, and are more

likely to suffer illness or death as a result.\textsuperscript{55} This is especially true if exposure is extended for a period of time and preventative measures are not taken immediately.

Given the frequency of heat waves and excessive heat events, CSU San Marco is aware of the potential for heat-related illnesses and other negative impacts. However, the campus’s Emergency Procedures Plan does not address specific responses or operations during a heat event. Emergency procedures for power outages, which can occur as a result of a heat wave or excessive heat event – are included in the plan.

Because this is a hazard that the campus experiences with regularity – and will continue to experience – CSU San Marcos may wish to make resources, plans, and procedures for heat events clearer in its Emergency Procedures Plan in order to better address the risks and vulnerabilities of heat-related illnesses and other impacts.

Estimate of Potential Losses

Based on the previous historical occurrences, annualized losses are considered to be negligible. In an extreme heat event, loss of human life or health impacts are a greater concern than is property damage.

Vulnerability Assessment Conclusions

While the ability to predict future heat events at the CSU San Marcos campus is limited, the effects of climate change may provide some information. According to the Environmental Protection Agency (EPA), Southern California has warmed about three degrees on average over the last century, with less rainfall. This may lead to stronger and more frequent heat events, drought, and an increased risk of wildfires.\textsuperscript{56}

Identified Data Limitations

Numerous public and private actors conduct research, acquire data and disseminate meteorological information and forecasting to the general public, including the CSU university system. Currently, it is assumed that, apart from regular access to climate change models on changes to temperature extremes over time, the CSU community maintains sufficient access to the data needed to plan for, respond to, and mitigate the effects of extreme heat and cold.

\textsuperscript{55} Centers for Disease Control and Prevention. \textit{Heat and People with Chronic Medical Conditions}. Retrieved 03.13.21 from https://www.cdc.gov/disasters/extremeheat/medical.html

Flood

Description of the Hazard

The incredible geographic diversity in California presents tremendous challenges for flood planning and response. The state is home to extensive mountain ranges such as the Sierra Nevada, Cascades, Klamath, Coastal Ranges, and the Southern California Transverse Range all creating tremendous watersheds. Large river systems drain the mountains traveling through populated communities including the Sacramento and San Joaquin Rivers draining into the California Delta. The state has a complex system of reservoirs, dams, and levees providing water storage and flood protection. Finally, California’s 840-mile coastline exposes the coastal regions to tidal influences.

Floods are characterized by the rising and overflowing of excess water from a water source such as a stream, river, lake, canal, or coastal body onto an area of normally dry floodplain. A floodplain is a lowland area downstream and adjacent to water bodies that are subject to flood events. Flooding is a naturally occurring event that become hazardous when populations and property are affected.

Flooding can result from excessive precipitation from weather systems generating prolonged rainfall, excessive snowmelt from watersheds upstream from the floodplain, infrastructure failure, exceeding the capacity of dams or levees, tidal influences, or a combination from any of the previous factors.

Floods represent one of the costliest and most frequent natural disasters that influences human suffering and economic impact in the United States. Flooding will likely result in significant damage to structures, infrastructure, utilities, landscapes, and the environment. Erosion of stream banks, roadways, other feature may result from the movement of flood waters. The saturated ground resulting from standing flood waters may cause ground instability, collapse, erosion, or other damages. Further, floods will often generate substantial debris that will accumulate and be deposited throughout the flooded areas.

Flooding can be either slow-rise or rapid onset floods. With slow rise floods, there is often warning preceding water rise by hours or days before dangerous conditions present themselves. Slow rise floods that are expected to enter into populated areas generally allow for some time to initiate evacuation and sand bagging efforts. Flooding that occurs rapidly conversely are water events that present with extremely limited warning times and a limited ability to take response actions until flooding has already begun to occur.

Flooding may take on different forms:

- **Flash Flooding** – Flash flooding is typically characterized by a rapid rise, short duration, and large volume of water in a localized area. Heavy rainfall in areas that have limited drainage capacities often contribute to flash flooding conditions. These flooding events frequently occur with limited notice requiring immediate evacuation or rapid response efforts such as sand bagging. Flash flooding may arrive with fast moving water creating added hazardous conditions.
- **Riverine Flooding** – Riverine flooding is usually caused by prolonged rainfall or rainfall combined with heavy snowmelt. When soils are already saturated, the ability for the ground to absorb water is minimized. In a riverine flood, the water way exceeds channel capacity and extends into areas outside of the channel, often in developed communities. In California, riverine flooding is most likely to occur from November through April. The duration of riverine floods may vary from a period of hours to weeks.

- **Localized Flooding** – Localized flooding is commonly the result of stormwater drainage systems being overwhelmed by unusually heavy rainfall. These flooding events frequently occur in areas that are urbanized or developed with greater amounts of impervious surfaces not allowing ground absorption. This generates added runoff into the drainage systems and onto roadways creating backups.

- **Infrastructure Failure** – Failures of dams or levees presents a serious flooding concern for areas downstream from the compromised structure. This situation may result in a catastrophic flood with limited warning time and widespread areas affected.

- **Coastal Flooding** – Coastal flooding can occur in multiple areas along the California coastline. Flooding may result from intense storms coming from the Pacific Ocean that generate elevated water levels or storm surge. The size, duration, winds generated, and intensity of the storm will influence the effect the waves will have on the shoreline. Periods of high tide can aggravate the conditions allowing greater wave impingement into coastal areas.

**Atmospheric Rivers**

California, including the location of this campus, is subject to the effects of a phenomenon referred to as atmospheric rivers. These weather events consist of long, narrow regions in the atmosphere transporting tremendous amounts of water vapor from the tropics. These weather regions behave like rivers in the sky. They can carry heavy volumes of water vapor compared to the amount of water flow at the mouth of the Mississippi River. As these atmospheric rivers arrive into California they tend to generate significant rain and snow.

Atmospheric rivers can arrive in many different shapes and sizes. The larger events are able to generate extreme rainfall amounts resulting in flooding. They can stall over watersheds vulnerable to flooding, often saturated with heavy snow amounts. The atmospheric rivers known as a “Pineapple Express” coming from the tropics and arriving with warmer air may produce heavy rains that will melt ground snow adding to the water volume that will be added in the flood runoff.

These events can produce heavy amounts of precipitation creating extensive damages. However, these events may present as weaker systems that produce precipitation that is enough to be beneficial for the local water supply. At the higher elevations in the California mountains, these events have the potential to generate a tremendous snowpack providing a source of water during the dry summer months.
Location of the Hazard

San Marcos lies within the San Marcos Creek Valley in northern San Diego County. Along the southern edges of San Marcos are low rising hills that form the backdrop to the CSU San Marcos campus. These include the San Elijo Hills which provide a potential for developing water run-off during heavy precipitation events. There are a number of flood retention basins and flood control channels along the base of these hills to protect these San Diego County communities including San Marcos. The area surrounding the campus is a combination of developed suburban environment predominately consisting of residential and commercial land uses and open hillsides.

57 National Oceanic and Atmospheric Administration, “What are atmospheric rivers?”, https://www.noaa.gov/stories/what-are-atmospheric-rivers
The CSU San Marcos campus is located ½ mile south of the San Marcos Creek that flows from Escondido through San Marcos towards the ocean. The San Marcos Creek receives the majority of its water from precipitation during the winter months. The San Marcos Creek does not contribute to a direct flood hazard to the campus but may compromise access routes to the campus. The South Lake drainage extends to the northwest of the campus towards Discovery Lake. The South Lake drainage does not contribute to a direct flood hazard to the campus but may compromise access routes to the campus. The entire CSU San Marcos campus sits within a Special Flood Hazard Area (SFHA) Zone X: Area of Minimal Flood Risk designation on the Flood Insurance Rate Map. Extending down the San Marcos Creek are areas that reside in a Zone AE: 1% Annual Chance Flood Hazard.

Extent of the Hazard

The CSU San Marcos campus is entirely located in a designated Zone X: Area of Minimal Flood Hazard. The access routes into and out of the campus servicing locations in all directions are also found in areas primarily designated as Zone X: Area of Minimal Flood Hazard. Access routes to the north at the point of crossing the San Marcos Creek are
located in designated Zone AE: 1% Annual Chance Flood Hazard. Due to the location of the campus, the extent of the hazard is limited on campus, though flooding in the community at large could disrupt nearby transportation routes. As such, the planning committee ranks the extent of the hazard as **Low**.

In support of the NFIP, FEMA identifies those areas that are more vulnerable to flooding by producing Flood Hazard Boundary Maps (FHBMs), Flood Insurance Rate Maps (FIRMs), and Flood Boundary and Floodway Maps (FBFMs). Several areas of flood hazards are commonly identified on these maps, including the 1% annual chance flood zone. Flood zones are further delineated by risk and are assigned a letter signifier. The flood zone designations are defined and described in the following table.

**Table 24-21: Flood Zone Designations and Descriptions**

<table>
<thead>
<tr>
<th>Zone Designation</th>
<th>Percent Annual Chance of Flood</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Zone V</td>
<td>1%</td>
<td>Areas along coasts subject to inundation by the 1% annual chance of flooding with additional hazards associated with storm-induced waves. Because hydraulic analyses have not been performed, no BFEs or flood depths are shown.</td>
</tr>
<tr>
<td>Zones VE and V1-30</td>
<td>1%</td>
<td>Areas along coasts subject to inundation by the 1% annual chance of flooding with additional hazards associated with storm-induced waves. BFEs derived from detailed hydraulic analyses are shown within these zones. (Zone VE is used on new and revised map in place of Zones V1-30.)</td>
</tr>
<tr>
<td>Zone A</td>
<td>1%</td>
<td>Areas with a 1% annual chance of flooding and a 26% chance of flooding over the life of a 30-year mortgage. Because detailed analyses are not performed for such areas, no depths or base flood elevations are shown within these areas.</td>
</tr>
<tr>
<td>Zone AE</td>
<td>1%</td>
<td>Areas with a 1% annual chance of flooding and a 26% chance of flooding over the life of a 30-year mortgage. In most instances, BFEs derived from detailed analyses are shown at selected intervals within these zones.</td>
</tr>
</tbody>
</table>
Zone AH 1% Areas with a 1% annual chance of flooding where shallow flooding (usually areas of ponding) can occur with average depths between 1 – 3 feet.

Zone AO 1% Areas with a 1% annual chance of flooding, where shallow flooding average depths are between 1 – 3 feet.

Zone X (shaded) 0.2% Represents areas between the limits of the 1% annual chance flooding and 0.2% chance flooding.

Zone X (unshaded) Undetermined Areas outside of the 1% annual chance floodplain and 0.2% annual chance floodplain, areas of 1% annual chance sheet flow flooding where average depths are less than one (1) foot, areas of 1% annual chance stream flooding where the contributing drainage area is less than one (1) square mile, or areas protected from the 1% annual chance flood by levees. No BFEs or depths are shown within this zone.

History of the Hazard

Flooding in San Marcos and the broader San Diego County regions have typically occurred during the winter months when Pacific storms are more common. The occurrences of significant flooding typically have been the result of successive intense storms with heavy precipitation. The region has experienced flood events that have caused tens of millions of dollars in damages and casualties. The following provides insight into information of past flooding events that are significant to the CSU San Marcos campus.

Table 24-22: Historic Flooding Events in San Diego County

<table>
<thead>
<tr>
<th>Date</th>
<th>Event</th>
<th>Declaration</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>March 1962</td>
<td>Flood</td>
<td>DR-122-CA</td>
<td>Countywide</td>
</tr>
<tr>
<td>October 1962</td>
<td>Flood</td>
<td>DR-138-CA</td>
<td>Countywide</td>
</tr>
<tr>
<td>February 1963</td>
<td>Flood; Heavy Rains</td>
<td>DR-145-CA</td>
<td>Countywide</td>
</tr>
<tr>
<td>February 1973</td>
<td>Flood; Winter Storms</td>
<td>DR-364-CA</td>
<td>Countywide</td>
</tr>
<tr>
<td>February 1978</td>
<td>Flood; Winter Storms</td>
<td>DR-547-CA</td>
<td>Countywide</td>
</tr>
<tr>
<td>February 1980</td>
<td>Flood; Winter Storms</td>
<td>DR-615-CA</td>
<td>Countywide</td>
</tr>
<tr>
<td>December 1988</td>
<td>Winter Storms</td>
<td>DR-812-CA</td>
<td>Countywide</td>
</tr>
<tr>
<td>January 1993</td>
<td>Winter Storms</td>
<td>DR-979-CA</td>
<td>Countywide</td>
</tr>
<tr>
<td>January 1995</td>
<td>Flash Flood; Heavy Rains</td>
<td>DR-1044-CA</td>
<td>Countywide</td>
</tr>
</tbody>
</table>

58 San Diego County Multi-Jurisdictional Hazard Mitigation Plan, October 2017
Potential Impacts of the Hazard

A flood will potentially result in extensive amounts of water entering onto developed areas. The force and volume of water that is generated by a flood may cause extensive structural damage in areas subject to standing or moving water. The effects of flooding may spread over significant distances covering large areas of land. The extent of the impacts would vary based on a number of factors such as the volume of water flooding, the time of the flood event, the amount of warning provided, the location and extent of the flood boundary, facility elevation, and distance from the flood source.

Potential impacts resulting from flooding include:

- Injuries or loss of life
- Property destruction or damage
- Loss of property contents
- Infrastructure damage including roadways, bridges, other transportation means
- Public health hazards resulting from mold, mildew, and disease due to flood water
- Flooded or destroyed lifelines/supply routes
- Damaged or destroyed utilities
- Loss of community economic base
- Employment losses
- Agricultural (crops and livestock) damages or destruction
- Environmental damage
- Prolonged periods of necessary dewatering
- Flooding erosion may alter natural drainage channels
- Societal and community impacts
- Psychological impacts of impacted populations
- Disruptions to education delivery to community

Additionally, individuals who were unable to evacuate in time or refused to leave will likely need assistance or rescue from the flooded area. Remaining in or being trapped by flood waters places individuals in significant risk of injury or death. The impacts extend beyond the danger placed upon the affected individual and places greater resource demands on agencies and organizations making efforts to rescue trapped individuals.
Probability of Future Occurrence of the Hazard

San Diego County is determined have considerable portions of the county to be at high risk from flooding. The repeated historic occurrences have shown that the region is subject to flooding in any given year. Floods can occur at any time but are most common in the San Diego area with winter storms that are saturated with subtropical moisture. The area surrounding the CSU San Marcos campus does not generally promote conditions for flood waters to accumulate. The majority of the campus is elevated on a hillside above the San Marcos Creek and urban core of the City of San Marcos. However, access to the campus from the valley floor may become compromised in flooding events along the San Marcos Creek. The campus is located within a Zone X (Area of Minimal Flood Hazard). The San Marcos Creek is located ½ mile north of the campus and is located within the Zone AE Special Flood Hazard Area (Area Inundated by 1% Annual Chance of Flooding). There are specific buildings and areas of the campus that have a greater risk for isolated flooding. However, the area is subject to isolated urban or street flood events providing a demonstration of potential flood activity.

The probability of future occurrence for flooding on the CSU San Marcos campus is **Unlikely**.

Vulnerability to the Hazard

The CSU San Marcos campus is subject to the effects of localized flooding resulting primarily from excessive precipitation and isolated strong storms. There is a more remote potential for flooding and damage on campus and surrounding residential and commercial areas of San Marcos due to overflow or damage to flood control systems. The flood control channels and drainage systems that surround the campus have limited storage or volume capacities. The campus and the campus community are vulnerable to the effects generated by flooding from these systems.

Vulnerability to flooding on the CSU San Marcos campus will vary depending on when the flood were to occur. The risk to the campus population will be lessened during periods when classes are not in session or during periods of breaks. Conversely, during the days and hours that classes are in session and staff are at their workplaces, the human vulnerability increases. Members of the campus community may become trapped on campus depending on the level of flooding occurring on surface streets. However, in rare, region-wide events this vulnerability may be extended to the homes and workplaces of members of the campus community and their families.

CSU San Marcos is in proximity to a variety of industrial and commercial facilities in the surrounding communities. When these facilities are inundated with flood water, the potential for chemical release exists presenting possible exposures to individuals from the campus community. These facilities additionally line many of the primary access routes in and out of the campus.

During low probability, severe flood events, campus buildings and infrastructure may be vulnerable to localized flooding reaching the university. Campus utilities and
communication capabilities might be impacted by flood waters rendering them disabled. A flood covering a large portion of the city might affect communication capabilities well beyond the boundaries of the campus. Remaining flood waters will leave behind molds and other health concerns in affected campus buildings and facilities likely requiring extensive restoration or demolishing. The residents of the on-campus residence halls may have transportation limitations requiring evacuation and alternative housing procedures to be implemented if populated. Flood waters may result in damage to campus equipment, communication systems, protected documents, artwork, academic materials, computer systems, research, and other critical activities on lower levels of buildings in the areas of localized or isolated flooding.

Certain campus populations will experience greater challenges to a post-flood / failure environment. Vulnerable populations will likely need to navigate through flood generated debris, face extreme health safety issues from flood waters, experience extreme stresses of a disaster, an inability to communicate to or gain access to support networks, and find difficulty in accessing equipment or supplies to aid in a specific need. Students remaining on campus such as those residing in the residence halls would be particularly vulnerable especially those without access to adequate transportation.

Estimate of Potential Losses

Estimates of potential losses will be influenced by a variety of factors. The volume and force of the water will determine the scale of damages affecting campus infrastructure, equipment, and other impacted features. The location and elevation above flood waters will affect the level of damage and individuals exposed. The time of the academic year, the day of week, and hour in which the flooding was to occur will influence the number of people on campus and potential casualties. The severity of the storms producing precipitation, the speed of the storms moving across the area, the level of snowpack in the higher elevations, and amount of resulting snowmelt will produce varying effects on damages produced and costs incurred. Losses will be generated by the physical damages, the loss of revenue, loss of academic research, loss of building contents, and community wide economic reductions.

Based on estimate replacement costs of facilities and structures on campus, the maximum total replacement costs due to flood are $217,777,651. However, it is unlikely for flood to cause destructive losses to the entire campus.

Table 24-23: Special Flood Hazard Area (SFHA) Estimated Losses

<table>
<thead>
<tr>
<th>Zone Designation</th>
<th>No of Buildings</th>
<th>Maximum Replacement Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Zone V</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Zone VE &amp; V 1-30</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Zone A</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Zone AE</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Zone AH</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Zone AO</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>
Zone X .2% | 0 | 0
---|---|---
Zone X Minimal Risk | 25 | $217,777,651
Not in a SFHA | 0 | 0
No Building Value Data Provided* | 10 | Unknown

*Buildings with no value defined are also included in the respective Zones they are found in.

**Vulnerability Assessment Conclusions**

While the campus is removed from designated flood zones, the primary vulnerabilities to flood on campus are people and assets exposed to localized flooding from overflow of campus creeks or large-scale storms that produce heavy amounts of precipitation directly over the campus and surrounding neighborhoods.

The potential for rare, but severe flooding on the campus and the surrounding area generates the potential for a number of cascading effects such as disruptions to the local economy, utility failures, disruptions to providing for the needs of the community, and development of public health hazards. These effects would be exacerbated by effects of seasonal flooding, ongoing heavy precipitation, or excessive run-off from the watershed contributing to the river system. The potential for widespread flooding and damage of structures due to the force of water, while unlikely, has exponentially powerful impacts on particular segments of the campus community including those with access or functional needs, international students, the homeless, and students residing in the residence halls.

**Identified Data Limitations**

Data limitations include missing campus structural replacement costs, and an incomplete inventory of both building construction features and mitigation efforts to lessen the impact due to flood inundation. HAZUS generated analysis is focused on the broader community level versus fine-tuning the analysis to the micro-level for facilities such as a university campus.
**Hazardous Materials**

Description of the Hazard

A hazardous material is defined in California’s State Hazardous Materials Incident Contingency Plan (1991) as “a substance or combination of substances which, because of quantity, concentration, physical, chemical, or infectious characteristics may: cause, or significantly contribute to an increase in deaths or serious illnesses; and/or pose a substantial present or potential hazard to humans or the environment.”\(^5^9\) Hazardous materials are one or more of the following: flammable, corrosive or an irritant, oxidizing, explosive, toxic (poisonous or infectious), thermally unstable or reactive, or radioactive. Hazardous materials are ubiquitous in modern society and may be found at all stages of production, consumption, and disposal.

Federal and state laws permit the intentional release of some hazardous materials into the environment such that the risk to human health and the environment is thought to be acceptable. However, sometimes releases are unintentional, resulting from leaks, accidents, or natural hazards. This section focuses on such accidental releases and fall into the following key categories:

**Fixed Hazardous Materials Incident:** A fixed hazardous materials incident is the accidental release of chemical substances or mixtures during production or handling at a fixed facility.

**Transportation Hazardous Materials Incident:** A transportation hazardous materials incident is the accidental release of chemical substances or mixtures during highway, waterway or air transport. Populations, built and natural environments are potentially impacted.

**Pipeline Incident:** A pipeline transportation incident occurs when a break in a pipeline creates the potential for an explosion or leak of a dangerous substance (oil, gas, etc.) possibly requiring evacuation. An underground pipeline incident can be caused by environmental disruption, accidental damage, or sabotage. Incidents can range from a small, slow leak to a large rupture where an explosion is possible. Inspection and maintenance of the pipeline system along with marked gas line locations and an early warning and response procedure can lessen the risk to those near the pipelines.

Hazardous materials can also be classified according to worker safety and health.\(^6^0\) Information provided by California Division of Safety and Health includes guidelines related to:

- **Safety hazards:** fire and fire byproducts, electricity, flammable gases, unstable structures, demolition, sharp or flying objects, excavations)

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\(^{60}\) California Department of Industrial Relations. *Worker Safety and Health During Fire Cleanup.* Retrieved 04.18.2021 from: [https://www.dir.ca.gov/dosh/wildfire/Worker-Health-and-Safety-During-Fire-Cleanup.html](https://www.dir.ca.gov/dosh/wildfire/Worker-Health-and-Safety-During-Fire-Cleanup.html)
- **Health hazards**: carbon monoxide ash, soot and dust; asbestos; hazardous liquids; other hazardous substances; heat illness

**Natural-Technological Incidents (Natechs)**: During the past two decades, increasing attention has been given to hazardous materials releases resulting from Natechs or a natural disaster event that triggers a technological hazard event. Natechs are of particular concern for the following reasons:

- They can produce a simultaneous effect on many industrial facilities
- Can overwhelm response capacity
- Containment systems may fail
- May produce cascading disasters
- Response may be hindered by a disaster’s impact on the physical environment

**Location of the Hazard**

Hazardous materials and infrastructure such as fuel tanks, rail lines, chemicals, hazardous waste sites and gas pipelines to varying degrees are located within the CSU system and/or within its surrounding communities. The planning committee indicates that chemicals are located in the science lab on campus, Mapping indicates two hazardous waste sites very near campus, and a chemical site, a rail line and a gas pipeline grouped about ½ mile from campus. At larger scales (beyond the campus planning area) hazardous materials and infrastructure are located throughout the city of San Jose and Santa Clara County, and reflect different types, configurations and scales dispersed across these geographic areas.

**Extent of the Hazard**

There is no comprehensive statewide vulnerability assessment available at this time. As such, the true extent of the hazardous materials risk in California and its communities is not known, meaning no overarching conclusions have been reached which have been able to integrate all qualitative and quantitative risk factors to produce a comprehensive measure of the extent of the hazard.

For the CSU – San Marcos planning committee, chemicals are managed in the campus science lab, and no chemical spills have taken place. Based on these factors, along with the close proximity of hazardous waste sites and the other hazmat infrastructure within ½ mile, the extent of the hazard for the CSU – San Marcos campus is Low to Moderate. That said, it is prudent to consider worst case scenarios as the main driver of policy in order to fully mitigate all possible hazardous materials event outcomes.

For example, according to the 2018 CA State Hazard Mitigation Plan, 400 hazardous materials problems are tied to 32 past earthquakes, including over 150 problems from the

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Loma Prieta Earthquake alone. 64 That said, the plan indicates that it is likely that many such hazardous materials releases have received little attention in the past because public authorities, the media, and the public have overlooked them in the rush to address and recover from immediate disaster threats, and that responsible parties may have an incentive to understate the extent of releases or not to report them at all.

History of the Hazard

According to the CA Governor’s Office of Emergency Services’ Hazardous Materials Spill Report, the state experiences from 10 to 30 spill events daily. As of April 20th, 2021 already 2096 spill events had occurred. Such events have occurred in all the cities and/or counties where CSU campuses are located. 65

According to the 2018 CA State Hazard Mitigation Plan, with regard to natural-technological hazard events (Natechs), 400 hazardous materials events are tied to 32 past earthquakes, including over 150 Natech events from the Loma Prieta Earthquake alone.

For more details on specific hazmat events, please refer to the local, county and/or multi-jurisdictional hazard mitigation plans where CSU campuses are located at: https://www.caloes.ca.gov/cal-oes-divisions/hazard-mitigation/hazard-mitigation-planning/local-hazard-mitigation-program

According to the campus planning committee, no hazmat events have taken place on the CSU San Marcos on campus.

Potential Impacts of the Hazard

A large hazardous materials release could affect an entire community or city under certain conditions related to direction of air flow (air-based chemical release) and population density or the contamination of a community’s main water supply. Either type of release could necessitate large scale evacuation. By contrast, in the rural unincorporated areas where population densities are low, even in the event of a large release, the number of homes that may need to be evacuated would be significantly lower than in an urban environment. The occurrence of a hazmat incident can also result in the shut-down of transportation corridors which can last for hours at a time while the impacted area is stabilized.

The release of some toxic gases may cause immediate death, disablement, or sickness if absorbed through the skin, injected, ingested, or inhaled. Contaminated water resources become unsafe and unusable, depending on the amount of contaminant. Some chemicals cause painful and damaging burns if they come in direct contact with skin. Prolonged and concentrated exposure to such chemicals can produce severe long-term impacts to respiratory, endocrine and nervous systems, heart and brain health.

The potential impacts of chemicals and toxic gases discussed here also to some degree apply to the students, staff and environment on the CSU – San Marcos campus.

With regard to the natural environment overall, contamination of air, ground, or water may result in harm to fish, wildlife, livestock, and crops. The release of hazardous materials into the environment may cause debilitation, disease, or birth defects over a long period of time. Loss of livestock and crops may lead to economic hardships within the community.

Recent California examples include the 2016 Aliso Canyon methane gas leak, which caused evacuation of nearby residents, many of whom experienced temporary health problems such as difficulty breathing and eye irritation; and the 2016 Fruitland metal recycle plant fire in Maywood, which released heavy metals such as lead, magnesium, copper, aluminum, antimony, calcium, iron, sulfur, tin, potassium, and zinc which pose severe risks to public health. Health effects from exposure to these metals included short-term symptoms such as irritation to the eyes, nose, throat, and lungs.

**Potential Impact of the Hazard (Natechs)**

Natural disasters, including earthquake, flood, and fire also pose risks to public health and the environment. For example, following the Northridge Earthquake, California State University (CSU) Northridge laboratories and chemical storage rooms experienced multiple chemical spills. Such incidents, triggered by a natural disaster, pose a significant risk to students, faculty, staff, and first responders. At a minimum, all CSU campuses with a science lab (including CSU – San Marcos) is at risk of potential impact from a natural-technological (combined impact) event.

In a severe flood event, floodwaters are often contaminated with hazardous materials posing a threat to public and animal health, groundwater, and other parts of the environment. These hazardous materials may be released from damaged or flooded underground tank sites (e.g., gas stations or chemical storage facilities), propane tanks, manure or human waste handling facilities, fertilizer and pesticide storage, agricultural sites, and household hazardous waste.

In a fire event, (such as the October 2017 Northern California firestorms which destroyed approximately 6,000 residences) entire neighborhoods can be burned to the ground. Hazardous material release creates public health concerns which can delay the initial steps of fire recovery, including reopening burned areas to residents and initiating debris removal activities. The post-fire “toxic sweep” poses a risk of coming into contact with toxic substances due to the presence of synthetic and hazardous materials.

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Probability of Future Occurrence of the Hazard

The probability of occurrence for a hazmat event on the CSU – San Marcos campus can be viewed in two different ways: the history of occurrence serves as a sound predictor of future probability assuming current risk and vulnerability factors remain somewhat constant. For the purposes of the current estimate, no current data clearly indicates otherwise. As such, the probability of occurrence is Low - the campus has experienced no chemical spills in the science lab. In addition, hazardous materials are in close proximity which may increase vulnerability and the probability of a campus-related event. Moreover, hazmat occurrences are largely based on human error, and any changes in risk and vulnerability factors such as a decreased vigilance in materials oversight and handling practices or changes in the amount of material or exposure will likely increase the probability on campus.

Vulnerability to the Hazard

Hazardous materials pose a risk to the CSU – San Marcos campus. As identified by the campus planning committee and on the hazmat map, the following vulnerabilities are present on campus chemicals are located in the science lab on campus, Mapping indicates two hazardous waste sites very near campus, and a chemical site, a rail line and a gas pipeline grouped about ½ mile from campus. Due to their somewhat close proximity, gases and chemicals or hazardous waste, if spilled or released, could impact human health and campus operations.

Although it is quite difficult to produce a quantitative measure of vulnerability because (unlike natural hazards) the probability of occurrence is dependent on human error, which itself is variable based upon a fluctuating set of interrelated factors, some of which lack prediction or control, given the complexity of how all natural and built environments and hazmat risks factors interrelate at the local or campus level, it is prudent to assume for planning purposes that the campus’ vulnerability is a sub-set of the larger community’s vulnerability. As such, the CSU – San Marcos leadership maintains vigilance to mitigate the campus’ vulnerabilities identified above at a minimum.

Estimate of Potential Losses

As discussed previously, it is difficult if not impossible to produce an accurate quantitative measure of vulnerability because of the variable nature of a hazardous materials spill. For example, the release of a toxic airborne chemical in a populated area has severe impact potential, whereas the impact potential of a small chemical spill in a remote or rural area is most likely limited to remediation of soil. And, in both cases, the probability of occurrence is dependent on human error, which itself is variable based upon a fluctuating set of interrelated factors, some of which lack prediction or control. In all cases, different types and amounts of hazardous materials interact with fluctuating combinations of human error to produce different event outcomes with variable impact costs.
Vulnerability Assessment Conclusions

It is well understood that with regards to hazmat vulnerability, each campus and its surrounding community (including CSU – San Marcos) operates through a complex and dynamic interaction between industrial and commercial inputs and outputs and the natural and built environment. Such activity produces hazardous materials that move through the environment along both convergent and divergent routes and across all levels of land-use from site to campus to city and county and beyond. It is also clear from a review of the San Diego County hazard mitigation plan and Cal OES’ records of hazardous material spills, that such events occur with great frequency and varying degrees of severity across jurisdictions statewide. As such, in assessing the vulnerability of the CSU – San Marcos campus, campus-level risks and vulnerabilities are not discreet or isolated but can become exacerbated or augmented through connections to broader community-level hazmat risks and vulnerabilities.

Finally, in order to draw conclusions on vulnerability, it should be noted that any identified vulnerabilities at the campus level and/or community level are circumscribed and potentially reduced by targeted policy and program interventions. Numerous policies and programs have been established in recent years in response to California’s widespread and complex and integrated hazardous materials risks - California established the Unified Program which consolidates and integrates the administrative requirements, permits, inspections, and enforcement activities of the following environmental and emergency response programs: the Aboveground Petroleum Storage Act (APSA) Program, Area Plans for Hazardous Materials Emergencies, the California Accidental Release Prevention (CalARP) Program, the Hazardous Materials Release Response Plans and Inventories (Business Plans), Hazardous Material Management Plan (HMMP) and Hazardous Material Inventory Statement (HMIS) requirements (California Fire Code), the Hazardous Waste Generator and Onsite Hazardous Waste Treatment (tiered permitting) Programs, and the Underground Storage Tank Program.

Identified Data Limitations

The CSU – San Marcos planning committee has provided information on campus-level hazmat materials and risks. Data limitations pertain to a comprehensive understanding of human activity and error related to materials control over the long term.
**Landslide**

Description of the Hazard

A landslide is a down-slope movement of soil, rock, or other debris, and can also be referred to as a mass movement or slope failure.\(^{67}\) These geological hazards can range in size from a few feet to over a mile in length and width and, when heavy and rapidly moving, can cause serious damage and loss of life.

Landslides are classified based on the type of material and type of movement involved. They can range from slow-moving earth flows to fast-moving debris flows, though many large slope failures involve more than one type of movement. The primary natural triggers of slope failures are water, seismic activity, and volcanic activity. Slope saturation by water can occur from intense rainfall, snowmelt, changes in ground-water levels, and surface-water level changes along coastlines. In winter months, El Nino storms or other high rainfall events may saturate soils and trigger slope failure.

**Deep-Seated Landslides**

Deep-seated landslides, ranging in depth from ten to several hundred feet, occur as a result of geologic and hydraulic changes, such as earthquakes or increased levels of groundwater. These landslides can move slowly or quickly and can cause extensive property damage, but rarely result in loss of life.

**Debris Flows Related to Shallow Landslides**

Shallow landslides may mobilize into rapidly moving debris flows and typically occur after sudden saturation of the ground. These types of debris flows are typically more dangerous because they move rapidly, causing both property damage and loss of life.

Debris flows may also occur as a result of post-fire conditions, where wildfires have left barren ground exposed to heavy rainfall. Intense rainfall, generally greater than .5 inch per hour, has the potential to trigger a post-fire debris flow.\(^{68}\) These landslides may impact lives and properties within its deposition zone, and can result in downstream flooding. These post-fire debris flows often occur during the fall and winter following major summer fires.

Location of the Hazard

The susceptibility of an area to landslides depends on several variables, including magnitude of slope gradients, water content, ground cover, presence of erosion, and slope material and structure. However, landslides are most prevalent in terrain with weak material and steep slopes, and the highest risk is found in areas with high rainfall or high

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earthquake potential. Slope failures are also most likely to occur in areas where they have occurred in the past. In California, the most landslide-prone areas are found along the coast and in the northern Franciscan Formation.

General landslide vulnerability can be estimated from the distribution of weak rocks and steep slopes as seen in Figure 24-13. Based on the Figure below, the CSU-San Marcos campus is connected to areas with low to moderate susceptibility to landslide.

Figure 24-12: Deep-Seated Landslide Susceptibility Surrounding CSU-San Marcos

![Deep Seated Landslide Susceptibility Surrounding CSU San Marcos](https://maps.conservation.ca.gov/cgs/lsi/app/)

Extent of the Hazard

Landslide risk in San Diego is concentrated along canyons near the coastal areas with steep slopes. Landslides also occur throughout the western portion of the County and in the mountains to the east. Mitigation measures have stabilized many but not all landslides in urban areas. The indirect impacts of landslides in the region may cover a larger geographical extent than that of direct impacts. Based on the campus’ close proximity to the landslide hazard zone, and the history of significant impacts in the San Diego county, the planning committee ranks the extent of the landslide hazard for the campus as Moderate.

History of the Hazard

FEMA has declared twelve major disasters involving landslides, mudslides, mud flows, or debris flows since 1978 in San Diego County. NOAA recorded twenty-nine debris flow events from 2003 to 2019. No landslides have occurred on or immediately adjacent to the campus.

Potential Impacts of the Hazard

CSU San Marcos may be impacted by the disruption of services as a result of landslides in the region. Landslides can result in physical damage to buildings and property and have the potential to significantly effect infrastructure. As a landslide moves, it distresses structural foundations by settlement, cracking, and tilting. Fast-moving flows can remove entire structures in one instance, while other types of flows can cause damage gradually. Transportation and utility infrastructure are particularly vulnerable to landslides, since the failure of any component can disrupt service over a large area. The loss of power and communication and disruption of transportation can have cascading effects throughout an area, including impaired disposal of sewage, contamination of water supplies, and the release of flammable fuels. Transportation routes are also often expensive to clean up, and prolonged obstruction can disrupt the movement of people and goods for long periods of time.

Probability of Future Occurrence of the Hazard

Slope failures are often triggered by other natural hazards such as heavy rainfall and earthquakes, so landslide frequency is often related to the frequency of these other hazards. As climate change impacts the frequency and intensity of triggers such as rain events, fires, and coastal erosion, landslides may generally occur more often. Historically, landslides have occurred frequently in San Diego County and therefore are highly likely to occur in the future. Given the location of the campus adjacent to the landslide zone, and the occasional occurrence of severe landslides in the county, the planning committee ranks the probability of the landslide hazard in some way impacting the campus as Possible.
Vulnerability to the Hazard

The vulnerability of the built environment to landslides depends on exposure and is more likely to incur damage as a result of proximity, rather than inferior structural design. The structures most vulnerable to landslides are buildings and utility/transportation lifelines, which can be impacted by either impact or ground deformation. Utilities and transportation infrastructure are particularly vulnerable, due to their geographic extent and susceptibility to physical distress. Any population proximal to a landslide when it occurs is vulnerable to its impacts. Based on the map provided, the campus might exhibit building and infrastructure vulnerabilities to some degree. Transportation routes surrounding the campus are vulnerable. See the landslide location map in relation to the campus along with landslide severity zones identified.

Estimate of Potential Losses

There are no current models for estimating potential losses from a landslide directly impacting the campus.

Although the economic impact of landslide damage can exceed that of the direct repair costs, there are currently no applicable methods for estimating indirect costs related to CSU San Marcos.

Vulnerability Assessment Conclusions

Community exposure to landslides varies depending on their physical locations – whether in flat plains or on steep hillsides – and on their dependence on critical infrastructure located in landslide hazard zones.

Landslides could impact the campus, primarily related to indirect impacts to transportation and utilities. Utility outages can impact health, particularly for vulnerable populations, and can cause interruptions in operations. Interruptions may impact student and employee’s ability to travel to campus and the delivery of classes and events.

Identified Data Limitations

The ability to predict future landslides at the CSU San Marcos campus is limited. However, the USGS estimates that climate change-induced shifts in weather will increase the frequency of post-wildfire landslides, which are expected to occur almost every year in California.

Power Outage

Description of the Hazard

San Marcos, CA is located in northern San Diego County, and spans across approximately 24 square miles.

Most aspects of modern life, and almost all aspects of urban life, rely on the availability of reliable utilities, such as electricity, water, and natural gas. An interruption in the supply or
distribution of these commodities can leave populated areas like San Marcos, without basic services, such as electricity or sanitation. These interruptions can be cascading effects from other hazard events, such as windstorms, floods, wildfires, and earthquakes, or they can be caused by intentional disruptions of transmission lines.

A power outage event can interrupt day-to-day operations of the CSU San Marcos campus, like in-person classes, impede or limit digital, telephonic or radio communications, create traffic jams around the busy avenues and boulevards surrounding the campus, close the student health center, and close restaurants around campus and outside the campus. Additionally, thousands of CSU San Marcos student residents in on-campus housing would also be affected by a power outage on campus and in the area.

Additionally, a severe outage to San Marcos would also directly affect the campus and the community. Electric power disruptions and outages fall into two categories: intentional and unintentional.

The four types of **intentional** disruptions are:

- Planned: Some disruptions are intentional and can be scheduled based on maintenance or upgrading needs.
- Unscheduled: Some intentional disruptions must be done "on the spot" in response to an emergency.
- Demand-Side Management: Some customers (i.e., on the demand side) have entered into an agreement with their utility provider to curtail their demand for electricity during periods of peak system loads.
- Load Shedding: When the power system is under extreme stress due to heavy demand and/or failure of critical components, it is sometimes necessary to intentionally interrupt the service to selected customers to prevent the entire system from collapsing. These intentional interruptions result in rolling blackouts.

**Unintentional** or unplanned disruptions are outages that come with essentially no advance notice or warning. This type of disruption is the most problematic. The following are categories of unplanned disruptions:

- Accident by the utility, utility contractor, or others.
- Malfunction or equipment failure.
- Equipment overload (utility company or customer).
- Reduced capability (equipment that cannot operate within its design criteria).
- Tree contact other than from storms.
- Vandalism or intentional damage.
- Weather, including lightning, wind, earthquake, flood, and broken tree limbs taking down power lines.
- Wildfire that damages transmission lines.
Location of the Hazard

Although power outages can take place within a certain area, it has the potential to affect the entire planning area equally.

Extent of the Hazard

In order to anticipate outage conditions and reduce impacts, campus facility managers and others keep track of conditions and data provided by the media, municipal utilities and the California Independent System Operator (CAISO). CAISO is tasked with managing the power distribution grid that supplies most of California, except in areas served by municipal utilities, and is thus the entity that coordinates statewide flow of electrical supply. CAISO uses a series of “stage alerts” to the media based on system conditions. The alerts are as follows:

- Stage 1 - reserve margin falls below 7 percent.
- Stage 2 - reserve margin falls below 5 percent.
- Stage 3 - reserve margin falls below 1.5 percent

Rotating blackouts become a possibility when Stage 3 is reached. Utility agencies aim to advise affected areas approximately 48 hours in advance of a potential PSPS event and will attempt notification again approximately 24 hours before power is shut off. Campus staff respond accordingly.

Given the prevalence of rolling blackouts and other power outages in California, the campus maintains safety precautions, situational awareness, access to emergency power generators and other protocols for managing campus power outages. Given that recorded outages have taken place on campus, the planning committee ranks the extent of the power outage hazard as Moderate.

History of the Hazard

Cal State San Marcos State has reported experiencing power outage events. PSPS outages impacted student housing interrupting everyday operations at resident halls and the use of electricity for scholastic and everyday needs while at the dorms. Two years ago, a west coast power outage prompted a campus shutdown, and, in the same year, a power pole car incident caused a small power outage.

Potential Impacts of the Hazard

Instructors, campus residents, staff and administration rely on electricity to maintain ongoing operations. During a widespread power failure, it may take days to restore operations. Electrical power may be the only cooling source for many individuals around the campus and its community, enabling students with disabilities to enter, navigate and leave University buildings and long-term outages can potentially put students, faculty and staff safety at risk. Additionally, many medical devices, communications devices, and security rely on power to maintain their functions and losing power can potentially lead to tragic results.

Climate Change and Energy Shortage
Climate change is expected to bring more frequent and intense natural disasters. These changes have created a variability at a rate that makes historical data a poor predictor of future climate. For example, the warmest years on record in California occurred in 2014, 2015, and 2016. The 2016-2017 year broke the record as the wettest ever recorded in the northern Sierra Nevada Mountains.

Changes in temperatures, precipitation patterns, extreme events, and sea-level rise have the potential to decrease the efficiency of thermal power plants and substations, decrease the capacity of transmission lines, render hydropower less reliable, spur an increase in electricity demand, and put energy infrastructure at risk of flooding.

With climate warming, higher costs from increased demand for cooling in the summer are expected to outweigh the decreases in heating costs in the cooler seasons. Hotter temperatures in California will mean more energy (typically measured in “cooling-degree days”) needed to cool homes and businesses both during heat waves and on a daily basis, during the daytime peak of the diurnal temperature cycle. During future heat waves, historically cooler coastal cities (e.g., San Francisco and Los Angeles) are projected to experience greater relative increases in temperature, such that areas that never before relied on air conditioning will experience new cooling demands.

Secondary impacts of energy shortages are most often felt by vulnerable populations. For example, those who rely on electric power for life-saving medical equipment, such as respirators, are extremely vulnerable to power outages. Also, during periods of extreme heat emergencies, the elderly and the very young are more vulnerable to the loss of cooling systems requiring power sources.

**Probability of Future Occurrence of the Hazard**

The probability of California experiencing a power outage can be difficult to quantify but is a hazard that occurs annually during the same seasonal periods of temperature variance throughout the calendar year. San Marcos and San Diego County experience such outages. As such, the probability ranking for the San Marcos area is **Likely**. Since CSU San Marcos campus has also recorded power outage events, it is prudent to assign this same ranking for the campus.

Climate models suggest summer global temperatures are likely to increase while changes between temperature extremes would be more pronounced. As such, it is expected that power outages will occur more frequently in the future.

**Vulnerability to the Hazard**

Based on the data available, and in consideration of the increasing effects of climate change, the probability of future occurrences prompting intentional outages and creating unintentional power outages the hazard is high for the county in different areas but not specifically influencing the CSU San Marcos. Nonetheless, as discussed, campus leadership works to reduce vulnerabilities through consistent use of safety and operational protocols and emergency power sources to ensure it is able to mitigate and cope with an interruption to electrical power.
Estimate of Potential Losses

Although the economic impact of power outage damage can exceed that of the direct repair costs, there are currently no applicable methods for estimating indirect costs related to CSU-San Marcos.

Vulnerability Assessment Conclusions

Elevators, entry ways, air filtration systems and lighting provide the campus community with the necessary infrastructure and systems to function and navigate through the campus and to maintain a safe campus environment and visibility during nighttime hours. The primary concern for campus leadership is that a loss of power can lead to potential hazards to students, faculty, and staff at CSU San Marcos. Vulnerable populations (especially students with physical disabilities) may be the most heavily affected by loss of power, as they rely on elevators, entry ways with automatic doors, and locks and lights; a power outage would impede a disabled student’s ability to travel and utilize the campus and its structures safely.

The use of communication devices, billing, records, and electrical tools may also become unusable due to a loss of electricity. Many records and billing items may have to revert to “by-hand” procedures and paper copies may have to be kept continuing operations. Additionally, classrooms may not be usable if lighting equipment is not functioning impacting a semester or quarter’s progress for the academic year.

Identified Data Limitations

CSU San Marcos did not report any monetary or life losses due to a power outage. Also, the campus did not report any incidents involving a power outage directly affecting the campus community and operations.

Volcano (Associated Air Quality)

Description of the Hazard

The US Geological Service defines volcanoes as “openings or vents where lava, tephra (small rocks), and steam erupt on to the Earth’s surface. Through a series of cracks within and beneath the volcano, the vent connects to one or more linked storage areas of molten or partially molten rock (magma). This connection to fresh magma allows the volcano to erupt over and over again in the same location.”

A volcanic eruption occurs when magma, lighter than surrounding rock, is driven upwards by its buoyancy and by pressure from the dissolved gases contained within it. Gases are released from magma as it reaches the surface and pressure decreases. Magma can be erupted in several ways and violent eruptions typically cause tiny pieces of tephra (ash) to be carried away by the wind. This ash is hard, does not dissolve in water, is extremely

abrasive and mildly corrosive, and conducts electricity when wet. The gases released in an eruption include carbon dioxide, sulfur dioxide, hydrogen sulfide, and hydrogen halides. Depending on their concentration, these are potentially hazardous to people, animals, agriculture, and property.

Location of the Hazard

There are eight volcanic areas located throughout California. Seven of these - Medicine Lake Volcano, Mount Shasta, Lassen Volcanic Center, Clear Lake Volcanic Field, Long Valley Volcanic Region, Coso Volcanic Field, and Salton Buttes – are considered active volcanoes. No portion of CSU San Marcos or San Diego County is within a volcano hazard zone.

Extent of the Hazard

Volcanic hazards are most severe within a few miles of the volcano vent and the severity generally decreases with distance. Ash impact zones can range from tens to hundreds of miles from the vent source. The US Geological Survey has estimated zones surrounding active volcanoes wherein 2 inches or more of ashfall following an eruption is possible. While CSU San Marcos does not fall within an estimated ashfall zone, lighter dustings of ash outside of those areas may directly or indirectly impact the campus. As such, the planning committee ranks the extent of the hazard for the campus as Low.

History of the Hazard

No historical eruption events in California have affected the campus. Over the last 1,000 years, there have been at least 12 eruptions in California. The most recent volcanic eruption in California occurred at Lassen Peak about 100 years ago, when a major explosion delivered windborne ash over 275 miles away.

Potential Impacts of the Hazard

The specific impacts vary widely and depend on which type of volcano erupts, the style of explosion, the volume of lava, the eruption duration, and the local water conditions. As CSU San Marcos is not proximal to an active volcano, only the potential impacts of ashfall and gases have been detailed. While both these hazards can be widespread, their most severe impacts are generally seen closer to the volcanic source.

Although ashfall is typically a nonlethal volcanic hazard, it is the most widespread and disruptive. Falling ash can damage crops, electronics, and machinery. It can also impact human health by irritating the respiratory tract, eyes, and skin. The particles may enter drinking water and structures and may cause structure failure if it is thick and heavy.

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enough. Even a fine layer of ash can disrupt utilities. A portion of California’s major electric transmission lines, aerial telecommunication lifelines, transportation corridors, and water storage and conveyance lie within the state’s volcano hazard zones. Impacts to any of these can impact operations at CSU San Marcos.

The potential impacts of gases released during volcanic eruptions are as follows:

- Carbon dioxide typically becomes diluted very quickly and is not life threatening. However, it can become trapped in higher concentrations in low-lying areas and has the potential to be fatal.
- Sulfur dioxide can cause acid rain and air pollution downwind of a volcano.
- Hydrogen sulfide can cause irritation of the upper respiratory tract. At high concentrations it can cause unconsciousness and death.
- Hydrogen halides can coat ash particles and, once deposited, poison drinking water, agricultural crops, and grazing land.

**Probability of Future Occurrence of the Hazard**

The US Geological Survey, based on the record of volcanic activity in California, estimates that the probability of another small- to moderate-sized eruption in the next thirty years is about 16 percent. As such, the annual probability of future occurrence for the campus is ranked as **Unlikely**.

**Vulnerability to the Hazard**

Populations living near volcanoes are the most vulnerable to eruptions and lava flows. However, volcanic ash can travel and affect populations miles away. The location and thickness of ash in any given area is a function of the severity of the eruption and wind speed and direction. For CSU San Marcos, there is low vulnerability to the immediate impacts of volcanic eruptions due to the limited area affected and remote potential of an eruption. In the event of a widespread ashfall event, the elderly, infants, and populations with existing respiratory disease will be at higher risk.

**Estimate of Potential Losses**

Impacts to critical infrastructure, agriculture, and property from ashfall have the potential to cause widespread disruption, damage, and economic loss throughout the state. In the event of a widespread ashfall event, impacts will be immediate.

Current modeling is not precise enough to allow for an assessment of potential losses from ashfall to structures or infrastructure on or surrounding the campus.

**Vulnerability Assessment Conclusions**

CSU San Marcos is unlikely to experience the direct impacts of a volcanic event. While the campus may be indirectly impacted by ashfall elsewhere in the state, direct ashfall impacts are generally unlikely but possible in a widespread event. However, the likelihood of any volcanic eruption in the state impacting the campus is very low.

**Identified Data Limitations**
Not all active volcanoes in California have been zoned for hazards by the US Geological Survey. This, together with the infrequent occurrence of volcanic explosions and number of factors determining type and extent of impacts, make the quantification of potential loss difficult.
**Wildfire**

**Description of the Hazard**

While wildfires are a natural part of California’s ecosystem, wildfires in California represent a hazard that presents one of the greatest probabilities of destruction along with a demonstrated history of catastrophic fire events in recent years. The destructive fire seasons of 2017 to 2020 illustrated the destructive forces fire presents to communities across the state. Wildfires may result in the structural loss, infrastructure loss, dangerous air quality, environmental damages, economic impacts, injuries, and loss of life. In many communities throughout California, wildfire presents greatest risk to human life and property.

Wildfires have been defined as any free burning vegetation fire that initiates from an unplanned ignition, whether natural or human caused demanding fire suppression actions to contain. These fires are prone to become uncontrolled, spreading through vegetative fuels rapidly exposing people and structures to harm. Wildfires present a significant risk to communities across the state, as evidenced by increasing trends of structural losses from wildland fires. This risk is elevated in areas where development and community growth has intersected, also known as the wildland-urban interface (WUI). In the interface setting, development itself can provide additional fuel for large fires. Recent fires have also demonstrated the ability of fire to consume populated areas in extreme conditions.

California’s Mediterranean climate in combination with its geography and vast population create a combination of factors that promotes an optimal environment for large fire growth and consequences. As there is great diversity of geographic characteristics across the state, the risks and potential consequences of wildfire must be assessed locally. The physical location, weather patterns, local fuel types and volume, extent of the WUI, topography, and additional factors will factor differently from part of the state to another.

The behavior of wildfires in California is significantly influenced by three distinct geographic factors. These factors will help shape the size, direction of spread, rate of combustion, fire intensity, and ability to pre-heat fuels. The physical factors contributing to wildfire behavior include:

- **Topography** – The rate in which wildfires spread increases with greater slopes in topography. The greater the slope will result in more pre-heating of fuel above the advancing fire. The direction that a slope faces will also influence fire behavior as south facing slopes receive greater solar radiation and thus drier vegetation that is more susceptible to combustion. Ridgetops often denote the end of fire spread as fire has greater difficulty spreading downhill.

- **Weather** – Weather factors substantially in influencing the behavior of wildfires. Wind, temperature, humidity, lightning, and lack of precipitation all contribute to a fire’s ability or inability to spread and intensify. California routinely experiences conditions in which these factors are in alignment to contribute to extreme fire

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behavior during the summer and fall seasons. High winds, low humidity, and high temperatures provide an environment promoting extreme fire activity.

- **Fuels** – Certain types of vegetation are increasingly prone to igniting and promote more intense burning. Areas with greater “fuel loading” (amount of fuel present in terms of weight of fuel per unit of area) increases the amount of fuel to fuel a fire. Greater volumes of dead or dry vegetation compared to live plants is a critical factor. Vegetation during drought conditions will experience decrease in moisture content increasing the conditions for combustion. Fuels close proximity to one another allows for rapid spread through contact or radiant exposures.

A risk assessment for wildfires should be implemented within a geospatial context focusing on the specific location features and incorporates the three components of the wildfire risk triangle – likelihood, intensity, and susceptibility.

**Location of the Hazard**

Substantial portions of the State of California are exceptionally vulnerable to wildfire activity or reside in a wildland-urban interface (WUI) area due to the vast open spaces, rangelands, forests, and other lands with high susceptibility to fire occurring throughout the state. CSU San Marcos is located at the base of the San Elijo and San Marcos Hills. Areas considered to be within Fire Hazard Severity Zones defined by the Fire and Resource Assessment Program (FRAP) within the California Department of Forestry and Fire Protection (CalFire) occur to the east and south of the campus. Additionally, these fire hazard zones exist in other areas throughout San Diego County. These areas of higher fire hazards occur extensively in suburban and rural areas of the northern and eastern areas of the county. Each of these hazard zones include moderate to heavy vegetation and are bordered by residential development.

The CSU San Marcos campus is located in northern San Diego County west of Escondido. The area immediately to the south and east of the campus is open hillsides with light to moderate vegetation. These areas of higher fire hazard border the campus in closest proximity to the Children’s Center, University Services Building, Social and Behavioral Sciences Building, the Arts Building, and Markstein Hall. The areas to the west are residential neighborhoods and areas to the north include commercial land uses. Fire Hazard Severity Zones are found on the western portions of the campus and throughout the hillsides surrounding the campus to include Very High Fire Hazard Severity Zones (VHFHSZ).
Fire Hazards Zones surrounding San Diego County and in proximity to the campus demonstrate the broader community threat that wildfires present to the population. Fire hazard severity zones are found surrounding the populated areas of the county. This presents the potential for fire related damages and smoke inundation to occur in many areas that members of the campus community reside at, are employed in, or where they recreate. Transportation routes are equally impacted causing potential added challenges for the campus community to get to areas if safety, get resources, or gain access to the campus.

Extent of the Hazard

The area immediately surrounding the CSU San Marcos campus is in direct proximity to fire hazard zones designated as a High Fire Hazard Severity Zones. The campus does have a history of wildfire activity occurring within direct proximity to the campus. Additionally, the campus has experienced the effects of large wildfires occurring elsewhere in San Diego County. The campus closed due to fires in 2007, 2014, and 2017. Given the above factors, the planning committee ranks the extent of the hazard as **High**.

The National Fire Danger Rating System (NFDRS) is the current system in use for rating and classifying the potential danger of fire. The NFDRS tracks the effects of previous weather events on both dead and live fuel loads and adjusts accordingly based on future or predicted weather conditions. These complex relationships and equations are computed, and the outputs are expressed in terms that users can quickly and easily
understand. The current NFDRS is used by all federal and most state agencies to assess fire danger conditions.

The following table depicts the NFDRS, from the US Forest Service’s Wildland Fire Assessment System.

Table 24-24: National Fire Danger Rating System

<table>
<thead>
<tr>
<th>Rating</th>
<th>Basic Description</th>
<th>Detailed Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>CLASS 1: Low Danger (L)</td>
<td>Fires not easily started</td>
<td>Fuels do not ignite readily from small firebrands. Fires in open or cured grassland may burn freely a few hours after rain, but wood fires spread slowly by creeping or smoldering and burn in irregular fingers. There is little danger of spotting.</td>
</tr>
<tr>
<td>COLOR CODE: Green</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CLASS 2: Moderate Danger (M)</td>
<td>Fires start easily and spread at a moderate rate</td>
<td>Fires can start from most accidental causes. Fires in open cured grassland will burn briskly and spread rapidly on windy days. Woods fires spread slowly to moderately fast. The average fire is of moderate intensity, although heavy concentrations of fuel -- especially draped fuel -- may burn hot. Short-distance spotting may occur but is not persistent. Fires are not likely to become serious and control is relatively easy.</td>
</tr>
<tr>
<td>COLOR CODE: Blue</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CLASS 3: High Danger (H)</td>
<td>Fires start easily and spread at a rapid rate</td>
<td>All fine dead fuels ignite readily, and fires start easily from most causes. Unattended brush and campfires are likely to escape. Fires spread rapidly and short-distance spotting is common. High intensity burning may develop on slopes or in concentrations of fine fuel. Fires may become serious and their control difficult, unless they are hit hard and fast while small.</td>
</tr>
<tr>
<td>COLOR CODE: Yellow</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CLASS 4: Very High Danger (VH)</td>
<td>Fires start very easily and spread at a very fast rate</td>
<td>Fires start easily from all causes and immediately after ignition, spread rapidly and increase quickly in intensity. Spot fires are a constant danger. Fires burning in light fuels may quickly develop high-intensity characteristics - such as long-distance spotting - and fire whirlwinds when they burn into heavier fuels. Direct attack at the head of such fires is</td>
</tr>
<tr>
<td>COLOR CODE: Orange</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Classification:

CLASS 5: Extreme (E)
COLOR CODE: Red

Fire situation is explosive and can result in extensive property damage.

Fires under extreme conditions start quickly, spread furiously, and burn intensely. All fires are potentially serious. Development into high intensity burning will usually be faster and occur from smaller fires than in the Very High Danger class (4). Direct attack is rarely possible and may be dangerous, except immediately after ignition. Fires that develop headway in heavy slash or in conifer stands may be unmanageable while the extreme burning condition lasts. Under these conditions, the only effective and safe control action is on the flanks, until the weather changes or the fuel supply lessens.

Due to the impacts of wildfires on public health, agencies across the nation have adopted the use of the Air Quality Index (AQI) to communicate and provide a consistent approach to air quality measurements and categorization. The AQI primarily focuses on the health effects caused by pollutants in the air such as smoke. The goal of the AQI is to provide advisories to assist the public in determining when to reduce exposures to inhalation of air pollution as pollution levels rise.
History of the Hazard

The State of California has a long history of chronic and destructive wildfires throughout the state. On average, 8,300 wildfires have caused burnt 928,245 acres across the state over the 20-year period between 2000 and 2020. San Diego County also has a long history of wildfire activity primarily in the foothills and mountains. Wildfires occurring in the San Diego County have resulted in hundreds of thousands of acres burned and hundreds of millions of dollars in damages.

The area immediately surrounding the CSU San Marcos campus is in direct proximity to fire hazard zones designated as a High Fire Hazard Severity Zones. The campus does have a history of wildfire activity occurring within direct proximity to the campus. Additionally, the campus has experienced the effects of large wildfires occurring elsewhere in San Diego County. The campus closed due to fires in 2007, 2014, and 2017. The County is surrounded by areas that are considered to be of high fire threat that would produce vast quantities of smoke and particulates into the air. The San Diego campus has experienced days of poor air quality due to fires burning in parts of the county, although infrequent.

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76 California Department of Forestry and Fire Protection, Stats and Events, https://www.fire.ca.gov/stats-events/
Table 24-25: Historic Large-Scale Fires Near CSU San Marcos

<table>
<thead>
<tr>
<th>Date</th>
<th>Fire</th>
<th>Location</th>
<th>Declaration</th>
<th>Damages</th>
</tr>
</thead>
<tbody>
<tr>
<td>10/2003</td>
<td>Cedar</td>
<td>Cuyamaca Mountains</td>
<td>DR-1498-CA; FM-2505-CA</td>
<td>280,278 acres; 5,171 structures; 14 fatalities</td>
</tr>
<tr>
<td>10/2007</td>
<td>Multiple</td>
<td>Countywide</td>
<td>DR-1731-CA; FM-2734-CA</td>
<td>&gt;270,000 acres, 7 fatalities</td>
</tr>
<tr>
<td>5/2014</td>
<td>Cocos</td>
<td>San Marcos Hills</td>
<td>FM-5055-CA</td>
<td>$6 million, 40 structures</td>
</tr>
<tr>
<td>12/2017</td>
<td>Lilac</td>
<td>Bonsall/Oceanside</td>
<td>EM-3396-CA; FM-5228-CA</td>
<td></td>
</tr>
</tbody>
</table>

Potential Impacts of the Hazard

The location of the CSU San Marcos campus surrounded by areas designated as High or Very High Fire Hazard Severity Zones places a threat of flame, ember, and smoke exposure from wildfire to the campus. There is potential for fire to occur on two sides of the campus and in the surrounding hillsides composed of light to moderate fuels. The threat of these neighboring hillsides to campus structures is substantial.

Potential impacts to the campus community resulting from wildfires include:

- Injuries or loss of life
- Campus property destruction of damage
- Residential property destruction or damage
- Commercial property destruction or damage
- Loss of property contents
- Infrastructure damage
- Threat to Central Plant
- Damaged or disrupted transportation, lifelines, and supply routes
- Damaged or destroyed utilities
- Damaged or destroyed critical facilities supporting campus emergency support needs
- Potential for community wide evacuation
- Loss of community economic base
- Employment losses
- Loss to ground supporting vegetation on hillsides resulting in erosion or landslides in future precipitation events
- Threat to Children’s Center
- Environmental damage
- Societal and community impacts
- Damage to organizations and facilities providing support services to vulnerable populations
- Greater evacuation challenges for those most vulnerable
- Psychological impacts of impacted populations

77 San Diego County Multi-Jurisdictional Hazard Mitigation Plan, October 2017
- Disruptions to education delivery to community

Potential impacts resulting from wildfire generated smoke include:

- Dangerous levels of air pollution
- Human Health Effects
  - Similar health impacts to pets
- Air conditioning systems overwhelmed
- Greater demands on air filtration systems
- Greater demands on healthcare systems
- Reduced outdoor staff work productivity
- Closures of academic sessions

Additionally, there remains a number of secondary impacts from wildfires that could affect the campus community. Utilities feeding areas of San Diego County including the campus may be damaged resulting in power outages. Fire related damage in the watersheds will likely cause future landslides, degradation to plants supporting hillsides, and impact the hydroelectric power capabilities. Fires may present threats to areas of recreation, scenic value, and wildlife that are a part of the culture of the campus community. Finally, the campus may experience effects of evacuated individuals arriving on campus from other areas as a location of refuge.

Probability of Future Occurrence of the Hazard

Based on the wildfire threat potential in the area surrounding the CSU San Marcos campus the hillsides east and south of the campus, including the immediate proximity to Local Fire Hazard Severity Zones listed as “Very High”, the density of residential and commercial development, and the historic occurrences of fires, the probability of wildfire related damage is considered Possible.

Based on the wildfire threat potential in the area surrounding Southern California including the hills and mountains throughout the region, the volume of areas in elevated Fire Hazard Severity Zones throughout the southern portions of the state, and the historic occurrences of smoke, the probability of wildfire generated smoke impacts to air quality is considered Possible.

Vulnerability to the Hazard

The CSU San Marcos campus is subject to direct impact from wildfire due to the campus location within a wildland-urban interface zone. The campus is identified to reside near a designated local High Fire Hazard Severity Zone. The campus is surrounded on by hillsides and open lands containing combustible vegetation combined with residential development. Additionally, vulnerabilities to the effects of wildfire would lie within the campus community who may reside or work in locations that are exposed to the Fire Hazard Severity Zones in other parts of the surrounding region. Wildfires occurring in other areas of the region may result in the displacement of large numbers of people.
These effects may spill onto the campus in the form of evacuees or facility support to emergency resources.

Fire directly threatening the campus would likely take the form of vegetation fires along the hillsides and extending onto the campus or localized fires involving single structures or small areas. Smaller vegetation fires are possible surrounding the campus in the urban forest or fields surrounding the city. These incidents would likely have significant impact to the campus.

The primary basis of vulnerability is based on the population affected and the built environment exposed. In general, newer construction will be more fire resistant than older buildings as building and fire codes and construction technology have improved. Density of buildings and proximity of fuels to buildings or equipment at risk of combustion would additionally influence the fire’s ability to spread to structures. Structures with vegetation and other combustibles near the structure increases the ability of fire to spread to buildings.

Access to the south using Twin Oaks Valley Road servicing access to San Elijo and Carlsbad could become cutoff during fire incidents. Routes to the west and north are primary roadways servicing the greater community that would unlikely be impacted by fire. Access for supplies, equipment, and emergency services in addition to evacuation away from the campus would likely be forced to use northern routes into San Marcos or west to the coast. The campus community residing in areas to the east and south may find difficulty in gaining access to the campus or returning home from the campus in fire incidents in these areas.

Additional concerns regarding vulnerabilities to wildfire are related to the smoke that fires in the area would produce. The recent summer seasons have clearly demonstrated the reality of large wildfires producing enough smoke to fill the northern San Diego County area even from substantial distances away. These recent fires have displayed how the effects of this smoke impact the general population and especially vulnerable populations. CSU San Marcos students, faculty, and staff both on campus and off campus face these same vulnerabilities related to smoke filled air.

Smoke generated from large wildfires pose a threat in terms of diminished air quality that would be exposed to the population within the area of smoke distribution. Individuals with existing health problems such as respiratory or cardiac illnesses are increasingly vulnerable to wildfire generated smoke. Staff who work in roles requiring outdoor activity will be increasingly exposed during days where the air quality index is considered unhealthy or worse. Student athletes participating in outdoor sports and engaging in aerobic activities are increasingly vulnerable to the effects of wildfire.

The vulnerability to members of the campus community in which wildfire generated smoke on the CSU San Marcos campus will vary depending on when the air quality was to reach unhealthy levels. The risk to the campus population will be lessened during periods when classes are not in session or during periods of breaks. Conversely, during the days and hours that classes are in session and staff are at their workplaces, the human
vulnerability increases. However, in region-wide events this vulnerability may be shared with the homes and workplaces of members of the campus community and their families.

Vulnerable populations will likely face disproportionate health safety issues from smoke filled air, experience increased stresses, may require the need to remain away from the campus enclosed at home, and may find difficulty in accessing equipment or supplies to aid in a specific need.

Estimate of Potential Losses

Estimates of potential losses will be influenced by a variety of factors. Costs would also be likely to include mitigation or repairs of HVAC systems, sealing of doors and windows, and other methods of keeping smoke from entering buildings. Secondary costs would include lost academic days during campus closures, lost staff on campus productivity, and health and medical interventions for affected members of the campus community.

Based on estimate replacement costs of facilities and structures on campus, the maximum total replacement costs due to wildfire are $217,777,651. However due to the lack of a complete inventory of building and facility costs, the total replacement estimate is likely much higher.

Table 24-26: Wildfire Hazard Potential (WHP) Zone Estimated Losses

<table>
<thead>
<tr>
<th>WHP Zone</th>
<th>No of Buildings</th>
<th>Maximum Replacement Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Extreme</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Very High</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>High</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Moderate</td>
<td>3</td>
<td>$337,000</td>
</tr>
<tr>
<td>Low</td>
<td>1</td>
<td>$3,916,567</td>
</tr>
<tr>
<td>Very Low</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Non-Burnable</td>
<td>21</td>
<td>$213,745,111</td>
</tr>
</tbody>
</table>

*Buildings with no value defined are also included in the respective Zones they are found in.

Vulnerability Assessment Conclusions

The occurrence of wildfires has been a frequent event in San Diego County, including wildfire incidents that have threatened or caused damages near the CSU Channel Islands campus. The location of the CSU San Marcos campus surrounded by open hillsides with light to moderate vegetative fuels along the entire eastern and southern edges presents a threat of fire to the campus community and campus assets. The foothills and mountains surrounding San Diego County host environments that are ideal for the development of wildfire activity. The consequences of fires in these areas would present primary and secondary consequences to the CSU San Marcos campus and expose vulnerabilities on the campus and to the campus community.
The topography of the valley surrounded by mountains allows for smoke filled air to linger in the valleys of Ventura County area with the potential for unhealthy air quality depending on wind conditions. Fires in the watersheds of the San Diego County Mountain ranges and tributaries may damage vegetation stabilizing hillsides and result in increased sediments to be discharged into the river system and reservoirs reducing their capacity and effectiveness. Communities located within or near the Wildland Urban Interface may be subject to damaging fires. These same communities may be home to members of the campus community. The potential for large-scale wildfires in the region further generates the added potential for a number of cascading effects such as disruptions to the local economy, utility failures, disruptions to providing for the needs of the community, and development of public health hazards. The potential for large-scale wildfires and resulting damage of homes and businesses has exponentially powerful impacts on particular populations among the campus community including those with access or functional needs, international students, the homeless, and students residing in the residence halls.

**Identified Data Limitations**

Data limitations include missing campus structural replacement costs and lack of a complete inventory of building construction types to lessen the impact due to fire activity. HAZUS generated analysis is focused on the broader community level versus fine-tuning the analysis to the micro-level for facilities such as a university campus.

Missing campus structural replacement costs and an inventory of building construction types to include status of earthquake retrofitting. HAZUS generated analysis is focused on the broader community level versus fine-tuning the analysis to the micro-level for facilities such as a university campus.

**Severe Weather (Wind, Tornado, Hail, Lightning)**

**Description of the Hazard**

Severe weather can be described as a variety of weather or climate events that are beyond or near the ends of the range of observed weather patterns and behavior. These events can include high or extreme winds, storms, lightning, hail, tornadoes, heat waves, unusually cold temperatures, extreme rainfall, and flooding. According to the Intergovernmental Panel on Climate Change (IPCC), to be classified as severe (or extreme), the occurrence of each value of a climate or weather variable (e.g., wind, hail,
lightning, tornado, etc.) must be “above (or below) a threshold value near the upper (or lower) ends of the range of observed values of the variable.”

Severe weather in California can be generated by local, regional, and/or global weather and climate influences. From the individual thunderstorm to the Santa Ana wind event to the strong El Niño, damaging weather elements that are produced by and accompany severe weather and climate phenomena (e.g., damaging winds, hail, lightning, and tornadoes) occur throughout California and the California State University (CSU) system.

**Global Scale Influences on Severe Weather in California: El Niño, La Niña, and ENSO**

The El Niño-Southern Oscillation (ENSO) is a recurring climate pattern involving changes in the temperature of waters in the central and eastern tropical Pacific Ocean. On periods ranging from about three (3) to seven (7) years, the surface waters across a large swath of the tropical Pacific Ocean warm or cool by anywhere from 1°C to 3°C, compared to normal. This oscillating warming and cooling pattern, referred to as the ENSO cycle, directly affects rainfall distribution in the tropics and can have a strong influence on weather across the United States and other parts of the world.

El Niño and La Niña are extreme phases of the ENSO cycle, with a third phase occurring between them called the Neutral phase. The El Niño phase is characterized by unusually warm ocean temperatures and weaker-than-normal east winds in the Equatorial Pacific, while the La Niña phase is characterized by unusually cold ocean temperatures and stronger-than-normal east winds in the Equatorial Pacific. Both extreme ENSO phases lead to significant differences from the average ocean temperatures, winds, surface pressure, and rainfall across parts of the tropical Pacific. The Neutral phase indicates that conditions are near their long-term average.

The extreme ENSO phases affect the frequency and intensity of weather events across the world, including in California. On average, areas across California experience exceptionally stormy winters with increased precipitation under El Niño conditions, but experience less stormy and drier winters under La Niña conditions. This variability in storminess and precipitation brought on by El Niño and La Niña events affects the both

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80 Retrieved on 07.18.2021 from https://www.weather.gov/mhx/ensowhat
82 Retrieved on 07.17.2021 from https://www.climate.gov/news-features/understanding-climate/el-ni%C3%B1o-and-la-ni%C3%B1a-frequently-asked-questions
83 Retrieved on 07.16.2021 from https://www.pmel.noaa.gov/elnino/what-is-el-nino
the frequency and intensity of severe weather conditions experienced by all CSU campuses, including CSU San Marcos.

**Regional Climate Influences on Severe Weather across California**

Most of the weather in California is influenced by the wet-winter/ dry-summer Mediterranean climate pattern. In the summer months, Pacific storm tracks are deflected north due to the position of the Pacific High (i.e., a large-scale atmospheric circulation over the Northeast Pacific Ocean), preventing Pacific storms from reaching California. As a result, most summer storms are generated due to the incursion of moist air from the Gulf of Mexico or the Gulf of California, and occur as scattered, locally heavy showers in the desert and mountain regions of the state. In the winter months, the Pacific High decreases in intensity and moves south, permitting powerful Pacific storms to move into and across the state; these storms can produce extreme winds, heavy rains (including “atmospheric river” events), and widespread coastal and inland flooding. (Please see the Flood Hazard profile in this document for information on Floods.) As a result, storm events accompanied by precipitation in California are far more frequent in the winter months than they are in the summer months.85

While the Mediterranean climate pattern influences the seasonal frequency, intensity, geographic spread, and type of some severe weather events CSU campuses experience (including CSU San Marcos), other severe weather phenomena may occur in California at any time of the year. For example, near the coast and over the Central Valley, there appears to be no defined seasonality to thunderstorms, and these storms are usually light and infrequent. Thunderstorms are more intense and more frequent in the intermediate and higher elevations of the Sierra Nevada, and occur with greater frequency during the summer months.86

**Types of Storms in California**

The 2018 California State Hazard Mitigation Plan (SHMP) defines a storm as a violent atmospheric disturbance occurring over land and/or water that is distinguished by its strength, characteristics, and the scale of the resulting damage.87 The SHMP also lists the following types of storms that produce hazardous conditions and potential damage throughout the state of California.88 These storms affect (in varying degrees) all CSU campuses, including CSU San Marcos.

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85 Retrieved on 07.17.2021 from [https://wrcc.dri.edu/Climate/narrative_ca.php](https://wrcc.dri.edu/Climate/narrative_ca.php)
86 Retrieved on 07.17.2021 from [https://wrcc.dri.edu/Climate/narrative_ca.php](https://wrcc.dri.edu/Climate/narrative_ca.php)
- **Thunderstorm**: A rain-bearing cloud that also produces lightning. Thunderstorms can produce some of nature’s most destructive and deadly weather including tornadoes, hail, strong winds, lightning and flooding.\(^{89}\) Thunderstorms are caused by an atmospheric imbalance from warm unstable air rising rapidly into the atmosphere. Lightning, which occurs during all thunderstorms, can strike anywhere.\(^{90}\) Thunderstorms can produce some of nature’s most destructive and deadly weather including tornadoes, hail, strong winds, lightning and flooding.\(^{91}\) **Severe thunderstorms** are more intense, violent, and dangerous thunderstorms. The National Oceanic and Atmospheric Administration (NOAA) defines a severe thunderstorm as any storm that produces one or more of the following elements: Damaging winds or speeds of 58 mph (50 knots) or greater, hail 1 inch in diameter or larger, and/or a tornado.\(^{92} \)\(^{93}\)

- **Hailstorm**: a type of storm that precipitates round chunks of ice. Hailstorms usually occur during regular thunderstorms.\(^{94}\)

- **Wind storm**: marked by high wind with little or no precipitation.\(^{95}\)

- **Winter storm**: A storm that can produce a combination of freezing rain, sleet, heavy snow, and/or strong winds.\(^{96}\)

- **Coastal storm**: large wind-driven waves and/or storm surge that strike the coastal zone.\(^{97}\)

- **Ice storm**: Ice storms are one of the most dangerous forms of winter storms. When surface temperatures are below freezing, but a thick layer of above-freezing air remains aloft, rain can fall into the freezing layer and freeze upon impact into a glaze of ice. In general, 8 millimeters (0.31 inch) of accumulation is all that is required, especially in combination with breezy conditions, to start downing power lines as well as tree limbs. Ice storms also make unheated road surfaces too slick

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\(^{89}\) Retrieved on 07.14.2021 from [https://www.weather.gov/phi/ThunderstormDefinition](https://www.weather.gov/phi/ThunderstormDefinition)


\(^{92}\) Retrieved on 07.15.2021 from [https://www.noaa.gov/explainers/severe-storms](https://www.noaa.gov/explainers/severe-storms)

\(^{93}\) Retrieved on 07.15.2021 from [https://www.weather.gov/safety/thunderstorm](https://www.weather.gov/safety/thunderstorm)


to drive on. Ice storms can vary in time range from hours to days and can cripple small towns and large urban centers alike.98

- **Snowstorm**: A heavy fall of snow accumulating at a rate of more than 5 centimeters (2 inches) per hour that lasts several hours. Snowstorms, especially ones with a high liquid equivalent and breezy conditions, can down tree limbs, cut off power, and paralyze travel over a large region.99

### Severe Weather Hazard Elements: Wind Hazards, Hail, and Lightning

This hazard profile concentrates on the following types of severe weather hazards: **wind hazards (including tornadoes)**, **hail**, and **lightning**. These hazards are produced by a variety of weather phenomena, including thunderstorms, coastal storms, winter storms, and topographically-enhanced downslope winds. While storm and downslope wind hazards are responsible for severe weather events across the CSU system, only the wind, tornado, hail, and lightning elements generated by these hazards are covered in this profile. (Storm-related hazards such as flooding and extreme temperatures are covered in other sections of this document.)

#### Wind Hazards

**Wind** is the horizontal movement of air past any given point. Wind begins with differences in air pressures; pressure that is higher at one point than another sets up a force, pushing the high towards the low pressure.100 Wind gusts are defined as “rapid fluctuations in the wind speed with a variation of 10 knots or more between peaks and lulls.” 101

Wind hazards in California take several forms: High Wind, Strong Winds, Thunderstorm Winds, Mountain-Valley (Downslope) Winds, and Tornadoes. These hazards are encountered across California, and have the potential to cause harm to or loss of life and/or property throughout California and the CSU system (including CSU San Marcos).

#### High Winds, Strong Winds, and Thunderstorm Winds

The National Weather Service reports three (3) types of wind events that occur areas over land: High Winds, Strong Winds, and Thunderstorm Winds. Collectively, these reports are used to determine the frequency with which wind hazard events have affected areas across the U.S., including California.

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High Winds

High winds are defined as sustained non-convective winds of 35 knots (40 mph) or greater lasting for 1 hour or longer, or gusts of 50 knots (58 mph) or greater for any duration (or otherwise locally/regionally defined). In some mountainous areas, the above numerical values are 43 knots (50 mph) and 65 knots (75 mph), respectively.102

Strong Winds

Strong winds are defined as non-convective winds gusting less than 50 knots (58 mph), or sustained winds less than 35 knots (40 mph), resulting in a fatality, injury, or damage.103

Thunderstorm Winds

Thunderstorm winds are winds that arise from thunderstorm convection (occurring within 30 minutes of lightning being observed or detected), with speeds of at least 50 knots (58 mph). They can also be winds of any speed (non-severe thunderstorm winds below 50 knots (58 mph)) producing a fatality, injury, or damage.104

Please note: Straight-line wind is a term used to define any thunderstorm wind that is not associated with rotation. It is used mainly to differentiate from the rotational winds found in tornado-producing storms.105 However, it is not a term used in the NCEI Storm Events Database, and therefore cannot be used to determine severe weather history of or potential impacts to CSU campuses.

Tornadoes

A tornado is an extreme severe weather wind hazard. A tornado is a rapidly rotating column of air extending from a thunderstorm to the surface of the Earth.106 This column extends between cloud and the Earth’s surface. The damage from tornadoes comes from the strong winds they contain and the flying debris they create. It is generally believed that rotational wind speeds can be as high as 300 mph in the most violent tornadoes.107 On a local scale, tornadoes are the most violent and most destructive of all atmospheric phenomena.108


Santa Ana Winds. A type of wind hazard that is peculiar to Southern California is called a Santa Ana Wind. Santa Ana winds are strong, topographically-enhanced, extremely dry downslope winds that originate inland and affect coastal southern California and northern

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106 Retrieved on 07.15.2021 from https://www.earthnetworks.com/tornado/
108 Retrieved on 07.15.2021 from https://www.weather.gov/bgm/severedefinitions
Baja California (Mexico). They occur when air from a region of high pressure over the dry, desert region of the southwestern U.S. flows westward towards low pressure located off the California coast. This creates dry winds that flow east to west through the mountain passages in Southern California. These winds have a strong seasonal component; they are most common during the cooler months of the year, occurring from September through May. Santa Ana winds typically feel warm (or even hot) because as the cool desert air moves down the side of the mountain, it is compressed, which causes the temperature of the air to rise. If strong enough, Santa Ana winds can cause major property damage, and may present difficulties for airborne and seagoing transportation. They also may increase wildfire risk because of the dryness of the winds and the speed at which they can spread a flame across the landscape. (Note: The Wildfire hazard is profiled elsewhere in this document.)

Figure below illustrates the mechanisms involved in the generation of Santa Ana winds across Southern California.


**Diablo Winds.** The Diablo wind is another type of topographically-enhanced downslope wind phenomenon that occurs in the North-Central areas of California. Diablo winds are offshore wind events that flow northeasterly over Northern California’s Coast Ranges, often creating high wind speeds downwind of major canyons and over ridges, and extreme fire danger for the San Francisco Bay Area. Diablo winds are driven by a surface pressure gradient that forms in response to an inverted pressure trough that develops over California.\(^{112}\)

**Sundowner Winds.** Sundowner winds are significant and potentially damaging downslope wind and warming events that periodically occur along a short segment of the southern California coast in the vicinity of Santa Barbara, CA. The unique topography of this coastal region promotes the development of Sundowner wind events: over a length of about 100 km, the coastline is oriented approximately west–east, with the adjoining narrow coastal plain bounded by a steeply rising (to elevations greater than 1200 m) and

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\(^{111}\) Retrieved on 07.14.2021 from [https://twitter.com/nwslosangeles/status/933049473034579968](https://twitter.com/nwslosangeles/status/933049473034579968)

\(^{112}\) Retrieved on 07.13.2021 from [https://www.fireweather.org/diablo-winds](https://www.fireweather.org/diablo-winds)
coast-parallel mountain range. Called Sundowner winds because they often begin in the late afternoon or early evening, their onset is typically associated with a rapid rise in temperature and decrease in relative humidity, and the winds tend to blow from the north from the Santa Ynez Mountains to the coast of Santa Barbara County, California. During the more intense Sundowner wind events, wind speeds can be of gale force (39-54 miles per hour) or higher, and can even reach hurricane force (≥74 miles per hour) in the most extreme cases. Temperatures over the coastal plain, and even at the coast itself, can rise significantly above 37.8°C (100°F). Seasonally, Sundowner winds peak in March, April, and May, with a minimum during summer and a secondary peak in winter that often corresponds with Santa Ana winds. In addition to causing a dramatic change from the more typical marine-influenced local weather conditions, Sundowner wind episodes have produced significant wind-related property and agricultural damage, as well as conditions of extreme fire danger.113 114 115

**Hail**

Hail is a form of precipitation consisting of solid ice that forms inside thunderstorm updrafts.116 It is roughly round in shape and at least 0.2’ in diameter. Hail develops in the upper atmosphere as ice crystals that are bounced about by high velocity updraft winds; the ice crystals accumulate frozen droplets and fall after developing enough weight. The size of hailstones varies and is a direct consequence of the severity and size of the storm that produces them – the higher the temperatures at the Earth’s surface, the greater the strength of the updrafts and the amount of time hailstones are suspended, and therefore the greater the size of the hailstone.117

**Lightning**

Lightning is an electrical discharge produced by a thunderstorm. Lightning rapidly heats the air in its immediate vicinity to about 50,000°F - about five times the temperature of the surface of the sun. This compresses the surrounding air and creates a supersonic shock wave, which decays to an acoustic wave that is heard as thunder.118

The discharge may occur within or between clouds, between the cloud and air, between a cloud and the ground, or between the ground and a cloud.119 Lightning that is produced

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from thunderstorms in which precipitation evaporates before reaching the ground is called “dry lightning.”

**Location of the Hazard**

Severe weather is a non-spatial hazard, and can occur anywhere in the CSU system, including either at the CSU San Marcos main campus or at satellite campus facilities owned by the school. No one area of the campus – or of the surrounding community – is subject to experiencing severe weather more than any other area.

There is geographic variability among the different types of mountain and valley wind events (as a sub-category of the severe weather hazard). Santa Ana winds occur in Southern California, Diablo winds occur in North-Central California, and Sundowner winds occur almost exclusively in Santa Barbara County, California.

**Extent of the Hazard**

Severe weather hazards are non-spatial hazards that potentially affect all CSU San Marcos campus areas equally. However, the smallest geographic unit of measurement for almost all official severe weather event data is at the county level. Because the severe weather data used do not exist at the campus level, it is assumed that the same (or similar) severe weather risks to CSU San Marcos campuses reflect those of the surrounding community and County. As a result, all assets and people at CSU San Marcos campuses are at risk from the effects of severe weather and can expect to experience at least some (or the complete range of) endemic severe weather hazards. In consideration of the campus’ design, layout, and operations, the severe weather history and degree of severity in the San Marcos (San Diego County) and Temecula (Riverside County) areas, and the history and degree of severity of each severe weather sub-type identified by the extent scales (below), the campus planning committee ranks the overall extent of the Severe Weather hazard as **MODERATE**. See each sub-hazard below for the planning committee’s sub-type extent ranking.

**Wind Hazard: Non-Rotational**

The Beaufort Scale is an empirical measure that relates wind speed to observed conditions at sea or on land. Its full name is the Beaufort wind force scale. First developed in 1805, it is still used today to estimate wind strengths.

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120 Retrieved on 07.15.2021 from [https://www.rmets.org/resource/beaufort-scale](https://www.rmets.org/resource/beaufort-scale)
121 Retrieved on 07.15.2021 from [https://www.weather.gov/mfl/beaufort](https://www.weather.gov/mfl/beaufort)
<table>
<thead>
<tr>
<th>Force</th>
<th>Speed (mph)</th>
<th>Speed (knots)</th>
<th>Description</th>
<th>Specifications for use at sea</th>
<th>Specifications for use on land</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0-1</td>
<td>0-1</td>
<td>Calm</td>
<td></td>
<td>Sea like a mirror.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Calm; smoke rises vertically.</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>1-3</td>
<td>1-3</td>
<td>Light Air</td>
<td>Ripples with the appearance of scales are formed, but without foam crests.</td>
<td>Direction of wind shown by smoke drift, but not by wind vanes.</td>
</tr>
<tr>
<td>2</td>
<td>4-7</td>
<td>4-6</td>
<td>Light Breeze</td>
<td>Small wavelets, still short, but more pronounced. Crests have a glassy appearance and do not break.</td>
<td>Wind felt on face; leaves rustle; ordinary vanes moved by wind.</td>
</tr>
<tr>
<td>3</td>
<td>8-12</td>
<td>7-10</td>
<td>Gentle Breeze</td>
<td>Large wavelets. Crests begin to break. Foam of glassy appearance. Perhaps scattered white horses.</td>
<td>Leaves and small twigs in constant motion; wind extends light flag.</td>
</tr>
<tr>
<td>4</td>
<td>13-18</td>
<td>11-16</td>
<td>Moderate Breeze</td>
<td>Small waves, becoming larger; fairly frequent white horses.</td>
<td>Raises dust and loose paper; small branches are moved.</td>
</tr>
<tr>
<td>5</td>
<td>19-24</td>
<td>17-21</td>
<td>Fresh Breeze</td>
<td>Moderate waves, taking a more pronounced long form; many white horses are formed.</td>
<td>Small trees in leaf begin to sway; crested wavelets form on inland waters.</td>
</tr>
<tr>
<td>6</td>
<td>25-31</td>
<td>22-27</td>
<td>Strong Breeze</td>
<td>Large waves begin to form; the white foam crests are more extensive everywhere.</td>
<td>Large branches in motion; whistling heard in telegraph wires; umbrellas used with difficulty.</td>
</tr>
<tr>
<td>7</td>
<td>32-38</td>
<td>28-33</td>
<td>Near Gale</td>
<td>Sea heaps up and white foam from breaking waves begins to be blown in streaks along the direction of the wind.</td>
<td></td>
</tr>
</tbody>
</table>

\(^{122}\) Retrieved on 07.15.2021 from [https://www.weather.gov/mfl/beaufort](https://www.weather.gov/mfl/beaufort)
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>8</td>
<td>39-46</td>
<td>34-40</td>
<td>Whole trees in motion; inconvenience felt when walking against the wind.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Moderately high waves of greater length; edges of crests begin to break into spindrift. The foam is blown in well-marked streaks along the direction of the wind.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Breaks twigs off trees; generally impedes progress.</td>
</tr>
<tr>
<td>9</td>
<td>47-54</td>
<td>41-47</td>
<td>Gale</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>High waves. Dense streaks of foam along the direction of the wind. Crests of waves begin to topple, tumble and roll over. Spray may affect visibility.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Slight structural damage occurs (chimney-pots and slates removed)</td>
</tr>
<tr>
<td>10</td>
<td>55-63</td>
<td>48-55</td>
<td>Severe Gale</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Very high waves with long overhanging crests. The resulting foam, in great patches, is blown in dense white streaks along the direction of the wind. On the whole the surface of the sea takes on a white appearance. The tumbling of the sea becomes heavy and shock-like. Visibility affected.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Seldom experienced inland; trees uprooted; considerable structural damage occurs.</td>
</tr>
<tr>
<td>11</td>
<td>64-72</td>
<td>56-63</td>
<td>Storm</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Exceptionally high waves (small and medium-size ships might be for a time lost to view behind the waves). The sea is completely covered with long white patches of foam lying along the direction of the wind. Everywhere the edges of the wave crests are blown into froth. Visibility affected.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Very rarely experienced; accompanied by widespread damage.</td>
</tr>
<tr>
<td>12</td>
<td>73+</td>
<td>64+</td>
<td>Violent Storm</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>The air is filled with foam and spray. Sea completely white with driving spray; visibility very seriously affected.</td>
</tr>
</tbody>
</table>

Based on those extent ranking factors identified (above), the planning committee ranks the extent of non-rotational wind hazards as **MEDIUM**.
**Extent: Tornado**

Tornadoes have their own severity/extent scale. Until 2007, tornadoes were measured and described according to the Fujita Scale.\(^{123}\)

In February 2007, use of the Fujita Scale was discontinued. In its place, the Enhanced Fujita (EF) Scale is used. The Enhanced Fujita scale considers how most structures are designed and is thought to be a much more accurate representation of the surface wind speeds in the most violent tornadoes. Like the original Fujita scale, the Enhanced Fujita scale is a set of wind estimates (not measurements) based on damage.

It is important to note the date that a tornado occurred. Tornadoes that occurred prior to February, 2007 are classified using the original Fujita scale and will not be converted to the Enhanced Fujita Scale.

Table below illustrates the Fujita Scale in use prior to February 2007.

Table 24-28: Fujita Tornado Scale (Pre-February 2007)\(^{124}\)

<table>
<thead>
<tr>
<th>F-Scale Number</th>
<th>Intensity Phrase</th>
<th>Wind Speed</th>
</tr>
</thead>
<tbody>
<tr>
<td>F0</td>
<td>Gale tornado</td>
<td>40-72 mph</td>
</tr>
<tr>
<td></td>
<td>Some damage to chimneys; breaks branches off trees; pushes over shallow-rooted trees; damages sign boards.</td>
<td></td>
</tr>
<tr>
<td>F1</td>
<td>Moderate tornado</td>
<td>73-112 mph</td>
</tr>
<tr>
<td></td>
<td>The lower limit is the beginning of hurricane wind speed; peels surface off roofs; mobile homes pushed off foundations or overturned; moving autos pushed off the roads; attached garages may be destroyed.</td>
<td></td>
</tr>
<tr>
<td>F2</td>
<td>Significant tornado</td>
<td>113-157 mph</td>
</tr>
<tr>
<td></td>
<td>Considerable damage. Roofs torn off frame houses; mobile homes demolished; boxcars pushed over; large trees snapped or uprooted; light object missiles generated.</td>
<td></td>
</tr>
<tr>
<td>F3</td>
<td>Severe tornado</td>
<td>158-206 mph</td>
</tr>
<tr>
<td></td>
<td>Roof and some walls torn off well-constructed houses; trains</td>
<td></td>
</tr>
</tbody>
</table>

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\(^{123}\) Retrieved on 07.19.2021 from [https://www.weather.gov/tae/ef_scale](https://www.weather.gov/tae/ef_scale)

F4  | Devastating tornado  | 207-260 mph  | Well-constructed houses leveled; structures with weak foundations blown off some distance; cars thrown and large missiles generated.  
F5  | Incredible tornado   | 261-318 mph  | Strong frame houses lifted off foundations and carried considerable distances to disintegrate; automobile sized missiles fly through the air in excess of 100 meters; trees debarked; steel reinforced concrete structures badly damaged.  
F6  | Inconceivable tornado| 319-379 mph  | These winds are very unlikely. The small area of damage they might produce would probably not be recognizable along with the mess produced by F4 and F5 wind that would surround the F6 winds. Missiles, such as cars and refrigerators would do serious secondary damage that could not be directly identified as F6 damage. If this level is ever achieved, evidence for it might only be found in some manner of ground swirl pattern, for it may never be identifiable through engineering studies.

Table below illustrates the Enhanced Fujita (EF) Scale, currently in use. Tornadoes that have occurred since February, 2007 are classified using the Enhanced Fujita Scale.
Table 24-29: Enhanced Fujita Scale (February 2007 and Later)\textsuperscript{125}

<table>
<thead>
<tr>
<th>Enhanced Fujita Category</th>
<th>Wind Speed</th>
<th>Potential Damage</th>
</tr>
</thead>
<tbody>
<tr>
<td>EF0</td>
<td>65-85 mph</td>
<td>Light damage. Peels surface off some roofs; some damage to gutters or siding; branches broken off trees; shallow-rooted trees pushed over.</td>
</tr>
<tr>
<td>EF1</td>
<td>86-110 mph</td>
<td>Moderate damage. Roofs severely stripped; mobile homes overturned or badly damaged; loss of exterior doors; windows and other glass broken.</td>
</tr>
<tr>
<td>EF2</td>
<td>111-135 mph</td>
<td>Considerable damage. Roofs torn off well-constructed houses; foundations of frame homes shifted; mobile homes completely destroyed; large trees snapped or uprooted; light-object missiles generated; cars lifted off ground.</td>
</tr>
<tr>
<td>EF3</td>
<td>136-165 mph</td>
<td>Severe damage. Entire stories of well-constructed houses destroyed; severe damage to large buildings such as shopping malls; trains overturned; trees debarked; heavy cars lifted off the ground and thrown; structures with weak foundations blown away some distance.</td>
</tr>
<tr>
<td>EF4</td>
<td>166-200 mph</td>
<td>Devastating damage. Well-constructed houses and whole frame houses completely leveled; cars thrown and small missiles generated.</td>
</tr>
<tr>
<td>EF5</td>
<td>&gt;200 mph</td>
<td>Incredible damage. Strong frame houses leveled off foundations and swept away; automobile-sized missiles fly through the air in excess of 100 m (107 yd); high-rise buildings have significant structural deformation; incredible phenomena will occur.</td>
</tr>
</tbody>
</table>

Based on the extent ranking factors identified (above), the planning committee ranks the extent of tornados as **LOW**.

**Extent: Hail**

The National Oceanic and Atmospheric Administration and the Tornado and Storm Research Organization (TORRO) have combined efforts to create the Hailstorm Intensity Scale. Table below provides details of this scale.

Table 24-30: Combined NOAA/TORRO Hailstorm Intensity Scale

<table>
<thead>
<tr>
<th>Size Code</th>
<th>Intensity Category</th>
<th>Typical Hail Diameter</th>
<th>Approximate Size</th>
<th>Typical Damage Impacts</th>
</tr>
</thead>
<tbody>
<tr>
<td>H0</td>
<td>Hard Hail</td>
<td>Up to 0.33”</td>
<td>Pea</td>
<td>No damage</td>
</tr>
<tr>
<td>H1</td>
<td>Potentially Damaging</td>
<td>0.33” – 0.60”</td>
<td>Marble or Mothball</td>
<td>Slight damage to plants and crops</td>
</tr>
<tr>
<td>H2</td>
<td>Potentially Damaging</td>
<td>0.60” – 0.80”</td>
<td>Dime or grape</td>
<td>Significant damage to fruit, crops, and vegetation</td>
</tr>
<tr>
<td>H3</td>
<td>Severe</td>
<td>0.80” – 1.20”</td>
<td>Nickel to Quarter</td>
<td>Severe damage to fruit and crops, damage to glass and plastic structures, paint and wood scored</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>H4</th>
<th>Severe</th>
<th>1.20” – 1.60”</th>
<th>Half Dollar to Ping Pong Ball</th>
<th>Widespread glass damage, vehicle body damage</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>H5</td>
<td>Destructive</td>
<td>1.60” – 2.0”</td>
<td>Silver Dollar to Golf Ball</td>
<td>Wholesale destruction of glass, damage to tiled roofs, significant risk of injuries</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>H6</td>
<td>Destructive</td>
<td>2.0” – 2.4”</td>
<td>Lime or Egg</td>
<td>Aircraft body dented; brick walls pitted</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>H7</td>
<td>Very Destructive</td>
<td>2.4” – 3.0”</td>
<td>Tennis Ball</td>
<td>Severe roof damage, risk of serious injuries</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>H8</td>
<td>Very Destructive</td>
<td>3.0” – 3.5”</td>
<td>Baseball to Orange</td>
<td>Severe damage to aircraft body</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>H9</td>
<td>Super Hailstorms</td>
<td>3.5” – 4.0”</td>
<td>Grapefruit</td>
<td>Extensive structural damage, risk of severe or fatal injuries to persons caught in the open</td>
</tr>
</tbody>
</table>

Based on those extent ranking factors identified (above), the planning committee ranks the extent of the hail hazard as **LOW**.
**Extent: Lightning**

The National Weather Service (NWS) uses a Lightning Activity Level (LAL) scale to indicate the frequency and character of cloud-to-ground (C/G) lightning. The scale uses a range of 1 – 6, with 6 being the high end of the scale. Table below provides details of the LAL scale.

Table 24-31: Lightning Activity Level (LAL) Scale

<table>
<thead>
<tr>
<th>Rank</th>
<th>Cloud and Storm Development</th>
<th>Areal Coverage</th>
<th>Counts C/G per 5 Minutes</th>
<th>Counts C/G per 15 Minutes</th>
<th>Average C/G per Minute</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>No Thunderstorms</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>2</td>
<td>Cumulus clouds are common but only a few reaches the towering stage. A single thunderstorm must be confirmed in the rating area. The clouds mostly produce virga, but light rain will occasionally reach ground. Lightning is very infrequent.</td>
<td>&lt;15%</td>
<td>1-5</td>
<td>1-8</td>
<td>&lt;1</td>
</tr>
<tr>
<td>3</td>
<td>Cumulus clouds are common. Swelling and towering cumulus cover less than 2/10 of the sky. Thunderstorms are few, but 2 to 3 occur within the observation area. Light to moderate rain will reach the ground, and lightning is infrequent.</td>
<td>15% to 24%</td>
<td>6-10</td>
<td>9-15</td>
<td>1-2</td>
</tr>
</tbody>
</table>

## Lightning Activity Level Scale

<table>
<thead>
<tr>
<th>Rank</th>
<th>Cloud and Storm Development</th>
<th>Areal Coverage</th>
<th>Counts C/G per 5 Minutes</th>
<th>Counts C/G per 15 Minutes</th>
<th>Average C/G per Minute</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>Swelling cumulus and towering cumulus cover 2-3/10 of the sky. Thunderstorms are scattered but more than three must occur within the observation area. Moderate rain is commonly produced, and lightning is frequent.</td>
<td>25% to 50%</td>
<td>11-15</td>
<td>16-25</td>
<td>2-3</td>
</tr>
<tr>
<td>5</td>
<td>Towering cumulus and thunderstorms are numerous. They cover more than 3/10 and occasionally obscure the sky. Rain is moderate to heavy, and lightning is frequent and intense.</td>
<td>&gt;50%</td>
<td>&gt;15</td>
<td>&gt;25</td>
<td>&gt;3</td>
</tr>
<tr>
<td>6</td>
<td>Dry lightning outbreak. (LAL of 3 or greater with majority of storms producing little or no rainfall.)</td>
<td>&gt;15%</td>
<td>None</td>
<td>None</td>
<td>None</td>
</tr>
</tbody>
</table>

Based on those extent ranking factors identified (above), the planning committee ranks the extent of the lightening hazard as **LOW**.

**Extent: Thunderstorms that Generate Wind, Tornado, Hail, and Lightning Hazard Events**

Thunderstorms are not explicitly identified as a severe weather category for this hazard profile. However, they are responsible for most tornado, lightning, and hail hazard events – as well as a significant number of wind hazard events – across California and the CSU system. While individual thunderstorms affect relatively small areas, there are many instances in which thunderstorms can cluster together and/or travel in a line over long distances, producing significant damage over large geographic areas.

A thunderstorm is classified as “severe” when certain meteorological parameters within the thunderstorm are reached (i.e., damaging winds or speeds of 58 mph (50 knots) or greater, hail 1 inch in diameter or larger, and/or a tornado). However, there is currently no
established, objective severity scale for thunderstorms. That said, according to the *Glossary of Meteorology* published by the American Meteorological Society (AMS), a thunderstorm is reported as *light, medium, or heavy* according to following five (5) characteristics:

- the nature of the lightning and thunder;
- the type and intensity of the precipitation, if any;
- the speed and gustiness of the wind;
- the appearance of the clouds; and
- the effect upon surface temperature.

A thunderstorm may also be classified by the nature of the overall weather situation in which the thunderstorm is produced, including:

- **Airmass Thunderstorm**: A thunderstorm produced by local convection within an unstable air mass;
- **Frontal Thunderstorm**: An individual thunderstorm the initiation of which results from rising motion associated with a front, or a thunderstorm within a convective system generated and organized by frontal rising motion;
- **Squall-line Thunderstorm**: An individual thunderstorm included within a squall line (i.e., a continuous or broken line of active deep moist convection frequently associated with thunder).

Based on the extent ranking factors identified (above) in relation to campus layout and operations, and past event low degree of severity, the planning committee ranks the extent of the thunderstorm hazard as **LOW**.

**History of the Hazard**

Severe weather hazards have been an annual occurrence in San Diego County and on the CSU San Marcos main campus. Severe weather hazards have also been an annual

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128 Retrieved on 07.15.2021 from [https://www.noaa.gov/explainers/severe-storms](https://www.noaa.gov/explainers/severe-storms)

129 Retrieved on 07.15.2021 from [https://www.weather.gov/safety/thunderstorm](https://www.weather.gov/safety/thunderstorm)


occurrence in Riverside County and on the CSU San Marcos – Palm Desert campus. Historical data for these hazards are presented below.

**Historical Storm Data Collection: NCEI Storm Events Database**

Historical information regarding severe weather hazards can be found using The National Centers for Environmental Information (NCEI) Storm Events Database. The Storm Events Database contains searchable, archived National Weather Service (NWS) storm data from January 1950 to April 2021, as entered by NOAA’s National Weather Service (NWS). Due to changes in the data collection and processing procedures over time, there are unique periods of record available depending on the event type. For example, from 1950 through 1954, only tornado events were recorded; from 1955 through 1995, only tornado, thunderstorm wind, and hail events were introduced into the database; from 1996 to present, 45 additional event types are recorded, including high wind, strong wind, and lightning events. To obtain the most accurate portrayal of severe weather event frequency, searches of the Storm Events Database are conducted using data collected since 01/01/1996. As a reminder, all official severe weather event data is at the county level. Severe weather data do not exist at the campus level. That said, it may be the case that the campus to some degree experiences the severe weather events reported for the surrounding community and County.

**San Diego County**

**Wind Hazards (excluding Tornadoes)**

Information obtained from the NCEI Storm Event Database website shows the number of events (or occurrences) of wind hazard events in San Diego County since 1996. Here, wind hazard events include all “High Wind,” “Strong Wind,” and “Thunderstorm Wind” storm reports.

- **High Wind:** at least 434 events, or approximately 17.13 events per year

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139 National Climatic Data Center. Storm Events Database. Retrieved 07.30.2021 from [https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28Z%29+High+Wind&beginDate_mm=01&beginDate_dd=01&beginDate_yy=1996&endDate_mm=04&endDate_dd=30&endDate_yy=2021&county=SAN%2BDIEGO%3A73&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA](https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28Z%29+High+Wind&beginDate_mm=01&beginDate_dd=01&beginDate_yy=1996&endDate_mm=04&endDate_dd=30&endDate_yy=2021&county=SAN%2BDIEGO%3A73&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA)
- **Strong Wind**: at least 61 events, or 2.41 events per year\(^\text{140}\)
- **Thunderstorm Wind**: at least 88 events, or approximately 3.47 events per year\(^\text{141}\)
- **All Wind Hazard events** (excluding Tornadoes): at least 577 events, or approximately 22.78 events per year.\(^\text{142} \, 143\) (Note: This was determined by conducting a simultaneous search of the component wind hazards of high wind, strong wind and thunderstorm wind.)

Overall, in San Diego County, there have been at least 577 wind hazard events since 1996, excluding tornadoes.\(^\text{144} \, 145\) That translates to an approximate average historical frequency of **22.78** wind hazard events per year.

Please note: Differences between the sums of individual component severe weather hazard event Database searches (i.e., 583 events) and simultaneous Database searches of all severe weather hazard events (i.e., 577 events) may be due to the following factors: (1) multiple event types are in the same record (e.g., "Thunderstorm Wind/Hail" or "Hail/Tornado;" and/or (2) severe weather hazard events such as "Thunderstorm Wind" or "Hail" that are reported for San Diego County have actually taken place hundreds of times.

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\(^{140}\) National Climatic Data Center. Storm Events Database. Retrieved 07.30.2021 from [https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28Z%29+Strong+Wind&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=SAN%2BDIEGO%3A73&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA](https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28Z%29+Strong+Wind&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=SAN%2BDIEGO%3A73&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA)

\(^{141}\) National Climatic Data Center. Storm Events Database. Retrieved 07.30.2021 from [https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Thunderstorm+Wind&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=SAN%2BDIEGO%3A73&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA](https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Thunderstorm+Wind&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=SAN%2BDIEGO%3A73&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA)

\(^{142}\) National Climatic Data Center. Storm Events Database. Retrieved 07.30.2021 from [https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28Z%29+High+Wind&eventType=%28Z%29+Strong+Wind&eventType=%28C%29+Thunderstorm+Wind&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=SAN%2BDIEGO%3A73&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA](https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28Z%29+High+Wind&eventType=%28Z%29+Strong+Wind&eventType=%28C%29+Thunderstorm+Wind&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=SAN%2BDIEGO%3A73&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA)

\(^{143}\) National Climatic Data Center. Storm Events Database. Retrieved 07.30.2021 from [https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28Z%29+High+Wind&eventType=%28Z%29+Strong+Wind&eventType=%28C%29+Thunderstorm+Wind&beginDate_mm=09&beginDate_dd=06&beginDate_yyyy=2019&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=SAN%2BDIEGO%3A73&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA](https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28Z%29+High+Wind&eventType=%28Z%29+Strong+Wind&eventType=%28C%29+Thunderstorm+Wind&beginDate_mm=09&beginDate_dd=06&beginDate_yyyy=2019&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=SAN%2BDIEGO%3A73&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA)

\(^{144}\) National Climatic Data Center. Storm Events Database. Retrieved 07.30.2021 from [https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28Z%29+High+Wind&eventType=%28Z%29+Strong+Wind&eventType=%28C%29+Thunderstorm+Wind&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=SAN%2BDIEGO%3A73&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA](https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28Z%29+High+Wind&eventType=%28Z%29+Strong+Wind&eventType=%28C%29+Thunderstorm+Wind&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=SAN%2BDIEGO%3A73&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA)

\(^{145}\) National Climatic Data Center. Storm Events Database. Retrieved 07.30.2021 from [https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28Z%29+High+Wind&eventType=%28Z%29+Strong+Wind&eventType=%28C%29+Thunderstorm+Wind&beginDate_mm=09&beginDate_dd=06&beginDate_yyyy=2019&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=SAN%2BDIEGO%3A73&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA](https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28Z%29+High+Wind&eventType=%28Z%29+Strong+Wind&eventType=%28C%29+Thunderstorm+Wind&beginDate_mm=09&beginDate_dd=06&beginDate_yyyy=2019&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=SAN%2BDIEGO%3A73&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA)
miles away, but are erroneously recorded as events that have occurred in the County. When such a discrepancy arises, the more conservative aggregate hazard wind event value (i.e., 577 events) is used to determine the historical frequency of occurrence for the severe weather hazard. The origin of this discrepancy is unknown at this time.

**Historical Wind Hazard Losses for San Diego County since 1996**

According to the NCEI Storm Events Database, the wind hazard events that San Diego County has experienced since 1996 have been costly. There have been 7 deaths and 29 injuries, and property and crop damage estimates have totaled approximately $44,415,000 and $36,745,000, respectively.

**Tornado Wind Hazards**

Information from the NCEI Storm Events Database indicates that since 1996, there have been 13 reported events of tornadoes in San Diego County, which translates to approximately 0.51 tornado events per year.

The vast majority of tornado reports in San Diego County since 1996 have been of tornadoes with a severity rating of F0/EF0. Only two (2) of the tornadoes reported have been rated F1/EF1 or higher; both have been F1/EF1 tornadoes. That means that approximately 0.08 F1/EF1 tornado hazard events have occurred per year in San Diego County.

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147 National Climatic Data Center. Storm Events Database. Retrieved 07.30.2021 from [https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28Z%29+High+Wind&eventType=%28Z%29+Strong+Wind&eventType=%28C%29+Thunderstorm+Wind&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=SAN%2BDIEGO%3A73&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA](https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28Z%29+High+Wind&eventType=%28Z%29+Strong+Wind&eventType=%28C%29+Thunderstorm+Wind&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=SAN%2BDIEGO%3A73&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA)

148 National Climatic Data Center. Storm Events Database. Retrieved 07.30.2021 from [https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Tornado&beginDate_mm=01&beginDate_dd=06&beginDate_yyyy=2019&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=SAN%2BDIEGO%3A73&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA](https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Tornado&beginDate_mm=01&beginDate_dd=06&beginDate_yyyy=2019&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=SAN%2BDIEGO%3A73&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA)

149 National Climatic Data Center. Storm Events Database. Retrieved 07.30.2021 from [https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Tornado&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=SAN%2BDIEGO%3A73&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA](https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Tornado&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=SAN%2BDIEGO%3A73&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA)

150 National Climatic Data Center. Storm Events Database. Retrieved 07.30.2021 from [https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Tornado&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=SAN%2BDIEGO%3A73&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA](https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Tornado&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=SAN%2BDIEGO%3A73&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA)
Historical Tornado Hazard Losses for San Diego County since 1996

According to the NCEI Storm Events Database, the tornado hazard events that San Diego County has experienced since 1996 have been costly. While there have been no reported deaths, injuries, or crop damage, property damage estimates have totaled approximately $219,600.151

Hail

Information from the NCEI Storm Events Database indicates that since 1996, there have been 39 reported events of hail in San Diego County, which translates to approximately 1.54 hail events per year.152

Historical Hail Hazard Losses for San Diego County since 1996

According to the NCEI Storm Events Database, the hail hazard events that San Diego County has experienced since 1996 have been costly. While there have been no deaths, there have been five (5) injuries, and property and crop damage estimates have totaled approximately $40,000 and $310,000, respectively.153

Lightning

Information from the NCEI Storm Events Database indicates that since 1996, there have been 33 reported event(s) of lightning in San Diego County, which translates to approximately 1.30 lightning events per year.154

Historical Lightning Hazard Losses for San Diego County since 1996

According to the NCEI Storm Events Database, the lightning hazard events that San Diego County has experienced since 1996 have been costly. There have been 1 death and 7

151 National Climatic Data Center. Storm Events Database. Retrieved 07.30.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Tornado&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=SAN%2BDIEGO%3A73&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA
152 National Climatic Data Center. Storm Events Database. Retrieved 07.30.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Hail&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=SAN%2BDIEGO%3A73&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA
153 National Climatic Data Center. Storm Events Database. Retrieved 07.30.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Hail&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=SAN%2BDIEGO%3A73&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA
154 National Climatic Data Center. Storm Events Database. Retrieved 07.30.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Lightning&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=SAN%2BDIEGO%3A73&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA
injuries, and property and crop damage estimates have totaled approximately $102,400 and $5,000, respectively.\(^{155}\)

**All Severe Weather Hazard Events Recorded by the NCEI Storm Events Database**

Information obtained from the NCEI Storm Events Database indicates that there have been 662 occurrences of the severe weather hazard in San Diego County. This translates to **26.13** severe weather hazard occurrences per year.\(^{156} \, 157\)

Please note: Differences between the sums of individual component severe weather hazard event Database searches (i.e., 668 events) and simultaneous Database searches of all severe weather hazard events (i.e., 662 events) are due to multiple event types in the same record (e.g., "Thunderstorm Wind/Hail" or "Hail/Tornado."\(^{158}\) When such discrepancies arise, the more conservative aggregate severe weather hazard event value (i.e., 662 events) is used to determine the historical frequency of occurrence for the severe weather hazard.

Please note: Differences between the sums of individual component severe weather hazard event Database searches (i.e., 668 events) and simultaneous Database searches of all severe weather hazard events (i.e., 662 events) may be due to the following factors: (1) multiple event types are in the same record (e.g., "Thunderstorm Wind/Hail" or "Hail/Tornado;” and/or (2) severe weather hazard events such as “Thunderstorm Wind” or “Hail” that are reported for San Diego County have actually taken place hundreds of miles away, but are erroneously recorded as events that have occurred in the County.\(^{159}\) When such a discrepancy arises, the more conservative aggregate hazard wind event

\(^{155}\) National Climatic Data Center. Storm Events Database. Retrieved 07.30.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Lightning&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=SANDIEGO%3A73&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA

\(^{156}\) National Climatic Data Center. Storm Events Database. Retrieved 07.30.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Hail&eventType=%28Z%29+HighWind&eventType=%28C%29+Lightning&eventType=%28Z%29+StrongWind&eventType=%28C%29+ThunderstormWind&eventType=%28C%29+Tornado&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=SANDIEGO%3A73&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA

\(^{157}\) National Climatic Data Center. Storm Events Database. Retrieved 07.30.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Hail&eventType=%28Z%29+HighWind&eventType=%28C%29+Lightning&eventType=%28Z%29+StrongWind&eventType=%28C%29+ThunderstormWind&eventType=%28C%29+Tornado&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=2017&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=SANDIEGO%3A73&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA


value (i.e., 662 events) is used to determine the historical frequency of occurrence for the severe weather hazard. The origin of this discrepancy is unknown at this time.

**Historical, Aggregated Severe Hazard Losses for San Diego County since 1996**

According to the NCEI Storm Events Database, the severe weather events that San Diego County has experienced since 1996 have been costly. There have been 8 deaths and 41 injuries, and property and crop damage estimates have totaled approximately $32,874,000 and $36,955,000, respectively.\(^{160}\)\(^{161}\) However, it is important to note that for all San Diego County severe weather hazard events recorded on the Storm Events Database, all but one (1) death, 70.7% of all injuries, and almost all (i.e., 99.2%) reported property and crop damage estimated have been attributed to wind hazard events alone.

**Riverside County**

**Wind Hazards (excluding Tornadoes)**

Information obtained from the NCEI Storm Event Database website shows the number of events (or occurrences) of wind hazard events in Riverside County since 1996.\(^{162}\) Here, wind hazard events include all “High Wind,” “Strong Wind,” and “Thunderstorm Wind” storm reports.\(^{163}\)

- **High Wind:** at least 486 events, or approximately 19.18 events per year\(^ {164}\)
- **Strong Wind:** at least 44 events, or 1.74 events per year\(^ {165}\)

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\(^{160}\) National Climatic Data Center. Storm Events Database. Retrieved 07.30.2021 from [https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Hail&eventType=%28Z%29+High+Wind&eventType=%28C%29+Lightning&eventType=%28Z%29+Strong+Wind&eventType=%28C%29+Thunderstorm+Wind&eventType=%28C%29+Tornado&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=SAN%2BDIEGO%3A73&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA

\(^{161}\) National Climatic Data Center. Storm Events Database. Retrieved 07.30.2021 from [https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Hail&eventType=%28Z%29+High+Wind&eventType=%28C%29+Lightning&eventType=%28Z%29+Strong+Wind&eventType=%28C%29+Thunderstorm+Wind&eventType=%28C%29+Tornado&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=RIVERSIDE%3A65&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA


\(^{164}\) National Climatic Data Center. Storm Events Database. Retrieved on 08.05.2021 from [https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28Z%29+High+Wind&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=RIVERSIDE%3A65&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA

\(^{165}\) National Climatic Data Center. Storm Events Database. Retrieved on 08.05.2021 from [https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28Z%29+Strong+Wind&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=RIVERSIDE%3A65&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA

\(^{166}\) National Climatic Data Center. Storm Events Database. Retrieved on 08.05.2021 from [https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Hail&eventType=%28Z%29+High+Wind&eventType=%28C%29+Lightning&eventType=%28Z%29+Strong+Wind&eventType=%28C%29+Thunderstorm+Wind&eventType=%28C%29+Tornado&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=RIVERSIDE%3A65&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA

\(^{167}\) National Climatic Data Center. Storm Events Database. Retrieved on 08.05.2021 from [https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28Z%29+Strong+Wind&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=RIVERSIDE%3A65&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA

\(^{168}\) National Climatic Data Center. Storm Events Database. Retrieved on 08.05.2021 from [https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28Z%29+Strong+Wind&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=RIVERSIDE%3A65&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA

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- **Thunderstorm Wind**: at least 114 events, or approximately 4.50 events per year\(^{166}\)

- **All Wind Hazard events** (excluding Tornadoes): at least 638 events, or approximately 25.18 events per year.\(^{167,168}\)

(Note: This was determined by conducting a simultaneous search of the component wind hazards of high wind, strong wind and thunderstorm wind.)

Overall, in Riverside County, there have been at least 638 wind hazard events since 1996, excluding tornadoes.\(^{169,170}\) That translates to an approximate average historical frequency of occurrence of 25.18 wind hazard events per year.

Please note: Differences between the sums of individual component severe weather hazard event Database searches (i.e., 644 events) and simultaneous Database searches of all severe weather hazard events (i.e., 638 events) may be due to the following factors: (1) multiple event types are in the same record (e.g., "Thunderstorm Wind/Hail" or "Hail/Tornado;" and/or (2) severe weather hazard events such as “Thunderstorm Wind” or “Hail” that are reported for Riverside County have actually taken place hundreds of miles away, but are erroneously recorded as events that have occurred in the County.\(^{171}\)

When such a discrepancy arises, the more conservative aggregate hazard wind event value (i.e., 638 events) is used to determine the historical frequency of occurrence for the severe weather hazard. The origin of this discrepancy is unknown at this time.

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\(^{166}\) National Climatic Data Center. Storm Events Database. Retrieved on 08.05.2021 from [https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Thunderstorm+Wind&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=RIVERSIDE%3A65&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA](https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Thunderstorm+Wind&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=RIVERSIDE%3A65&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA)

\(^{167}\) National Climatic Data Center. Storm Events Database. Retrieved on 08.05.2021 from [https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28Z%29+High+Wind&eventType=%28Z%29+Strong+Wind&eventType=%28C%29+Thunderstorm+Wind&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=RIVERSIDE%3A65&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA](https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28Z%29+High+Wind&eventType=%28Z%29+Strong+Wind&eventType=%28C%29+Thunderstorm+Wind&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=RIVERSIDE%3A65&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA)

\(^{168}\) National Climatic Data Center. Storm Events Database. Retrieved on 08.05.2021 from [https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28Z%29+High+Wind&eventType=%28Z%29+Strong+Wind&eventType=%28C%29+Thunderstorm+Wind&beginDate_mm=04&beginDate_dd=29&beginDate_yyyy=2017&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=RIVERSIDE%3A65&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA](https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28Z%29+High+Wind&eventType=%28Z%29+Strong+Wind&eventType=%28C%29+Thunderstorm+Wind&beginDate_mm=04&beginDate_dd=29&beginDate_yyyy=2017&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=RIVERSIDE%3A65&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA)

\(^{169}\) National Climatic Data Center. Storm Events Database. Retrieved on 08.05.2021 from [https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28Z%29+High+Wind&eventType=%28Z%29+Strong+Wind&eventType=%28C%29+Thunderstorm+Wind&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=RIVERSIDE%3A65&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA](https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28Z%29+High+Wind&eventType=%28Z%29+Strong+Wind&eventType=%28C%29+Thunderstorm+Wind&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=RIVERSIDE%3A65&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA)

\(^{170}\) National Climatic Data Center. Storm Events Database. Retrieved on 08.05.2021 from [https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28Z%29+High+Wind&eventType=%28Z%29+Strong+Wind&eventType=%28C%29+Thunderstorm+Wind&beginDate_mm=04&beginDate_dd=29&beginDate_yyyy=2017&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=RIVERSIDE%3A65&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA](https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28Z%29+High+Wind&eventType=%28Z%29+Strong+Wind&eventType=%28C%29+Thunderstorm+Wind&beginDate_mm=04&beginDate_dd=29&beginDate_yyyy=2017&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=RIVERSIDE%3A65&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA)

Historical Wind Hazard Losses for Riverside County since 1996

According to the NCEI Storm Events Database, the wind hazard events that Riverside County has experienced since 1996 have been costly. There have been three (3) deaths and 40 injuries, and property and crop damage estimates have totaled approximately $62,933,000 and $65,000, respectively.172 173

Tornado Wind Hazards

Information from the NCEI Storm Events Database indicates that since 1996, there have been 18 reported events of tornadoes in Riverside County, which translates to approximately 0.71 tornado events per year.174 While the vast majority of tornado reports in Riverside County since 1996 have been of tornadoes with a severity rating of F0/EF0, there have been (3) F1/EF1 tornadoes and one (1) EF2 tornado also reported.175

Historical Tornado Hazard Losses for Riverside County since 1996

According to the NCEI Storm Events Database, the tornado hazard events that Riverside County has experienced since 1996 have been costly. While there have been no deaths or crop damages reported, there have been three (3) injuries, and property damage estimates have totaled approximately $21,486,000.176

Hail

172 National Climatic Data Center. Storm Events Database. Retrieved on 08.05.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28Z%29+High+Wind&eventType=%28Z%29+Strong+Wind&eventType=%28C%29+Thunderstorm+Wind&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=RIVERSIDE%3A65&hailfilter=0.00&tornfilter=0&windfilter=0&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA
173 National Climatic Data Center. Storm Events Database. Retrieved on 08.05.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28Z%29+High+Wind&eventType=%28Z%29+Strong+Wind&eventType=%28C%29+Thunderstorm+Wind&beginDate_mm=04&beginDate_dd=29&beginDate_yyyy=2017&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=RIVERSIDE%3A65&hailfilter=0.00&tornfilter=0&windfilter=0&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA
174 National Climatic Data Center. Storm Events Database. Retrieved on 08.05.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Tornado&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=RIVERSIDE%3A65&hailfilter=0.00&tornfilter=0&windfilter=0&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA
175 National Climatic Data Center. Storm Events Database. Retrieved on 08.05.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Tornado&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=RIVERSIDE%3A65&hailfilter=0.00&tornfilter=0&windfilter=0&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA
176 National Climatic Data Center. Storm Events Database. Retrieved on 08.05.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Tornado&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=RIVERSIDE%3A65&hailfilter=0.00&tornfilter=0&windfilter=0&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA
Information from the NCEI Storm Events Database indicates that since 1996, there have been 17 reported events of hail in Riverside County, which translates to approximately **0.67** hail events per year.\(^{177}\) (Note: The NCEI Storm Event Database search results for hail indicate that there has been a total of 18 reports of hail since 1996. However, one (1) entry is for a hail event in San Diego County coastal areas not proximal to Riverside County. The origin of this error is unknown at this time.)

**Historical Hail Hazard Losses for Riverside County since 1996**

According to the NCEI Storm Events Database, the hail hazard events that Riverside County has experienced since 1996 have been moderate. While there have been no deaths or crop damage, there have been two (2) injuries, and property damage estimates have totaled approximately $16,500.\(^{178}\)

**Lightning**

Information from the NCEI Storm Events Database indicates that since 1996, there have been 31 reported events of lightning in Riverside County, which translates to approximately **1.22** lightning events per year.\(^{179}\)

**Historical Lightning Hazard Losses for Riverside County since 1996**

According to the NCEI Storm Events Database, the lightning hazard events that Riverside County has experienced since 1996 have been costly. There have been one (1) death and six (6) injuries, and property and crop damage estimates have totaled approximately $249,500 and $10,100, respectively.\(^{180}\)

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\(^{177}\) National Climatic Data Center. Storm Events Database. Retrieved on 08.05.2021 from [https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Hail&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=RIVERSIDE%3A65&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA](https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Hail&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=RIVERSIDE%3A65&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA)

\(^{178}\) National Climatic Data Center. Storm Events Database. Retrieved on 08.05.2021 from [https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Hail&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=RIVERSIDE%3A65&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA](https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Hail&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=RIVERSIDE%3A65&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA)

\(^{179}\) National Climatic Data Center. Storm Events Database. Retrieved on 08.05.2021 from [https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Lightning&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=RIVERSIDE%3A65&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA](https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Lightning&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=RIVERSIDE%3A65&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA)

\(^{180}\) National Climatic Data Center. Storm Events Database. Retrieved on 08.05.2021 from [https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Lightning&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=RIVERSIDE%3A65&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA](https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Lightning&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=RIVERSIDE%3A65&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA)
All Severe Weather Hazard Events Recorded by the NCEI Storm Events Database 
(Riverside County)

Information obtained from the NCEI Storm Events Database indicates that there have been 704 occurrences of the severe weather hazard in Riverside County. This translates to 27.79 severe weather hazard occurrences per year.181 182

Please note: Differences between the sums of individual component severe weather hazard event Database searches (i.e., 710 events) and simultaneous Database searches of all severe weather hazard events (i.e., 704 events) may be due to the following factors: (1) multiple event types are in the same record (e.g., "Thunderstorm Wind/Hail" or "Hail/Tornado;" and/or (2) severe weather hazard events such as “Thunderstorm Wind” or “Hail” that are reported for Riverside County have actually taken place hundreds of miles away, but are erroneously recorded as events that have occurred in the County.183 When such a discrepancy arises, the more conservative aggregate hazard wind event value (i.e., 704 events) is used to determine the historical frequency of occurrence for the severe weather hazard. The origin of this discrepancy is unknown at this time.

Historical, Aggregated Severe Hazard Losses for Riverside County since 1996

According to the NCEI Storm Events Database, the severe weather events that Riverside County has experienced since 1996 have been costly. There have been four (4) deaths and 51 injuries, and property and crop damage estimates have totaled approximately $84,685,000 and $75,100, respectively.184 185 It is important to note that for all Riverside

181 National Climatic Data Center. Storm Events Database. Retrieved on 08.05.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Hail&eventType=%28Z%29+High+Wind&eventType=%28C%29+Lightning&eventType=%28Z%29+Strong+Wind&eventType=%28C%29+Thunderstorm+Wind&eventType=%28C%29+Tornado&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=RIVERSIDE%3A65&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitButton=Search&statefips=6%2CCALIFORNIA

182 National Climatic Data Center. Storm Events Database. Retrieved on 08.05.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Hail&eventType=%28Z%29+High+Wind&eventType=%28C%29+Lightning&eventType=%28Z%29+Strong+Wind&eventType=%28C%29+Thunderstorm+Wind&eventType=%28C%29+Tornado&beginDate_mm=12&beginDate_dd=30&beginDate_yyyy=2014&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=RIVERSIDE%3A65&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitButton=Search&statefips=6%2CCALIFORNIA


184 National Climatic Data Center. Storm Events Database. Retrieved on 08.05.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Hail&eventType=%28Z%29+High+Wind&eventType=%28C%29+Lightning&eventType=%28Z%29+Strong+Wind&eventType=%28C%29+Thunderstorm+Wind&eventType=%28C%29+Tornado&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=RIVERSIDE%3A65&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitButton=Search&statefips=6%2CCALIFORNIA

185 National Climatic Data Center. Storm Events Database. Retrieved on 08.05.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Hail&eventType=%28Z%29+High+Wind&eventType=%28C%29+Lightning&eventType=%28Z%29+Strong+Wind&eventType=%28C%29+Thunderstorm+Wind&eventType=%28C%29+Tornado&beginDate_mm=12&beginDate_dd=30&beginDate_yyyy=2014&
County severe weather hazard events recorded on the Storm Events Database, 75% of all deaths, 78.4% of all injuries, 74.9% of all estimated property damages, and 86.6% of all estimated crop damages have been attributed to wind hazard events alone.

Wind Hazards Not Included in the NCEI Storm Events Database

Santa Ana Winds

Santa Ana wind events occur at least twice per month from October through April. From 1948 to 2012, total of 2056 events on the 65-year record were recorded in the Southern California region, yielding an average of 32 occurrences per year. Typical Santa Ana wind events last 1–2 days and represent 27% of the occurrences, with events lasting up to 6 days accounting for 90% of all occurrences. The remaining 10% are made up almost entirely of events lasting between 7 and 12 days.

Figure below shows the mean monthly frequency per season of Santa Ana Wind events detected from 1948 to 2012. Extreme Santa Ana wind events are shown in dark red, and are defined as those events that are above the 90th percentile of all events on record.

**Diablo Winds**

Diablo wind events occur approximately **2.5 events per year**. These events are most frequent during the fall and early winter seasons, with the highest frequency of events occurring in October. As a result, the highest risk of Diablo-wind-related damage is in the fall and early winter.¹⁹¹

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Figure below shows the monthly frequency of Diablo winds (along with average live fuel moisture content). The Diablo Wind data are derived from a 17-year climatology of San Francisco Bay Area regional surface weather stations.\textsuperscript{192}

Figure 24-18: Monthly Frequency of Diablo Winds and Average Live Fuel Moisture Content (Dashed Line)\textsuperscript{193}

\textit{Sundowner Winds}

Strong sundowner wind events occur approximately \textit{2-3 times per year}. These events can create sharp temperature rises, local gale force winds, and significant weather-related problems. Rare, “explosive” types of sundowner wind events occur about 6 times per century that present dangerous weather situations, generating extremely strong and hot winds that can reach gale force or higher speeds.\textsuperscript{194}

\textbf{Historical Frequency of All Severe Weather Hazards}

Table below shows the average historical frequency of severe weather hazard events for San Diego County since 1996.

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\textsuperscript{192} Retrieved on 07.15.2021 from https://www.fireweather.org/diablo-winds
\textsuperscript{193} Retrieved on 07.13.2021 from https://www.fireweather.org/diablo-winds
Table 24-32: Severe Weather Hazard Event

Frequencies for San Diego County since 1996.

<table>
<thead>
<tr>
<th>Severe Weather Hazard Category</th>
<th>Average Number of Hazard Events Per Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wind (Includes High, Strong and Thunderstorm Winds ONLY)</td>
<td>22.78</td>
</tr>
<tr>
<td>Tornado</td>
<td>0.51</td>
</tr>
<tr>
<td>Hail</td>
<td>1.54</td>
</tr>
<tr>
<td>Lightning</td>
<td>1.30</td>
</tr>
<tr>
<td>Diablo Wind*</td>
<td>2.5</td>
</tr>
<tr>
<td>Santa Ana Wind</td>
<td>32</td>
</tr>
<tr>
<td>Sundowner Wind*</td>
<td>2 to 3</td>
</tr>
</tbody>
</table>

* Note: The Diablo and Sundowner wind hazards are not present in San Diego County. They are included here for information purposes only.

Table below shows the average historical frequency of severe weather hazard events for Riverside County since 1996.

Table 24-33: Severe Weather Hazard Event

Frequencies for Riverside County since 1996.

<table>
<thead>
<tr>
<th>Severe Weather Hazard Category</th>
<th>Average Number of Hazard Events Per Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wind (Includes High, Strong and Thunderstorm Winds ONLY)</td>
<td>25.18</td>
</tr>
<tr>
<td>Tornado</td>
<td>0.71</td>
</tr>
<tr>
<td>Hail</td>
<td>0.67</td>
</tr>
<tr>
<td>Lightning</td>
<td>1.22</td>
</tr>
<tr>
<td>Diablo Wind*</td>
<td>2.5</td>
</tr>
</tbody>
</table>
Potential Impacts of the Hazard

The significance (or priority) of a hazard’s potential impacts is based primarily on the frequency and resulting damage caused by the hazard, including deaths/injuries and property, crop, and economic damage. All assets and people within CSU San Marcos main campus and satellite campus areas are at risk from the effects of severe weather hazards.

**Wind Hazards (Including Tornadoes)**

Wind hazard events have the potential to impact people, property, and operations on campuses across the CSU system. People caught in the open during an extreme wind event are exposed to high winds and debris, and could be injured or killed.

The habitability of buildings can be compromised (by damaging roofs, windows, or other weak points in the building envelope), leading to long-term operational issues for the campus. As with most university campuses, space is always at a premium at the CSU San Marcos campus, and the loss of any currently utilized space due to building or structural damage would likely disrupt operations and the University’s mission.

Extreme wind events can result in power failure, which would impact the operation of the campus. Fallen tree limbs and other potential transportation hazards may also cause disruption to the surrounding community and limit ingress/egress to the campus.

**CSU San Marcos Main Campus, San Marcos (San Diego County)**

The 2017 San Diego County Multi-Jurisdictional Hazard Mitigation Plan profiles only one severe weather-related hazard – coastal storm/coastal erosion/tsunami hazard. High winds are a component of this hazard. Damage from high wind speeds by themselves is considered to be minor, although they contribute to storm surge and erosion. As a result, wind hazards (including tornadoes) are considered to be of low to moderate significance, and therefore to have a minimal to moderate potential impact on the County and on the CSU San Marcos main campus. Tornadoes are not profiled at all by the Plan. As a result,
tornado hazards are considered to be of low significance, and therefore to have minimal potential impact on the County and on the CSU San Marcos main campus.195

**CSU San Marcos – Temecula Campus, (Riverside County)**

According to the 2018 County of Riverside Multi-Jurisdictional Local Hazard Mitigation Plan, wind hazards (excluding tornadoes) are considered to have a moderate to high potential impact, and tornadoes are considered to have a moderate potential impact, on Riverside County and (by extension) the CSU San Marcos – Temecula campus.196

**Hail**

Hail typically impacts property by damaging structures, cars, and utilities as it falls. Dents in cars, broken glass, and holes in roofs are common impacts of hail. Injuries to people from hail are less common, though they can happen, as hail is a hard object falling in an unpredictable manner at a fairly high rate of speed.

**CSU San Marcos Main Campus, San Marcos (San Diego County)**

The 2017 San Diego County Multi-Jurisdictional Hazard Mitigation Plan profiles only one severe weather-related hazard – coastal storm/coastal erosion/tsunami hazard. Hail hazards are not profiled in the Plan. As a result, hail hazards are considered to be of low significance, and therefore to have a minimal potential impact on the County and on the CSU San Marcos main campus.197

**CSU San Marcos – Temecula Campus, (Riverside County)**

The 2018 County of Riverside Multi-Jurisdictional Local Hazard Mitigation Plan does not include the hail hazard as significant enough to profile; as a result, the hail hazard is considered to have a minimal potential impact on Riverside County and (by extension) the CSU San Marcos – Temecula campus.198

**Lightning**

Lightning strikes the United States about 20-25 million times a year.199 Although most lightning occurs in the summer months, people can be struck at any time of year. Since 1990, lightning has killed an average of 39 people each year in the United States, and

hundreds more have been injured.\textsuperscript{200} Property losses due to lightning have been very costly across the U.S. For example, from 2005 through 2020, U.S. homeowner’s insurance claim payouts for lightning losses totaled approximately $15,334,600,000, or $958,412,500 worth of payouts per year.\textsuperscript{201} (Commercial claim payouts for lightning losses for the U.S. were not available.)

**CSU San Marcos Main Campus, San Marcos (San Diego County)**

The 2017 San Diego County Multi-Jurisdictional Hazard Mitigation Plan profiles only one severe weather-related hazard – coastal storm/coastal erosion/tsunami hazard. Lightning hazards are not profiled in the Plan. As a result, lightning hazards are considered to be of low significance, and therefore to have a minimal potential impact on the County and on the CSU San Marcos main campus.\textsuperscript{202}

**CSU San Marcos – Temecula Campus, (Riverside County)**

The 2018 County of Riverside Multi-Jurisdictional Local Hazard Mitigation Plan does not include the lightning hazard as significant enough to profile; as a result, the lightning hazard is considered to have a minimal potential impact on Riverside County and (by extension) the CSU San Marcos – Temecula campus.\textsuperscript{203}

**Probability of Future Occurrence of the Hazard**

Areas throughout California, including all California State University (CSU) campuses, experience severe weather events every year. Future occurrences of such events are projected to increase in both their frequency and intensity.

**CSU San Marcos Main Campus, San Marcos (San Diego County)**

The 2017 San Diego County Multi-Jurisdictional Hazard Mitigation Plan states that damage from high wind speeds by themselves is considered to be minor, although they do contribute to storm surge and erosion.\textsuperscript{204} However, according to the NCEI Storm Events Database, wind, hail, and lightning events occur on average far more than once per year, with wind hazard events occurring on average 22.78 per year since 1996. Furthermore, while the severe weather hazard is a non-spatial hazard that affects all areas of the CSU San Marcos main campus equally, the smallest geographic unit of measurement for almost all official severe weather event data is at the county level. Because the severe weather data used in this assessment do not exist at the campus level.

\textsuperscript{201} Retrieved on 07.21.2021 from https://www.iii.org/table-archive/20504
level, it is assumed that the severe weather probabilities for the CSU San Marcos main campus reflect those of the surrounding community and County.

Based on the data available from both 2017 San Diego County Multi-Jurisdictional Hazard Mitigation Plan and the NCEI Storm Events Database, the severe weather hazard is expected to occur on (or otherwise impact) the CSU San Marcos main campus at least once on an annual basis. Therefore, the probability of future occurrence of the severe weather hazard for CSU San Marcos is HIGHLY LIKELY.

**CSU San Marcos – Temecula Campus, (Riverside County)**

The 2018 County of Riverside Multi-Jurisdictional Local Hazard Mitigation Plan states that there is a moderate possibility that high wind hazard events will occur in the County occasionally (i.e., once every 5 years) in the future. However, according to the NCEI Storm Events Database, severe weather wind hazards have occurred in Riverside County far more than once annually – at an average of 25.18 events per year since 1996. Furthermore, while the severe weather hazard is a non-spatial hazard that affects all areas of the CSU San Marcos – Temecula campus equally, the smallest geographic unit of measurement for almost all official severe weather event data is at the county level. Because the severe weather data used in this assessment do not exist at the campus level, it is assumed that the severe weather probabilities for CSU San Marcos – Temecula reflect those of the surrounding community and County identified in the Table below.

Taking into account the data available from both 2018 County of Riverside Multi-Jurisdictional Local Hazard Mitigation Plan and the NCEI Storm Events Database, the severe weather hazard is expected to occur on (or otherwise impact) the CSU San Marcos – Temecula campus at least once on an annual basis. Therefore, the probability of future occurrence of the severe weather hazard for the CSU San Marcos – Temecula campus is HIGHLY LIKELY.

**CSU San Marcos – All Campus Areas**

The probability of future occurrence of the severe weather hazard for all CSU San Marcos campus areas is HIGHLY LIKELY.

The following tables show the probabilities of future occurrence for component severe weather hazards for CSU San Marcos campuses in San Diego County and Riverside County.

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Table 24-34: Severe Weather Hazard Probabilities of Future Occurrence for San Diego County and CSU San Marcos.

<table>
<thead>
<tr>
<th>Severe Weather Hazard Category</th>
<th>Average Number of Hazard Events Per Year</th>
<th>Probability of Future Occurrence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wind (Includes High, Strong and Thunderstorm Winds ONLY)</td>
<td>22.78</td>
<td>Highly Likely</td>
</tr>
<tr>
<td>Tornado</td>
<td>0.51</td>
<td>Likely</td>
</tr>
<tr>
<td>Hail</td>
<td>1.54</td>
<td>Highly Likely</td>
</tr>
<tr>
<td>Lightning</td>
<td>1.30</td>
<td>Highly Likely</td>
</tr>
<tr>
<td>Diablo Wind**</td>
<td>2.5</td>
<td>Not Rated</td>
</tr>
<tr>
<td>Santa Ana Wind</td>
<td>32</td>
<td>Highly Likely</td>
</tr>
<tr>
<td>Sundowner Wind**</td>
<td>2 to 3</td>
<td>Not Rated</td>
</tr>
</tbody>
</table>

** Note: The Diablo and Sundowner wind hazards are not present in San Diego County, and therefore are not rated for probability of future occurrence. They are included here for information purposes only.
Table 24-35: Severe Weather Hazard Probabilities of Future Occurrence for Riverside County and CSU San Marcos – Temecula Campus

<table>
<thead>
<tr>
<th>Severe Weather Hazard Category</th>
<th>Average Number of Hazard Events Per Year</th>
<th>Probability of Future Occurrence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wind (Includes High, Strong and Thunderstorm Winds ONLY)</td>
<td>25.18</td>
<td>Highly Likely</td>
</tr>
<tr>
<td>Tornado</td>
<td>0.71</td>
<td>Likely</td>
</tr>
<tr>
<td>Hail</td>
<td>0.67</td>
<td>Likely</td>
</tr>
<tr>
<td>Lightning</td>
<td>1.22</td>
<td>Highly Likely</td>
</tr>
<tr>
<td>Diablo Wind**</td>
<td>2.5</td>
<td>Not Rated</td>
</tr>
<tr>
<td>Santa Ana Wind</td>
<td>32</td>
<td>Highly Likely</td>
</tr>
<tr>
<td>Sundowner Wind**</td>
<td>2 to 3</td>
<td>Not Rated</td>
</tr>
<tr>
<td>** Note: The Diablo and Sundowner wind hazards are not present in Riverside County, and therefore are not rated for probability of future occurrence. They are included here for information purposes only.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Vulnerability to the Hazard

People, structures, and assets on the CSU San Marcos campuses are all vulnerable to the impacts associated with severe weather. Infrastructure can be damaged or destroyed by hail, wind, tornadoes, thunderstorms, and lightning, which can result in service interruptions and outages. Structures can be damaged or destroyed by hail, wind, tornadoes, thunderstorms, and lightning. People can be injured or killed by lightning, flying debris, hail, or extreme wind events. CSU San Marcos also has vehicles that are all vulnerable to a severe weather event.

Estimate of Potential Losses

Severe weather is a non-spatial hazard that affects the both CSU San Marcos campuses. Each of the hazards associated with severe weather can result in losses throughout the planning area.

All structures within all CSU San Marcos campus areas are at risk from severe weather. There are approximately 35 buildings that could be damaged by wind, hail, and/or lightning. If even a fraction of these assets were to be damaged, the resulting estimated losses would still be in the millions of dollars. The total replacement costs due to severe weather hazard are $217,777,651 for 25 buildings, and are unknown for the remaining 10
buildings. An analysis of projected dollar losses to campus buildings from severe weather as a percentage of building replacement costs is also not currently available, though CSU leadership may pursue such data in the future.

The population at CSU San Marcos varies throughout the day. As of Fall, 2019, CSU San Marcos had 14,519 students and 1,687 faculty and staff. All are at risk from severe weather events, with 16,206 being directly vulnerable in this scenario.

Vulnerability Assessment Conclusions

Severe weather presents a variety of hazards to all CSU San Marcos campus areas. People, assets, infrastructure, and vehicles can all be damaged by this hazard, and losses can quickly begin to rise. In the aggregate, severe weather is a frequently occurring hazard (mostly in the form of wind hazard events) that presents a variety of risks to CSU San Marcos.

It is evident that CSU San Marcos has vulnerabilities to and risks from severe weather hazard incidents, and that pre-event planning, communication, and mitigation efforts should be implemented. Public education and outreach regarding areas of shelter that could be used by campus populations during severe weather events is considered by campus leadership to be one viable mitigation option. The campus planning committee will continue to look for feasible and cost-effective options for the mitigation of severe weather risks going forward.

Identified Data Limitations

Numerous federal agencies maintain a variety of records regarding losses associated with hazards. Unfortunately, no single source is considered to offer a definitive accounting of all losses. The Federal Emergency Management Agency (FEMA) maintains records on federal expenditures associated with declared major disasters. The US Army Corps of Engineers (USACE) and the Natural Resources Conservation Service (NRCS) collect data on losses during the course of some of their ongoing projects and studies. Additionally, the National Oceanic and Atmospheric Administration’s (NOAA) National Centers for Environmental Information (NCEI) collects and maintains data about natural hazards in summary format, as well as occurrences, dates, injuries, deaths, and estimated costs for individual storm events. Many of these databases and other data collection services, including the NCEI, have inherent data limitations when searching for information at a scale as small as a single campus.

The best available data and records have been used throughout this section. Where no data or records exist or could be located, that deficiency is noted.

24.4 Social Resilience Assessment

Overview

While every person is vulnerable to risk, individuals from diverse populations such as those with access and functional needs are disproportionately more vulnerable and may be at a higher risk to harm in a disaster event. In addition to physical vulnerabilities, the intersectionality between physical hazard risks and population social vulnerabilities must be considered to holistically address overall campus risk.

As inclusivity is a high priority for CSU, addressing campus risk and resilience must be done through the lens of inclusion and equity. Addressing social vulnerability is an increasingly critical requirement of state and national doctrines and described in Section 4.4 of the HVRA Base Plan. Every individual of the campus’s richly diverse population group needs to have the capacity, skills, and knowledge in order to understand, access, and participate in risk reduction and disaster response in ways that are meaningful to their own unique situation. In a campus community, having strong social support networks and active involvement in community disaster responses may negatively or positively impact these opportunities and reduce the resilience-building process. This section offers a glimpse into the CSU San Marcos campus’s unique social construct, population demographics, strengths and concerns and presents a high-level assessment of the resilience, coping capacities and potential social vulnerabilities of students, staff and faculty. The research variables that were asked are often considered sensitive subjects, and few are traditionally included in emergency management/hazard mitigation planning.

This social resilience assessment of college campuses is the first of its kind in the nation. The research methodology unfolded as the interviews with campuses progressed. The assessment data presented are not definitive or authoritative. The answers, analysis, and suggested trends are strictly indicators for potential social risk. They do not represent an accurate data capture as limitations on the data gathering process influenced an ability to provide accuracy. This assessment provides indications of increased risk, not accuracy of response or a true reflection of the situation of the campus. The information presented is to be considered in the context of the more
detailed system-wide CSU social vulnerability assessment that is included in the baseline HVRA.

Campus-Identified Populations of Concern

During the campus interview, the following responses were provided when asked, “In considering the diverse population group(s) amongst student body, faculty and staff, which are of the most concern in your emergency management planning?”

Table 24-36: High level summary of campus populations of concern

<table>
<thead>
<tr>
<th>Question</th>
<th>Campus Response</th>
</tr>
</thead>
</table>
| Which population groups amongst the student body, faculty, and staff, are of the most concern for physical and social vulnerabilities in emergency management planning? | ▪ Disabled students  
▪ Students in out-of-service areas  
▪ Students in or ageing out of foster care  
▪ Students from migrant worker families  
▪ Other small groups |
| Which population groups are most difficult to reach in an event?          | None                                                  |
| Which population groups have little/limited support networks if impacted by an event? | International students |
Resilience Variables Related to Campus Emergency Management

The interviewees were asked to reflect on a set of 12 variables for the campus populations of student, faculty and staff: homelessness (*housing insecurity*), food security, health and wellness, disability/access and functional needs (AFN), racial equity, digital equity, communications, international students, immigrants/immigration status issues (*undocumented, DACA, etc.*), LGBTQI (Lesbian Gay Bisexual Transgender Questioning (or queer) Intersex), and transportation dependency. They were also offered an opportunity to add any other factor they wanted to include. The following two questions were asked:

- Is this factor a particular issue of concern for emergency management on your campus? Responses were summarized as **Very High, High, Medium, Low**
- Is this factor reflected in the emergency plans and processes for your campus? Responses were summarized as **Yes, No, In Progress, NA**

In order to provide a high-level qualitative response for the answers, the approach of averaging response was taken. If conflicting answers were expressed by the interviewees, the answer (code) was averaged out. A detailed explanation of the response averaging approach is included in the base HVRA.

Table 24-37: Campus-specific emergency management issues of concern and inclusion in emergency management plans and processes.

<table>
<thead>
<tr>
<th>Issue of Concern</th>
<th>Plans &amp; Processes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Homelessness (Housing Insecurity)</td>
<td>Medium</td>
</tr>
<tr>
<td>Food Security</td>
<td>Low</td>
</tr>
<tr>
<td>Health &amp; Wellness</td>
<td>Low</td>
</tr>
<tr>
<td>AFN</td>
<td>Low</td>
</tr>
<tr>
<td>Racial Equity</td>
<td>Low</td>
</tr>
<tr>
<td>Digital Equity</td>
<td>Medium</td>
</tr>
<tr>
<td>Comms.</td>
<td>Medium</td>
</tr>
<tr>
<td>International Students</td>
<td>Low</td>
</tr>
<tr>
<td>Immigrants / Immigration Status</td>
<td>Low</td>
</tr>
<tr>
<td>LGBTQI</td>
<td>Low</td>
</tr>
<tr>
<td>Transportation Dependency</td>
<td>Low</td>
</tr>
</tbody>
</table>
Qualitative Narrative: Campus Overview of Potential Resilience Vulnerabilities

The following are interview notes of interest:

- Meet with LGBTQI groups annually to review processes, emergency procedures, and discuss their vulnerabilities. Look at the issues of them being targeted in their spaces and what to do if there if there is a locked down.
- In addition to the university food pantry, a church near campus has food pantry and there are lots of north county food banks.
- Have an annex in EOP for health, and the dept has safety talks about how they would assist in an event.
- Using GEOFENCING for communications so if someone comes on campus will get messaging – good for visitors.
- Actively working with the international program and students. The risk managers work hand in hand with international program students for protocols, blackboard, etc., and are providing presentations on emergency management and giving them informational kits.
- Work with student support center and policies for immigrants and give the same talk to DACA and dreamers as give to the international students. The center directors give emergency managers an invitation, so they go to dept, give presentations and supply emergency management kits.
- They have a sprinter transportation station, if evacuation is needed, and have contracts with bus companies to request buses to get commuters where they need to go. It was used in the 2014 fire. They have specific areas identified on campus for commuter pickups – refer to the area to come in and get picked up.

Campus High Hazards and Potentially Vulnerable Populations

This section provides a brief introduction to the link between socially vulnerable populations and a particular hazard type. While extensive research has been conducted on the impacts of hazards, not all linkages have been documented or published, and detail for finding them are beyond the scope of this assessment. It’s important to note, the intersectional nature of what makes an individual’s personal experience and resilience to an event is played out by unique factors for that individual or population. The nuanced
social vulnerabilities often come from the social and physical environment in which a person is embedded.

In order to aid in further assessing campus resilience, below is a general description of the known impacts. From some hazards, the descriptions are robust, while others are only brief introductions.
Table 27-38: CSU San Marcos *Highly Likely, Likely and Possible* Hazards

<table>
<thead>
<tr>
<th>Hazard</th>
<th>Future Occurrence Probability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Communicable Disease</td>
<td>Highly Likely</td>
</tr>
<tr>
<td>Drought</td>
<td>Highly Likely</td>
</tr>
<tr>
<td>Earthquake</td>
<td>Possible</td>
</tr>
<tr>
<td>Erosion</td>
<td>Likely</td>
</tr>
<tr>
<td>Extreme Temperature</td>
<td>Highly Likely (Heat only)</td>
</tr>
<tr>
<td>Landslide</td>
<td>Likely</td>
</tr>
<tr>
<td>Power Outage</td>
<td>Likely</td>
</tr>
<tr>
<td>Wildfire</td>
<td>Possible (Fire); Possible (Smoke)</td>
</tr>
</tbody>
</table>

**Drought**

The 2012-2016 drought had severe effects on two vulnerable sectors of our population: those in low-income brackets, and those, especially Native Americans, who rely on subsistence fishing for their livelihoods.208 Water bills increased throughout the state. Due to rising water prices, for the working poor, many have paid four to five percent of their income for water. Since many CSU students are commuters, and many living with families, future drought impacts may potentially affect a percentage of non-resident students. NASA’s modeling shows that future droughts are likely to last longer and be more intense, even leading to “megadroughts” in the western states. 209 Fresh water supplies are predicted to be full of extremes, with both droughts and extreme precipitation events being more severe. The interrelationship between drought and other hazard conditions may lead to a set of secondary impacts. Drought conditions lead to water quality issues due to loss of drinking water, increased fire danger that leads to drought-induced fires and elevated AQI levels, as well as extreme heat or prolonged heat events.

**Earthquake**

Impacts on populations from earthquakes are complex, with long-term implications on social stability for all populations. In addition to the physical impact exposure during a no-notice earthquake event and the social and logistical challenges of a recovering

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community, an earthquake can have lasting impacts long afterwards due to post traumatic stress disorder (PTSD).

Socioeconomic vulnerabilities of populations at risk were analyzed in the hypothetical yet scientifically realistic earthquake sequence that is being used to better understand hazards for the San Francisco Bay region during and after a magnitude-7 earthquake (mainshock) on the Hayward Fault and its aftershocks. In this study, the at-risk populations located in areas of concentrated damage are anticipated to experience longer recovery trajectories, increased long term housing displacement, and transportation impacts due to dependencies on transit dependencies. When neighborhood schools close, families with school age children may move to other areas to keep their children in schools. Persons with access and functions needs are likely to be more dependent on access to functioning medical, social and personal health care services that would be overwhelmed by the event and therefore increasing their vulnerabilities. For the homeless populations, the loss of social community services and damages to shelters could add to protracted relocations. For the young and mobile populations who rent, the major disruption to housing, jobs and transit will also drive relocation. Widespread housing damage and preexisting housing market constraints will make it “extremely challenging” for the socially and economically vulnerable populations to find alternative housing near their home communities. Those who utilize interim and irregular housing for months and years after a disaster are more vulnerable to physical, social, and mental disorders, including suicide, substance abuse, and physical and verbal abuse. Aftershocks and post disaster conditions delay population return and increase outmigration.\textsuperscript{210}

\textit{Erosion}

Risk from erosion relates to earthen and infrastructural losses. The degree of vulnerability to these events and their impacts depends on human behavior and the traditional social factors such as situational awareness, prior knowledge of hazards, social capital and decision-making capabilities, as well as increased vulnerability due to social factors, such as racial and economic disparities.

\textit{Extreme Temps}

People susceptible to respiratory ailments (asthma, lower and upper respiratory disease) disproportionately suffer from the effects of fire, smoke, air pollutions, allergens, heat and PSPS. Those with limited income or without resources are affected disproportionately due to the inability to provide safe shelter, air conditioning, cooling, air purification, medical

care, and quality foods, and are also least able to obtain information related to climate risks and adaptation strategies.

**Heat**

Heatstroke, cardiovascular disease, respiratory disease and cerebrovascular disease are related to extreme heat events. Increased number of heat waves creates heat-related physical stress on populations and is exacerbated in the metropolitan areas where greater amounts of heat-absorbing surfaces (e.g., asphalt and concrete) trap heat and emit higher temperatures throughout the night.

The heat also extends the geographic range and the distribution of disease-carrying insects and pests. Health professionals are concerned that California’s warming climate will allow species to acclimate. Such vectors include such pests as ticks that carry Lyme disease, and mosquitos that transmit Zika, dengue fever, West Nile, plague and tularemia. Some others, such as chikungunya, Chagas disease, and Rift Valley fever virus, are threats as well.

Some communities of color and some low-income, homeless, and immigrant populations are more exposed to heat waves, as these groups often reside in urban areas affected by heat island effects. In addition, these populations are likely to have limited adaptive capacity due to a lack of adequately insulated housing, inability to afford or to use air conditioning, inadequate access to public shelters such as cooling centers, and inadequate access to both routine and emergency health care. These social, economic, and health risk factors give rise to the observed increase in deaths and disease from extreme heat in some immigrant and impoverished communities.

Heat stroke, the most serious heat-related illness, occurs when the body is unable to control its temperature. Body temperature rises rapidly, the sweating mechanism fails, and the body cannot cool down. In extreme cases, heat stroke can cause confusion and unconsciousness, so the victim is unable to seek treatment without assistance.

There are several groups of people who are uniquely vulnerable to the effects of extreme heat, such as infants and children, older adults aged 65 and up, athletes and outdoor workers, low-income households, and individuals with certain chronic medical conditions.

When dealing with an extreme heat event, the most common impacts are those generally felt by the people living in the targeted area. For people in particular, heat can kill when the body is pushed beyond its limits. Most heat disorders occur because the victim has been overexposed to heat. As discussed, the major human risks associated with extreme heat include dehydration, sunburn, fatigue, heat exhaustion, heat stroke, and in severe cases, death.

Some portions of the population are more at risk to the effects of extreme heat. The very young, the elderly, and certain groups with chronic medical conditions (such as asthma or other pulmonary illnesses, heart disease, poor blood circulation, neurological illnesses,
and obesity) are generally more vulnerable to the effects of extreme heat, and are more likely to suffer illness or death as a result.

This is especially true if exposure is extended for a period of time and preventative measures are not taken immediately. Distributional implications of impacts, and even less on distributional implications of adaptation actions.” 211

**Landslides**

Although infrastructural losses are of secondary importance to the risk to humans themselves, research investigating the vulnerability of people to landslides is rare. The many reasons for this lack of data are related to the fact that the collapse of occupied buildings which makes it a function of structural vulnerability and therefore, indirect. The degree of vulnerability to landslides by an individual considered at high risk, or even the general populations, also depends on human behavior, including many of the traditional social factors that are difficult to measure such as situational awareness, prior knowledge of hazards, and decision-making capabilities.212

Landslides can result in primary lifeline failures through the loss of roads or power and communication lines. Transportation routes are often expensive to clean up, and prolonged obstruction can disrupt the movement of people and goods. Risk from landslide relates to earthen and infrastructural losses. The degree of vulnerability to these events and their impacts depends on human behavior and the traditional social factors such as situational awareness, prior knowledge of hazards, social capital and decision-making capabilities, as well as increased vulnerability due to social factors, such as racial and economic disparities.

**Power Outage/Public Safety Power Shutdowns (PSPS)**

Loss of power creates economic hardship to a region experiencing regular PSPS events, such as those experienced throughout the state over the recent years. Many businesses close, including gas stations, grocery stores, and local retail establishments. These impacts may deeply impact students dependent on support jobs, as well impacting family members of campus staff and faculty. PSPS increases risks to the public due to inability to use medical devices, spoilage of food and medicines, and disruption to infrastructure,
such as supply of clean water and electricity used to run home medical equipment, such as lift chairs and ventilators.

**Wildfire**

Increased wildfire threat occurs especially in the end of fall, when conditions are driest, but before the winter rains have come; an east-to-west wind gusts exacerbate fire risk. Wildfire threats have the concomitant threat of Public Safety Power Shutoffs (PSPS). And, in the case of an actual wildfire, danger exists both from fire and from the smoke. Recent wildfires have demonstrated that some demographics are disproportionately affected. Native Americans are six times more likely to be affected than white people. Blacks and Hispanic people are 50 percent more vulnerable. These values take into account the likelihood of a community being affected and the greater difficulty of that community to recover. These statistics reflect the lack of access to resources to pay for insurance, to rebuild and recover, to implement fire safety measures, and to access other resources. Price gouging after a fire (such as documented in Sonoma County after the 2017 Tubbs Fire) further exacerbates the disparity.\(^\text{213}\) Furthermore, the disabled and the elderly are at particular risk from extreme wildfire conditions, as they are often not as able to effectively evacuate. Of the 85 people who died in the Camp Fire in Butte in 2018, 62 of them were at least 65 years old.\(^\text{214}\)

Smoke from wildfires creates a significant public health threat. Especially vulnerable are individuals who have heart or lung issues, such heart disease, lung disease or asthma. Those most vulnerable include the medically fragile, elderly and children. Air Quality Indexes track the level of the following:\(^\text{215}\) particulate matter, surface levels of ozone, carbon monoxide, sulfur dioxide, and nitrogen dioxide. All of these can cause respiratory distress and harm lungs.\(^\text{216}\)

The California Department of Public Health reports the increased public health risks, and risk indicators that include: heat-related ED visits, populations living in wildfire areas, 

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adults with multiple chronic conditions, populations living in poverty, race/ethnicity, outdoor workers, public transit access, air conditioner ownership and tree canopy.217

Hazard Mitigation and Emergency Management Planning

The goal of this high-level assessment is to provide a starting point to encourage further exploring campus social risks and vulnerabilities, as well as to inform and to enhance holistic emergency management and hazard mitigation decision making, planning processes and future adaptive risk management strategies. By including the social resilience factors, mitigation investments may move beyond standardized planning and regulations, structure and infrastructure projects, and natural systems protections to embrace a more expanded, customized emergency operations plan and an education and outreach program unique to the campus.

A more robust social resilience inquiry is strongly encouraged to develop an accurate picture, based on methodical and scientific research-based data. Such an effort would be envisioned through both nuanced discussions with a variety of campus stakeholders and the invitation of nontraditional stakeholders to join in a collaborative resilience partnership. Such a forward-leaning effort would be directly in keeping with CSU’s commitment to inclusion and equity in risk reduction.

Section 25
Sonoma State University

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25.1 University Profile

University History

Sonoma State College was established by the California State Legislature in 1960 to be part of the California State College system, with significant involvement of the faculty from San Francisco State University. Sonoma State later became part of the California State University system. In 1978, Sonoma State College became Sonoma State University when the school officially gained university status.

Sonoma State is designated as a Hispanic-Serving Institution (HSI).

University Governance

The campus president is the chief executive officer who oversees the administration of the entire university. The president manages campus operations and fundraising, sets campus priorities, and oversees the hiring and support of staff and faculty. The president also maintains a close working relationship with the CSU’s systemwide office, reporting to the chancellor and participating in the systemwide Executive Council.

The provost is the chief academic officer of the university, overseeing all academic affairs and programs of the university. The provost reports directly to the president.

The president is supported by multiple committees; Structure and Functions, the Executive Committee, the Senate Diversity Subcommittee, and the Senate Standing Committee (Academic Planning, Educational Policies, Faculty Standards and Affairs and Student Affairs; along with their respective subcommittees). The Academic Senate and Senate Standing Committees operate in an advisory capacity.

University Mission

“Sonoma State is a regionally serving public university committed to educational access and excellence. Guided by our core values and driven by a commitment to the liberal arts and sciences, Sonoma State delivers high-quality education through innovative programs that leverage the economic, cultural, and natural resources of the North Bay.”

Sonoma State University outlines four strategic priorities in support of their goals. The priorities are directed towards students’ success, academic excellence, leadership cultivation and transformative impact.

University Location

Sonoma State occupies approximately 269 acres (109 ha) on the east side of the main suburban area of Rohnert Park. Directly adjacent to the main campus is Wolf’s Den Plaza, a frequent hangout and eating area for SSU students.

In addition to the main campus, the university also owns and operates two off-campus study sites for students of the natural sciences. The first site is the 411-acre
The second site is the 3,200-acre (1,300 ha) Galbreath Wildlands Preserve in Mendocino County.[26] Both offer opportunities for research and hands-on education to students of the university. Sonoma State also offers students the opportunity to obtain their bachelor’s degree in liberal arts partly through classes offered at Napa Valley College and the Vallejo Satellite Campus of Solano Community College.

University Population

In the fall of 2019, the enrollment of graduate and undergraduate students exceeded 8,600 students. White students make up 45.6% of the student population with Latino students making up 35% of the population. A majority of undergraduate students are first generation and full-time, and many are Pell Grant eligible.

25.2 Interim Final Rule for Hazard Vulnerability and Risk Assessment

Requirement §201.6(c)(2): The plan shall include a risk assessment that provides the factual basis for activities proposed in the strategy to reduce losses from identified hazards. Local risk assessments must provide sufficient information to enable the jurisdiction to identify and prioritize appropriate mitigation actions to reduce losses from identified hazards.

Requirement §201.6(c)(2)(i): [The risk assessment shall include a] description of the type...location and extent of all natural hazards that can affect the jurisdiction. The plan shall include information on previous occurrences of hazard events and on the probability of future hazard events.

Requirement §201.6(c)(2)(ii): [The risk assessment shall include a] description of the jurisdiction’s vulnerability to the hazards described in paragraph (c)(2)(i) of this section. This description shall include an overall summary of each hazard and its impact on the community.

Requirement §201.6(c)(2)(ii): [The risk assessment] must also address National Flood Insurance Program (NFIP) insured structures that have been repetitively damaged floods.

Requirement §201.6(c)(2)(ii)(A): The plan should describe vulnerability in terms of the types and numbers of existing and future buildings, infrastructure, and critical facilities located in the identified hazard area.

Requirement §201.6(c)(2)(ii)(B): [The plan should describe vulnerability in terms of an] estimate of the potential dollar losses to vulnerable structures identified in paragraph (c)(2)(ii)(A) of this section and a description of the methodology used to prepare the estimate.
Requirement §201.6(c)(2)(ii)(C): [The plan should describe vulnerability in terms of] providing a general description of land uses and development trends within the community so that mitigation options can be considered in future land use decisions.

Requirement §201.6(c)(2)(iii): For multi-jurisdictional plans, the risk assessment must assess each jurisdiction’s risks where they vary from the risks facing the entire planning area.

25.3 Hazard Identification and Risk Assessment

Overview of Sonoma State University History of Hazards

Numerous federal agencies maintain a variety of records regarding losses associated with hazards. Unfortunately, no single source is considered to offer a definitive accounting of all losses. The Federal Emergency Management Agency (FEMA) maintains records on federal expenditures associated with declared major disasters. The US Army Corps of Engineers (USACE) and the Natural Resources Conservation Service (NRCS) collect data on losses during the course of some of their ongoing projects and studies. Additionally, the National Oceanic and Atmospheric Administration’s (NOAA) National Centers for Environmental Information (NCEI) database collects and maintains data about natural hazards in summary format. The data includes occurrences, dates, injuries, deaths, and estimated costs. Many of these databases and other data collection services, including the NCEI, have inherent data limitations when searching for information at a university scale.

The best available data and records were used throughout this assessment.

Hazard Identification

As part of the initial hazard identification process, the Campus Assessment Team considered potential hazards with the most chance to significantly affect the planning area. The hazards include those that have occurred in the past and may occur in the future. A variety of sources were used to develop the list of hazards considered including national, regional, and local sources such as emergency operations plans, FEMA’s How-To Series, websites, published documents, databases, and maps, as well as discussion among the Campus Assessment Team members.

In the initial phase of the planning process, the Campus Assessment Team considered 14 hazards and the risks they create for the University and its material assets, population, and operations. The hazards initially considered, and the determinations as to the treatment of those hazards, are shown in Table 25-1 (following).

Table 25-1: Hazard Identification Determinations

<table>
<thead>
<tr>
<th>Hazard</th>
<th>Determination (Yes/No)</th>
<th>Reason for Determination</th>
<th>Future Occurrence Probability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hazard</td>
<td>Yes/No</td>
<td>Hazard of concern to campus</td>
<td>Future Occurrence Probability</td>
</tr>
<tr>
<td>--------------------------------</td>
<td>--------</td>
<td>-------------------------------</td>
<td>-------------------------------</td>
</tr>
<tr>
<td>Communicable Disease</td>
<td>Yes</td>
<td>Highly Likely</td>
<td></td>
</tr>
<tr>
<td>Dam and Levee Failure</td>
<td>Yes</td>
<td>Unlikely</td>
<td></td>
</tr>
<tr>
<td>Drought</td>
<td>Yes</td>
<td>Highly Likely</td>
<td></td>
</tr>
<tr>
<td>Earthquake</td>
<td>Yes</td>
<td>Possible</td>
<td></td>
</tr>
<tr>
<td>Erosion</td>
<td>Yes</td>
<td>Unlikely</td>
<td></td>
</tr>
<tr>
<td>Extreme Temperature</td>
<td>Yes</td>
<td>Possible (Heat); Possible (Cold)</td>
<td></td>
</tr>
<tr>
<td>Flood</td>
<td>Yes</td>
<td>Possible</td>
<td></td>
</tr>
<tr>
<td>Hazardous Materials</td>
<td>Yes</td>
<td>Unlikely</td>
<td></td>
</tr>
<tr>
<td>Landslide</td>
<td>Yes</td>
<td>Unlikely</td>
<td></td>
</tr>
<tr>
<td>Power Outage</td>
<td>Yes</td>
<td>Likely</td>
<td></td>
</tr>
<tr>
<td>Sea Level Rise</td>
<td>No</td>
<td>Not a hazard of concern to campus</td>
<td>N/A</td>
</tr>
<tr>
<td>Tsunami</td>
<td>No</td>
<td>Not a hazard of concern to campus</td>
<td>N/A</td>
</tr>
<tr>
<td>Volcano</td>
<td>Yes</td>
<td>Unlikely</td>
<td></td>
</tr>
<tr>
<td>Wildfire</td>
<td>Yes</td>
<td>Likely (Fire); Possible (Smoke)</td>
<td></td>
</tr>
</tbody>
</table>

**Future Occurrence Probability**

In order to determine the probability of future occurrences of each hazard profiled, the following scale was developed:

- **Highly Likely** - 76%-100% that the hazard would occur annually.
- **Likely** - 50%-75% that the hazard would occur annually.
- **Possible** - 11%-49% that the hazard would occur each annually.
- **Unlikely** - 0%-10% that the hazard would occur each annually.
Communicable Disease

Description of the Hazard

Communicable diseases are illnesses that occur due to infectious agents or their toxic products and are infectious due to their potential of transmission from one person or species to another by a replicating agent.¹ They may be transmitted from a reservoir to a susceptible host either directly as from an infected person or animal or indirectly through the agency of an intermediate plant or animal host, vector, or the inanimate environment. Communicable diseases are clinically evident illness resulting from the presence of pathogenic microbial agents, including pathogenic viruses, pathogenic bacteria, fungi, protozoa, multi-cellular parasites, and aberrant proteins known as prions.² The degree of spread of a communicable disease depends on both the ability of an organism to enter, survive and multiply in the host and the comparative ease with which the disease is transmitted to other hosts.³

Some ways in which communicable diseases spread are by:

- Travel through the air, such as tuberculosis, measles, or COVID-19;
- Physical contact with an infected person, such as through touch (staphylococcus), sexual intercourse (gonorrhea, HIV), fecal/oral transmission (hepatitis A), or droplets (influenza, TB, COVID-19);
- Contact with a contaminated surface or object (Norwalk virus), food (salmonella, E. coli), blood (HIV, hepatitis B), or water (cholera); and
- Bites from insects or animals capable of transmitting the disease (mosquito: malaria and yellow fever; flea: plague)⁴

Collectively, the twenty-three (23) campuses and Chancellor’s Office of the California State University (CSU) system have identified nine (9) communicable disease hazards that have had significant impacts on their respective student, faculty, and staff populations. Of these communicable diseases, COVID-19 is considered to be the most prominent and widespread agent across all CSU campuses. (See Table CD.1 below.)


Table 25-2: Communicable Diseases Identified CSU Campuses

<table>
<thead>
<tr>
<th>Collective List of Communicable Diseases Identified by All CSU Campuses</th>
<th>Number of CSU Campuses (Including Chancellor’s Office) Identifying Communicable Disease Having Significant Impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>COVID-19 (SARS-CoV-2)</td>
<td>24</td>
</tr>
<tr>
<td>Meningitis</td>
<td>7</td>
</tr>
<tr>
<td>Measles</td>
<td>6</td>
</tr>
<tr>
<td>Influenza (Including H1N1/Swine Flu)</td>
<td>6</td>
</tr>
<tr>
<td>Tuberculosis</td>
<td>5</td>
</tr>
<tr>
<td>Norovirus</td>
<td>4</td>
</tr>
<tr>
<td>Mumps</td>
<td>2</td>
</tr>
<tr>
<td>E. Coli</td>
<td>2</td>
</tr>
<tr>
<td>Sexually Transmitted Diseases (STDs)</td>
<td>2</td>
</tr>
</tbody>
</table>

(Source: Interviews with CSU campus staff at CSU campuses and at CSU Chancellor’s Office.)

With the exception of COVID-19, there is variability among CSU campuses regarding which communicable diseases have had the greatest impact on individual campus communities. Table 25-3 shows the communicable disease hazards that have had the greatest impact on each CSU campus.

Table 25-3: Communicable Disease Hazards at CSU Campuses with Greatest Impact

<table>
<thead>
<tr>
<th>CSU Campus</th>
<th>Identified Communicable Disease Hazards with the Greatest Impact on CSU Campus</th>
</tr>
</thead>
<tbody>
<tr>
<td>CSU Bakersfield</td>
<td>COVID-19, Meningitis</td>
</tr>
<tr>
<td>CSU Channel Islands</td>
<td>COVID-19, Measles</td>
</tr>
<tr>
<td>Chico State</td>
<td>COVID-19, Tuberculosis</td>
</tr>
<tr>
<td>CSU Dominguez Hills</td>
<td>COVID-19</td>
</tr>
<tr>
<td>Cal State East Bay</td>
<td>COVID-19, Meningitis</td>
</tr>
<tr>
<td>Fresno State</td>
<td>COVID-19, Meningitis, Tuberculosis</td>
</tr>
<tr>
<td>Cal State Fullerton</td>
<td>COVID-19, Influenza</td>
</tr>
</tbody>
</table>
Humboldt State | COVID-19, Measles, Norovirus, Influenza, STDs
---|---
Cal State Long Beach | COVID-19
Cal State LA | COVID-19, E. coli, Measles
Cal Maritime | COVID-19
CSU Monterey Bay | COVID-19
CSUN (Northridge) | COVID-19, Measles
Cal Poly Pomona | COVID-19, Influenza (Swine Flu - H1N1)
Sacramento State | COVID-19
Cal State San Bernardino | COVID-19, Tuberculosis
San Diego State | COVID-19, Meningitis, Mumps
San Francisco State | COVID-19
San José State | COVID-19, H1N1
Cal Poly San Luis Obispo | COVID-19, Meningitis, Norovirus
CSU San Marcos | COVID-19
**Sonoma State** | **COVID-19, H1N1, Norovirus**
Stanislaus State | COVID-19, Tuberculosis
Office of the Chancellor | COVID-19
CSU System-Wide | COVID-19, Meningitis, Measles, Tuberculosis, Influenza-Swine Flu-H1N1, Mumps, Norovirus, E. coli, STDs

(Source: Interviews with CSU campus staff at CSU campuses and at CSU Chancellor’s Office.)

**Descriptions of Identified Communicable Disease Hazards at Sonoma State University**

Sonoma State University (SSU) has identified three (3) communicable disease hazards that have had the greatest impact on campus – COVID, H1N1, Norovirus. The following are brief descriptions of the communicable disease hazards at SSU.

**COVID-19 (SARS-CoV-2)** Coronaviruses are a family of viruses that can cause illnesses such as the common cold, severe acute respiratory syndrome (SARS) and Middle East respiratory syndrome (MERS). In 2019, a new coronavirus was identified as the cause of a disease outbreak that originated in China. This virus is now known as the **severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2)**. The disease it causes is called Coronavirus Disease 2019 (COVID-19). In March 2020, the World Health Organization (WHO) declared the COVID-19 outbreak a pandemic.
Signs and symptoms of coronavirus disease 2019 (i.e., COVID-19) may appear two to 14 days after exposure. Common signs and symptoms can include fever, cough, and tiredness. Early symptoms of COVID-19 may also include a loss of taste or smell.

The virus that causes COVID-19 spreads easily among people, and more continues to be discovered over time about how it spreads. Data has shown that the COVID-19 virus spreads mainly from person to person among those in close contact (within about 6 feet, or 2 meters). The virus is transmitted by respiratory droplets being released when someone with the virus coughs, sneezes, breathes, sings or talks. These droplets can be inhaled or land in the mouth, nose or eyes of a person nearby. In some situations, the COVID-19 virus can spread by a person being exposed to small droplets or aerosols that stay in the air for several minutes or hours (i.e., airborne transmission). It's not yet known how common it is for the virus to spread this way. The COVID-19 virus can also spread if a person touches a surface or object with the virus on it and then touches his or her mouth, nose or eyes; however, this is not considered to be a main way it spreads.

The severity of COVID-19 symptoms can range from very mild to severe. Some people may have only a few symptoms, and some people may have no symptoms at all. However, some people may experience worsened symptoms, such as worsened shortness of breath and pneumonia. People who are older have a higher risk of serious illness from COVID-19, and the risk increases with age. People who have existing medical conditions also may have a higher risk of serious illness from COVID-19. In some cases, the disease can cause severe medical complications and may even lead to death.\(^5\)

**Influenza (Including sub-type H1N1/Swine Flu)**

Influenza is a viral infection that attacks the respiratory system (i.e., nose, throat, and lungs). Influenza viruses travel through the air in droplets when someone with the infection coughs, sneezes or talks. Influenza is transmitted either by inhaling virus-laden droplets directly, or by coming into physical contact with an object (e.g., telephone or computer keyboard) and then transferring the virus to the eyes, nose or mouth. People with the virus are likely contagious from about a day before symptoms appear until about five days after symptoms begin.

Common signs and symptoms of the flu include: fever, aching muscles, hills and sweats, headache, dry and persistent cough, shortness of breath, tiredness and weakness, runny or stuffy nose, sore throat, and eye pain. (Vomiting and diarrhea are also influenza signs and symptoms, but these are more common in children than in adults.)

Influenza viruses are constantly changing, with new strains appearing regularly. As a result, antibodies against influenza viruses that have been encountered in the past

may not offer protection from new influenza strains, as the new strains can be very
different viruses from previous strains.⁶

**H1N1 Flu (Swine Flu)**

The H1N1 flu, commonly known as swine flu, is a type of influenza A virus and is one
of several flu viruses strains that can cause the seasonal flu. It is primarily caused by
the H1N1 strain of the flu (influenza) virus. Symptoms of the H1N1 flu are the same as
those of the seasonal flu.

The H1N1 virus is a combination of viruses from pigs, birds and humans that causes
disease in humans. The virus enters your body when you inhale contaminated
droplets or transfer live virus from a contaminated surface to your eyes, nose or
mouth. It then infects the cells that line your nose, throat and lungs.⁷

**Norovirus**

Norovirus is a highly contagious virus commonly spread through food or water that is
contaminated by fecal material during food preparation or by contaminated surfaces.
Specifically, this virus can be transmitted through: consuming contaminated food,
drinking contaminated water, and touching one’s hand to one’s mouth after the hand
has been in contact with a contaminated surface or object.

Norovirus can also be transmitted through close contact with an infected person.

Norovirus infections occur most frequently in closed and crowded environments such
as hospitals, nursing homes, child care centers, schools and cruise ships. Noroviruses
are difficult to kill off because they can withstand hot and cold temperatures and most
disinfectants.

Symptoms such as diarrhea, stomach pain and vomiting typically begin 12 to 48 hours
after exposure, and usually last one to three days. Most people recover from
norovirus completely without treatment. However, for some people — especially
infants, older adults and people with underlying disease — vomiting and diarrhea can
be severely dehydrating and require medical attention.⁸

**Location of the Hazard**

Communicable diseases have the potential to affect the entire Sonoma State
University (SSU) planning area equally. As a result, the communicable disease hazard
can be found at the SSU main campus located in Rohnert Park, CA (Sonoma County).
Because of the ubiquitous nature of many communicable diseases, students, faculty,
staff at (and visitors to) SSU are at risk of exposure to the communicable disease

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hazard.\(^9\) (Please note: SSU also offers upper-division BA degree completion programs in Liberal Studies at Mendocino College in Ukiah, CA (Mendocino County), Napa Valley College in Napa, CA (Napa County), and Solano Community College in Vallejo, CA (Solano County). However, SSU does not appear have ownership of any buildings on these campuses.)

**CSU Student Housing Locations and Populations**

Although CSU-campus-owned student housing opportunities have been severely limited due to the COVID-19 pandemic, this situation is temporary. Eventually, students will be allowed back on campus at full capacity, and many of these students will be living in campus-owned housing. When this occurs, over 53,000 students (i.e., just over 11% of the CSU total enrollment) will be at increased risk of exposure to communicable disease hazards, owing to the “close-quarters” living arrangements in student housing. Table 25-4 shows the number of students that were living in CSU-campus-owned housing in Fall, 2019, prior to the COVID-19 pandemic. For Sonoma State, approximately 37% of its 8,649 enrolled students (or 3,200 students) reside in student housing.\(^{10,11}\)

**Extent of the Hazard**

Various communicable diseases are categorized by the Center for Disease Control and Prevention (CDC) by levels of containment called Biosafety Levels (or BSLs). The higher the BSL, the greater the level of containment and level of effort necessary to prevent transmission of the disease, and therefore the greater the hazard. Biosafety Levels prescribe procedures and levels of containment for a particular microorganism or material (including research involving recombinant or synthetic nucleic acid molecules) and procedures associated with that containment. BSLs also consider primary barriers (e.g., biosafety cabinets), secondary barriers, facility design, air handling, laboratory security, etc. BSLs are graded from 1 to 4; as the BSL increases so does the relative risk of the agent/procedures as well the stringency of procedures and facility design.

Figure 25-1 describes the different BSLs, and provides examples of communicable diseases that would typically fall in to these classifications, as well as the typical protections that would be necessary to prevent transmission of each of the diseases.

\(^9\) California State University. About CSU. Retrieved 04.30.2021 from: [https://www2.calstate.edu/csu-system/about-the-csu](https://www2.calstate.edu/csu-system/about-the-csu);

\(^{10}\) California State University. Enrollment. Retrieved 04.30.2021 from: [https://www2.calstate.edu/csu-system/about-the-csu/facts-about-the-csu/enrollment/Pages/default.aspx](https://www2.calstate.edu/csu-system/about-the-csu/facts-about-the-csu/enrollment/Pages/default.aspx)

\(^{11}\) California State University. CSU Campus Match. Retrieved 04.30.2021 from: [https://www2.calstate.edu/attend/campuses/campus-match/Pages/campus-match.aspx](https://www2.calstate.edu/attend/campuses/campus-match/Pages/campus-match.aspx)
The Extent of Sonoma State University (SSU) Communicable Disease Hazards Except COVID-19:

Before the COVID-19 pandemic, there were cases of measles at CSU Channel Islands. Measles would be classified at the BSL-2 containment level.\textsuperscript{13}

The Extent of Sonoma State University (SSU) COVID-19 Communicable Disease Hazard:

As a microorganism, the SARS-CoV-2 (COVID-19) virus requires a high level of containment. It is therefore classified at BSL-3.\textsuperscript{14}

History of the Hazard

Over an approximately one-year period, from mid-March, 2020 to March 23, 2021, there were a reported 137 cases of COVID-19 at SSU. Most communicable disease data are maintained by at the state and at the county levels, and are not generally available at the municipal or campus levels, unless (a) the CSU campus falls under the

jurisdiction of a city-level health department, or (b) a geographically specific outbreak occurs on campus or in the local community. The exception to this is the current COVID-19 pandemic, where both campus and County-level case data have been collected. As a result, it is important to provide COVID-19 case statistics for both CSU campuses and the counties where CSU campus assets are located.

The following tables (25-5 and 25-6) show both campus- and County-level COVID-19 Case data for Sonoma State (SSU). These case data are updated on at least a weekly basis. (Please note that the COVID-19 case numbers here may not reflect the most recent updates.)

Table 25-4: Sonoma State University (SSU) Campus-Level COVID-19 Case Data (as of 03.22.2021) 

<table>
<thead>
<tr>
<th>Community Population</th>
<th>On Campus</th>
<th>Off Campus</th>
<th>Total Cases</th>
</tr>
</thead>
<tbody>
<tr>
<td>Students</td>
<td>11</td>
<td>103</td>
<td>114</td>
</tr>
<tr>
<td>Faculty &amp; Staff</td>
<td>5</td>
<td>16</td>
<td>21</td>
</tr>
<tr>
<td>Contractors</td>
<td>2</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>Totals</td>
<td>18</td>
<td>119</td>
<td>137</td>
</tr>
</tbody>
</table>

(Note: Dashboard is updated weekly. Last updated March 22, 2021.)

Table 25-5: Confirmed COVID-19 Statistics for Sonoma County (as of 03/21/2021): 

<table>
<thead>
<tr>
<th>Cases</th>
<th>28,981</th>
</tr>
</thead>
<tbody>
<tr>
<td>Deaths</td>
<td>308</td>
</tr>
</tbody>
</table>

Potential Impacts of the Hazard

Communicable disease outbreaks and pandemics have (and will continue to have) direct impact on life, health, and safety across the CSU system including the SSU campus. The extent of this impact is contingent on the type of infection or contagion, the severity of the outbreak, and the speed at which it is transmitted. Property and infrastructure integrity may be affected if large portions of CSU campus populations contract communicable diseases at the same time and are therefore unable to perform

maintenance, operations, and educational tasks. This would be particularly disruptive if those impacted are first responders or other essential personnel. Long-term outbreaks affecting large numbers of SSU students could result in cancelled classes, delayed matriculation, or other disruptions to the CSU System’s mission. This has already occurred with the current COVID-19 pandemic and could occur again with more virulent strains of communicable diseases, including COVID-19.

Communicable disease hazards found across the CSU system (including SSU) vary both by level of containment (BSL) (described previously) and by level of individual/public health risk, or Risk Group (RG) level. While BSLs describe the procedures and required levels of containment in a laboratory setting, Risk Groups (RGs) reflect the potential effects of disease exposure on humans or animals. Like BSLs, RGs range from Level 1 (RG1) to Level 4 (RG4), with Level 1 (RG1) posing minimal risk to healthy individuals and public health and Level 4 (RG4) posing a very serious or extreme risks to individuals and public. BSLs generally correlate with Risk Group (RG) Levels (e.g., a RG2 agent is worked with at BSL-2), but there are exceptions (e.g., production volumes, high-risk procedures, etc.).

The World Health Organization’s (WHO) Laboratory Biosafety Manual, 3rd ed., NIH Guidelines, categorizes Risk Groups (RGs) in the following way:

Table 25-6: WHO Risk Group Characterization

<table>
<thead>
<tr>
<th>Risk Group (RG)</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>RG1</td>
<td>Rarely associated with disease in healthy adult humans or animals and pose no-to-little public health risk (e.g., Saccharomyces cerevisiae, E. coli K-12 strain derivatives often used for recombinant/molecular biology, many environmental organisms)</td>
</tr>
<tr>
<td>RG2</td>
<td>Associated with mild to moderate disease for which preventative measures or post exposure treatments are often available; public health impact is limited (e.g., Streptococcus pyogenes, Salmonella, hepatitis B virus)</td>
</tr>
<tr>
<td>RG3</td>
<td>Associated with serious to lethal human disease for which preventative vaccines or post exposure therapies may be scarce. Public health impact is limited-to-moderate (e.g., Mycobacterium tuberculosis, hantaviruses, West Nile virus, SARS)</td>
</tr>
<tr>
<td>RG4</td>
<td>Associated with serious to lethal human disease for which preventative vaccines or post exposure therapies</td>
</tr>
</tbody>
</table>


are not usually available. Public health impact is high (e.g., Ebola virus, Marburg virus, smallpox virus, etc.)

Table 25-8 describes the four (4) Risk Group Levels (RGs), and provides examples of communicable diseases that would typically fall into these classifications, and the typical protections that would be necessary to prevent transmission of the disease. It is important to note that all but two (2) communicable disease hazards identified by CSU campuses fall under either the lower-risk RG1 or RG2 categories. COVID-19 and tuberculosis are the two (2) communicable diseases that fall under the higher-risk RG3 category. However, with the advent of the recently-developed COVID-19 vaccine, and with the expectation of an increasingly robust vaccine supply, it is possible that the RG level for COVID-19 could be lowered in the future, thereby reducing both the extent and the potential impact of COVID-19.
Table 25-7: Risk Group Levels (RGs) with Example Diseases and Recommended Precautions

<table>
<thead>
<tr>
<th>Level</th>
<th>Examples</th>
<th>Typical Protection to Prevent Transmission</th>
</tr>
</thead>
<tbody>
<tr>
<td>RG 1</td>
<td>E. Coli</td>
<td>Precautions are minimal, most likely involving gloves and some sort of facial protection. Usually, contaminated materials are left in open (but separately indicated) waste receptacles. Decontamination procedures for this level are similar in most respects to modern precautions against everyday viruses (i.e.: washing one's hands with anti-bacterial soap, washing all exposed surfaces of the lab with disinfectants, etc.).</td>
</tr>
<tr>
<td>RG 2</td>
<td>Chicken Pox, Hepatitis A, B, C, Lyme disease, Salmonella, Mumps, Measles, Malaria, Scrapie, Dengue Fever, HIV</td>
<td>These bacteria and viruses cause mild disease in humans or are difficult to contract via aerosol. Routine diagnostic work with clinical specimens can be done safely at BSL-2, using BSL-2 practices and procedures.</td>
</tr>
</tbody>
</table>

| RG 3 | Anthrax  
West Nile Virus  
SARS Virus  
(Including COVID-19)  
Tuberculosis  
Typhus  
Yellow Fever  
Hantaviruses  
Avian Flu | These bacteria and viruses cause severe to fatal disease in humans, but vaccines or other treatments do exist to combat them. Laboratory personnel have specific training in handling pathogenic and potentially lethal agents and are supervised by competent scientists who are experienced in working with these agents. This is considered a neutral or warm zone. |
|---|---|
| RG 4 | H5N1 (Bird Flu)  
Dengue Hemorrhagic Fever  
Marburg Virus  
Ebola Virus  
Smallpox  
Lassa Fever  
Crimean-Congo Hemorrhagic Fever  
Other Hemorrhagic Diseases | These viruses and bacteria cause severe to fatal disease in humans, for which vaccines or other treatments are *not* available. When dealing with biological hazards at this level the use of a Hazmat suit and a self-contained oxygen supply is mandatory. The entrance and exit of a BSL-4 lab will contain multiple showers, a vacuum room, an ultraviolet light room, autonomous detection system, and other safety precautions designed to destroy all traces of the biohazard. Multiple airlocks are employed and are electronically secured to prevent both doors opening at the same time. All air and water service going to and coming from a BSL-4 lab will undergo similar decontamination procedures to eliminate the possibility of an accidental release. |
Probability of Future Occurrence of the Hazard

There are significant data limitations regarding non-COVID-19 communicable disease cases, as the information thereof is outdated, anecdotal, and/or inadequate. As a result, it is not feasible to provide quantitative probabilities of future occurrence for non-COVID-19 communicable disease hazards. However, based on the limited data, it is feasible to present qualitative probabilities of future occurrence based on ranges of communicable disease frequency. Table 25-9 shows a probability scale of future occurrence for the nine (9) communicable disease hazards profiled in this assessment. This scale is divided into four (4) levels of probability:

Table 25-8: Likelihood of Future Hazard Occurrence

<table>
<thead>
<tr>
<th>Likelihood</th>
<th>Parameters for Determining Likelihood</th>
</tr>
</thead>
<tbody>
<tr>
<td>Highly Likely</td>
<td>76 – 100% probability that hazard will occur annually (high to very high frequency)</td>
</tr>
<tr>
<td>Likely</td>
<td>50 – 75% probability that hazard will occur annually (moderate to high frequency)</td>
</tr>
<tr>
<td>Possible</td>
<td>11 – 49% probability that hazard will occur annually (low to moderate frequency)</td>
</tr>
<tr>
<td>Unlikely</td>
<td>0 – 10% probability that hazard will occur annually (very low to low frequency)</td>
</tr>
</tbody>
</table>

Due to significant data limitations surrounding non-COVID communicable diseases, the probability of future occurrence of CSU-system-wide communicable disease is measured by the proportion of campuses that have identified a particular communicable disease as having an impact on the campus community. In this measure, the more frequent a communicable disease is seen as impactful CSU-wide, the greater the probability of future occurrence.

Note: Each communicable disease’s probability of future occurrence ranking CSU-system-wide reflects the ranking at the individual CSU campus level unless noted otherwise.
### Table 25-9: Probability of Future Occurrence of Communicable Disease Hazard for CSU System

<table>
<thead>
<tr>
<th>Collectively List of Communicable Diseases Identified by All CSU Campuses</th>
<th>Number of CSU Campuses (Including Chancellor’s Office) Identifying Communicable Disease Having Significant Impact</th>
<th>Proportion of CSU Campuses Identifying Communicable Disease as Having Significant Impact System-Wide</th>
<th>CSU System-Wide Probability Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>COVID-19 (SARS-CoV-2)</td>
<td>24</td>
<td>1.00</td>
<td>Highly Likely</td>
</tr>
<tr>
<td>Meningitis</td>
<td>7</td>
<td>0.29</td>
<td>Possible</td>
</tr>
<tr>
<td>Measles</td>
<td>6</td>
<td>0.25</td>
<td>Possible</td>
</tr>
<tr>
<td>Influenza (Including H1N1/Swine Flu)</td>
<td>6</td>
<td>0.25</td>
<td>Possible</td>
</tr>
<tr>
<td>Tuberculosis</td>
<td>5</td>
<td>0.21</td>
<td>Possible</td>
</tr>
<tr>
<td>Norovirus</td>
<td>4</td>
<td>0.17</td>
<td>Possible</td>
</tr>
<tr>
<td>Mumps</td>
<td>2</td>
<td>0.08</td>
<td>Unlikely</td>
</tr>
<tr>
<td>E. Coli</td>
<td>2</td>
<td>0.08</td>
<td>Unlikely</td>
</tr>
<tr>
<td>Sexually Transmitted Diseases (STDs)</td>
<td>2</td>
<td>0.08</td>
<td>Unlikely</td>
</tr>
</tbody>
</table>

(Source: Interviews with staff at CSU campuses and at the CSU Chancellor’s Office.)

**Vulnerability to the Hazard**

Vulnerability to a communicable diseases hazard resides in the population of a given area – both human and animal – not in the infrastructure or physical assets. While CSU assets and infrastructure could be impacted indirectly by the communicable disease hazard, these impacts would be secondary to the impact that the communicable disease hazard would have on students, faculty, staff, and visitors at the SSU campus.

CSU campus settings are geographically diverse, with locations ranging from small towns to medium-sized cities to densely populated urban areas. Hundreds of thousands of people work, study, and/or pass through CSU campuses on any given day. (As of Fall 2019, CSU – Sonoma had 8,649 students and additional faculty and
Each of these persons is vulnerable to communicable disease, particularly if it is a pathogen that individual has not been immunized against, or for which no immunization exists. Prolonged outbreaks could result in a loss of services, failure of infrastructure (from lack of operators or maintenance), and closure of facilities. This exact scenario has played out in the current COVID-19 pandemic on the SSU campus.

Estimate of Potential Losses

COVID-19 Pandemic Health Impact on CSU Campuses and Surrounding Communities

The most prescient metric for estimating losses from COVID-19 is loss of life. The nationwide campus-related COVID-19 death rate of 0.02% remains well below the average COVID-19 death rate in the U.S. However, due to data limitations, there is no information on CSU-campus-specific deaths by COVID-19 or by any other communicable diseases. In fact, COVID-19 is the only communicable disease for which case reports have been readily available for CSU campuses.

At some point in the future, CSU campuses will return to full capacity. Without adequate surveillance regarding campus access and student and employee interaction, CSU campuses (including CSU – Channel Islands) are at risk of developing an extreme incidence of COVID-19, and may become “super-spreaders” for adjacent communities. The emergence of more virulent COVID-19 variants would only add to the potential for high negative impacts on life safety, operations, and service delivery across the CSU system. (Other communicable diseases would also re-emerge, but with low to moderate negative impacts on life safety, operations, and service delivery.)

Economic Impact of COVID-19 Pandemic on CSU Financial Health

During the first few months of the COVID-19 pandemic in 2020, the CSU system suffered tremendous negative fiscal impacts. From March through July of 2020 alone, over $146 million worth of revenue losses were sustained across the CSU system due to refunds to students for parking, housing and dining service fees during Spring Semester, 2020. (See Figure 25-2 below for the economic impact to Sonoma State.) Several CSU campuses saw refund losses surpass $10 million. (See Figure 25-2.)

20 The California State University. Enrollment. Retrieved 05.03.2021 from: https://www2.calstate.edu/csu-system/about-the-csu/facts-about-the-csu/enrollment/Pages/default.aspx
21 The California State University. Employee Head Count by Campus. Retrieved 05.03.2021 from: https://www2.calstate.edu/csu-system/faculty-staff/employee-profile/csu-workforce/Pages/employee-headcount-by-campus.aspx
Mitigative Relief from Federal Assistance

The $1.5 billion in total federal assistance sent to the CSU system will help relieve the losses of revenues from services like dorms, parking and dining services during a year of mainly empty campuses. (See Table 25-11) However, because of staggering COVID-related revenue losses, the CSU system is planning for three (3) years of fiscal duress.

---

Table 25-10: Total Federal Assistance to CSU for COVID-19 Related Losses, 2020 – 2021\textsuperscript{24,25,26}

<table>
<thead>
<tr>
<th>Institution</th>
<th>December 2020 Stimulus</th>
<th>CARES Act</th>
<th>APLU Projection of HEERF Total ARP Act Funding Allocation</th>
<th>Total Estimated Federal COVID Relief Funding</th>
</tr>
</thead>
<tbody>
<tr>
<td>California Polytechnic State University</td>
<td>$20,752,799</td>
<td>$14,725,000</td>
<td>$37,000,928</td>
<td>$72,478,727</td>
</tr>
<tr>
<td>California State Polytechnic University, Pomona</td>
<td>$48,614,353</td>
<td>$31,102,000</td>
<td>$86,044,649</td>
<td>$165,761,002</td>
</tr>
<tr>
<td>California State University Channel Islands</td>
<td>$14,288,099</td>
<td>$8,512,000</td>
<td>$24,915,170</td>
<td>$47,715,269</td>
</tr>
<tr>
<td>California State University Maritime Academy</td>
<td>$1,381,700</td>
<td>$1,204,000</td>
<td>$2,472,622</td>
<td>$5,058,322</td>
</tr>
<tr>
<td>California State University - Sacramento</td>
<td>$59,891,260</td>
<td>$35,643,000</td>
<td>$104,900,133</td>
<td>$200,434,393</td>
</tr>
<tr>
<td>California State University, Bakersfield</td>
<td>$22,855,632</td>
<td>$12,483,000</td>
<td>$40,285,565</td>
<td>$75,624,197</td>
</tr>
<tr>
<td>California State University, Chico</td>
<td>$31,603,856</td>
<td>$20,019,000</td>
<td>$55,754,538</td>
<td>$107,377,394</td>
</tr>
<tr>
<td>California State University,</td>
<td>$31,843,563</td>
<td>$18,312,000</td>
<td>$55,915,410</td>
<td>$106,070,973</td>
</tr>
</tbody>
</table>


<table>
<thead>
<tr>
<th>Institution</th>
<th>2020-21</th>
<th>2021-22</th>
<th>2022-23</th>
<th>2023-24</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dominguez Hills</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>California State University, East Bay</strong></td>
<td>$24,243,65</td>
<td>$14,394,00</td>
<td>$42,929,20</td>
<td>$81,566,860</td>
</tr>
<tr>
<td><strong>California State University, Fresno</strong></td>
<td>$52,725,31</td>
<td>$32,557,00</td>
<td>$92,926,59</td>
<td>$178,208,911</td>
</tr>
<tr>
<td><strong>California State University, Fullerton</strong></td>
<td>$67,736,94</td>
<td>$41,088,00</td>
<td>$120,859,84</td>
<td>$229,684,833</td>
</tr>
<tr>
<td><strong>California State University, Long Beach</strong></td>
<td>$67,421,42</td>
<td>$41,202,00</td>
<td>$119,508,329</td>
<td>$228,131,753</td>
</tr>
<tr>
<td><strong>California State University, Los Angeles</strong></td>
<td>$61,905,56</td>
<td>$40,067,00</td>
<td>$108,543,672</td>
<td>$210,516,233</td>
</tr>
<tr>
<td><strong>California State University, Monterey Bay</strong></td>
<td>$13,455,71</td>
<td>$8,705,000</td>
<td>$23,922,768</td>
<td>$46,083,484</td>
</tr>
<tr>
<td><strong>California State University, Northridge</strong></td>
<td>$74,004,08</td>
<td>$47,458,00</td>
<td>$131,021,450</td>
<td>$252,483,538</td>
</tr>
<tr>
<td><strong>California State University, San Bernardino</strong></td>
<td>$42,438,13</td>
<td>$27,924,00</td>
<td>$74,982,459</td>
<td>$145,344,590</td>
</tr>
<tr>
<td><strong>California State University, San Marcos</strong></td>
<td>$26,602,68</td>
<td>$15,542,00</td>
<td>$46,496,808</td>
<td>$88,641,492</td>
</tr>
<tr>
<td><strong>California State University, Stanislaus</strong></td>
<td>$22,007,20</td>
<td>$12,928,00</td>
<td>$38,636,391</td>
<td>$73,571,598</td>
</tr>
<tr>
<td><strong>Humboldt State University</strong></td>
<td>$16,130,01</td>
<td>$11,146,00</td>
<td>$28,831,61</td>
<td>$56,107,635</td>
</tr>
<tr>
<td><strong>San Diego State University</strong></td>
<td>$46,914,12</td>
<td>$30,394,00</td>
<td>$80,592,38</td>
<td>$156,900,512</td>
</tr>
<tr>
<td><strong>San Francisco State University</strong></td>
<td>$47,404,40</td>
<td>$30,000,00</td>
<td>$83,075,47</td>
<td>$160,479,879</td>
</tr>
<tr>
<td><strong>San Jose State University</strong></td>
<td>$46,631,93</td>
<td>$30,977,00</td>
<td>$82,976,13</td>
<td>$160,585,069</td>
</tr>
</tbody>
</table>
### Vulnerability Assessment Conclusions

Before the COVID-19 pandemic, populations at all CSU campuses and CSU-affiliated facilities were substantial. Collectively, as of Fall 2019, CSU campuses had 480,541 students and 53,763 faculty and staff. All were at risk from the communicable disease events, with 534,304 people being directly vulnerable. The COVID-19 pandemic has caused campus population numbers to plummet to a small fraction of full capacity.

At some point in the future, campus population numbers will return to their pre-pandemic levels, and students, faculty, and staff will again be vulnerable to the communicable disease hazard. *If just 10% of the total CSU population were to become ill with a highly infective communicable disease like influenza or another strain of SARS, this would mean that approximately 53,430 people would be sick at the same time.* This scenario would likely overwhelm available on-campus medical services and could even overwhelm portions of the larger community’s medical resources – especially if there were large numbers of infected people with immune system compromises or other underlying health problems.

See Table 25-12 below for the “10% outbreak scenario” projections for the SSU campus and for the entire CSU system.
### Table 25-11: Scenario of Communicable Disease Hazard Affecting 10% of the CSU Population.

<table>
<thead>
<tr>
<th>CSU Campus</th>
<th>Approximate Enrollment Population (Fall 2019)(^{27})</th>
<th>Approximate Total FT/PT Faculty/Staff Population (Fall 2019)(^{28})</th>
<th>Total Combined Approximate Student and Faculty/Staff Population</th>
<th>10% Outbreak Scenario (Students and Faculty/Staff Combined)</th>
</tr>
</thead>
<tbody>
<tr>
<td>CSU Bakersfield</td>
<td>11,199</td>
<td>1,277</td>
<td>12,476</td>
<td>1,248</td>
</tr>
<tr>
<td>CSU Channel Islands</td>
<td>7,093</td>
<td>994</td>
<td>8,087</td>
<td>809</td>
</tr>
<tr>
<td>Chico State</td>
<td>17,019</td>
<td>1,969</td>
<td>18,988</td>
<td>1,899</td>
</tr>
<tr>
<td>CSU Dominguez Hills</td>
<td>17,027</td>
<td>1,761</td>
<td>18,788</td>
<td>1,879</td>
</tr>
<tr>
<td>Cal State East Bay</td>
<td>14,705</td>
<td>1,764</td>
<td>16,469</td>
<td>1,647</td>
</tr>
<tr>
<td>Fresno State</td>
<td>24,139</td>
<td>2,534</td>
<td>26,673</td>
<td>2,667</td>
</tr>
<tr>
<td>Cal State Fullerton</td>
<td>39,868</td>
<td>3,736</td>
<td>43,604</td>
<td>4,360</td>
</tr>
<tr>
<td>Humboldt State</td>
<td>6,983</td>
<td>1,171</td>
<td>8,154</td>
<td>815</td>
</tr>
<tr>
<td>Cal State Long Beach</td>
<td>38,074</td>
<td>4,004</td>
<td>42,078</td>
<td>4,208</td>
</tr>
<tr>
<td>Cal State LA</td>
<td>26,361</td>
<td>2,821</td>
<td>29,182</td>
<td>2,918</td>
</tr>
<tr>
<td>Cal Maritime</td>
<td>911</td>
<td>329</td>
<td>1,240</td>
<td>124</td>
</tr>
<tr>
<td>CSU Monterey Bay</td>
<td>7,123</td>
<td>1,059</td>
<td>8,182</td>
<td>818</td>
</tr>
<tr>
<td>CSUN (Northridge)</td>
<td>38,391</td>
<td>3,832</td>
<td>42,223</td>
<td>4,222</td>
</tr>
<tr>
<td>Cal Poly Pomona</td>
<td>27,914</td>
<td>2,650</td>
<td>30,564</td>
<td>3,056</td>
</tr>
<tr>
<td>Sacramento State</td>
<td>31,156</td>
<td>3,228</td>
<td>34,384</td>
<td>3,438</td>
</tr>
</tbody>
</table>


Cal State San Bernardino  |  20,311 |  2,118 |  22,429 |  2,243  
San Diego State         |  35,081 |  3,702 |  38,783 |  3,878  
San Francisco State    |  28,880 |  3,401 |  32,281 |  3,228  
San José State          |  33,282 |  3,568 |  36,850 |  3,685  
Cal Poly San Luis Obispo |  21,242 |  2,871 |  24,113 |  2,411  
CSU San Marcos          |  14,519 |  1,687 |  16,206 |  1,621  
**Sonoma State**        |  **8,649** |  **1,338** |  **9,987** |  **999**  
Stanislaus State        |  10,614 |  1,276 |  11,890 |  1,189  
Office of the Chancellor |        |  673   |        |  67    
**CSU System-Wide**     |  **480,541** |  **53,763** |  **534,304** |  **53,430**

*Note: Enrollment figures do not include non-specific CSU campus International Programs (455 students) or CALStateTEACH Program (933 students).*

While the case numbers of COVID-19 have been significantly lower (about 1% of the total CSU population) than those in the 10% scenario, the degree of virulence and resultant morbidity and mortality caused by COVID-19 have led to widespread campus shutdowns, educational disruption, and economic harm to the CSU system, including Sonoma State. In short, the real-time COVID-19 communicable disease outbreak scenario has proven far more devastating than the 10% simulated scenario.

**Identified Data Limitations**

There is a wealth of technical information available for communicable disease. However, there is also limited non-COVID-19 communicable disease data available regarding risk or vulnerability of specific populations throughout the CSU. Much of the data that does exist is protected by privacy policies, and therefore cannot be obtained for more specific populations. As a result, performing a detailed quantitative assessment for this hazard is difficult.

Data that could be collected prior to the next update in order to improve this methodology includes:

- Data regarding infection rates at the campus level and for specific populations;
- Data regarding communicable disease case numbers and outcomes, by CSU campus;
Data regarding projected population changes;
Data regarding absenteeism; and
Data regarding increased operating costs as a result of absenteeism (i.e., temporary shifting of duties resulting in business interruption).

**Dam and Levee Failure**

**Description of the Hazard**

A dam failure represents the structural collapse of a dam that stores water in a reservoir behind the dam. These failures are typically the result of structural age, damage to the structure caused by earthquake or flooding, inadequate discharge or spillway capacity, inadequate maintenance, improper construction materials, or extreme inflow of water into the reservoir. Prolonged precipitation may result in overtopping of the dam resulting in structural compromise. The tremendous energy generated by a sudden breach of the dam will have significant downstream effects. Flood damage resulting from dam failures potentially will result in economic losses, environmental damage, destruction of agriculture, and human casualties. This type of incident is extremely dangerous as it can occur rapidly, with no warning resulting in an inability to effectively evacuate threatened communities.

A levee failure is similar to dam failures as the result will be a breach causing flooding on the dry side of the levee. Levees are embankments whose primary purpose is to furnish flood protection from seasonal high water or divert the flow of water. Most levees in California are intended to withstand peak water levels generated by heavy precipitation or rapid snowmelt in a watershed. Other levees are designed to withstand fluctuating water levels on a continuous basis such as those in the California Delta exposed to tidal influences. Levees routinely extend for lengthy distances immediately protecting communities. Levees can be found throughout the state but are most prominent in the Sacramento and San Joaquin Valleys.

Levee failures can vary from overtopping to small uncontrolled discharge to catastrophic failure. Areas downstream of the failure will be subject to inundation dependent on the volume of water released. These levee failures are also typically the result of structural age, damage to the structure caused by earthquake or flooding, slumping, seepage underneath the levee, high velocity flows eroding the levee, inadequate capacity, inadequate maintenance, improper construction materials, or extreme inflow of water into the system. Flood damage resulting from levee failures potentially will result in economic losses, environmental damage, destruction of agriculture, and human casualties.

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A Dam or levee failure flooding will vary depending on a number of factors including the extent of the collapse or breach, the volume of water behind the structure, and the nature of the exposed downstream features. This unpredictable flooding presents a threat to life and property in addition to critical infrastructure. Lifelines and supply routes will likely be damaged or made impassible by flood erosion or standing water. Water quality and health concerns would likely be cascading effects of dam or levee failures.

Location of the Hazard

Sonoma County is home to flood control facilities and levee systems. The dam facilities are mostly along the base of the various mountains and hills throughout the county. Levees have been constructed along the San Francisco Bay and flood control channels providing community protection. The Sonoma State University campus is not in proximity to dams presenting a threat to the campus.

However, the Warm Springs Dam holding Lake Sonoma demonstrates an inundation area that extends from the lake through Santa Rosa and reaching the northern boundaries of Rohnert Park. The campus is shown to remain out of the inundation zone for Lake Sonoma. Lake Sonoma is located 32 miles north of the Sonoma State University campus west of Geyserville. There are a number of small dams in the eastern portion of Santa Rosa but these dams do not show an inundation extending beyond the City of Santa Rosa.
Lake Sonoma releases water into Dry Creek and later into the Russian River before reaching the Pacific Ocean. The Russian River travels in a south bound direction before turning to the west just north of Santa Rosa. The Sonoma State University campus is separated from the turn of the Russian River by 15 miles. The river is not lined with levees and the campus is not within a levee protected zone.
Extent of the Hazard

Dams are classified according to the hazard that they pose to life and property in the event of failure, rather than the likelihood of that failure.

- High hazard potential dams may result in loss of human life, and will likely result in economic, environmental, or lifeline losses.
- Significant hazard potential dams are not expected to result in loss of life, but are expected to cause economic, environmental, and lifeline losses.
• Low hazard potential dams are not expected to result in loss of like, and there is a low expectation of economic, environmental, or lifeline losses. What losses do occur are generally limited to the dam owner.

Dams classified as high hazard are required to have Emergency Action Plans (EAP). EAPS are formal documents that identify potential emergency conditions at the dam and specify preplanned actions to be followed in case of failure. An EAP is required for all high hazard dams and is recommended for all significant hazard dams.

Table 25-12: Sonoma County Dams Affecting Sonoma State University

<table>
<thead>
<tr>
<th>River</th>
<th>Dam</th>
<th>Storage</th>
<th>Hazard Severity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dry Creek</td>
<td>Warm Springs</td>
<td>449,000af</td>
<td>High Hazard</td>
</tr>
</tbody>
</table>

The Sonoma State University campus lies outside of the inundation zone of the dams listed above. In the unlikely event of a catastrophic failure of the identified dams, the Sonoma State University campus is expected to remain out of the inundation area. The inundation area is expected to spread water in areas to the north and west of the campus. The inundation zone extends to the northwest corner of Rohnert Park but does enter the city. Additionally, there are multiple transportation corridors that lie within the dam inundation zones that could compromise access, evacuation, and supply routes. The inundation areas have the potential to threaten areas in which the campus community resides or works. However, based on these conditions, the planning committee ranks the extent of the dam failure hazard as **Low**.

Extent – Levee Failure

There are no identified levees in proximity to the campus and thus the campus is not located within an area subject to flooding from levee failure. Based on no levee failure risk to the campus and no historical occurrences elsewhere in the larger community, the planning committee ranks the extent of this hazard is **Low**.

History of the Hazard

There are no records of dam or levee failures in areas that present a threat to the Sonoma State University campus. Sonoma County has no record of dam failures:

Table 2-13: Sonoma County Dam Failures

<table>
<thead>
<tr>
<th>Date</th>
<th>Dam</th>
<th>Release</th>
<th>Damage</th>
</tr>
</thead>
<tbody>
<tr>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
</tr>
</tbody>
</table>

31 Sonoma County Hazard Mitigation Plan Update, April 2017
Potential Impacts of the Hazard

Dam Failure Impacts - Water that is released due to a dam that has failed generates tremendous energy and force causing a flood that will be catastrophic to life and property. Water levels from the failed dam could be significantly higher than those experienced in worst case scenario flood events. Areas closer to the failed dam will be more likely to experience complete devastation while other areas within the inundation zone will see varying levels of flood waters. The extent of the impacts of a failed dam would vary based on a number of factors such as the volume of water released, the base flow of the river, the time of the failure, the amount of warning provided, and the distance from the dam. Impacts resulting from a dam failure include:

- Loss of life
- Property destruction or damage
- Loss of property contents
- Infrastructure damage
- Flooded or destroyed lifelines/supply routes
- Damaged or destroyed utilities
- Loss of community economic base
- Employment losses
- Agricultural (crops and livestock) damages or destruction
- Environmental damage
- Floods generating threats to public health
- Flood generated debris

Levee Failure Impacts

A levee failure may result in substantial amounts of water to enter into developed areas protected by the levee. The force and volume of water that is generated by a levee failure may cause extensive structural damage in close proximity to the breach and effects of flooding spreading well beyond the point of the failure. The extent of the impacts would vary based on a number of factors such as the volume of water released, the time of the failure, the amount of warning provided, the location of the breach, elevation, and distance from the breach. Potential impacts resulting from a levee failure include:

- Loss of life
- Property destruction or damage
- Loss of property contents
- Infrastructure damage
- Public health hazards resulting from mold, mildew, and disease due to flood water
- Flooded or destroyed lifelines/supply routes
- Damaged or destroyed utilities
- Loss of community economic base
- Employment losses
- Agricultural (crops and livestock) damages or destruction
- Environmental damage
- Prolonged periods of necessary dewatering
- Disruptions to education delivery to community

**Probability of Future Occurrence of the Hazard**

Sonoma County remains at risk from dam and levee failure. The facility most likely to impact campus operations is the Warm Springs Dam containing Lake Sonoma. The facility is located 32 miles north of the campus. However, the location of the Sonoma State University campus is located outside of identified dam inundation zone 2 miles to the east opposite of US Highway 101. There are no identified levees in proximity to the campus and thus the campus is outside of any levee protected zone. There are no official recurrence intervals that have been calculated for dam or levee failures. Based on historical experience and occurrences, the likelihood of this hazard is low, and the probability of future occurrence for both dam and levee failures is **Unlikely**.

**Vulnerability to the Hazard**

Given high priority monitoring and maintenance practices in place, a catastrophic dam or levee failure is highly unlikely. As such, the campus’ vulnerability is tied to the consistency of these practices, and, therefore, is not considered to be truly vulnerable on a daily basis. However, in the unlikely event of a catastrophic failure, the effects of flooding from compromised dams and levees would likely mostly affect members of the campus community in terms of disruption to regional transportation networks and services and the amount of time to respond to the needs of the campus community prior to inundation would be limited.

Any breach along a dam is impossible to predict where a failure may occur. It is likely that response action will not be fully implemented until the incident situational intelligence provides adequate information as to compromised locations. These variables place all those working and living within the dam inundation and flood protection zones in vulnerable locations.

The distributed placement of levees, most near development may expose significant vulnerabilities to other areas of the region even if the campus is unaffected. There is potential the campus community will be affected as a breach may cause flooding and damages to the homes of students, faculty, and staff or to access/supply routes, utilities, or other critical services. The potential for flood damaged structures being left uninhabitable including campus residence halls will result in the vulnerability of numerous displaced individuals and households. The lack of flood insurance will cause extreme financial burdens on those affected.

Vulnerability to a dam or levee failure on the Sonoma State University campus will vary depending on when the failure was to occur. The risk to the campus population will be lessened during periods when classes are not in session or during periods of breaks. Conversely, during the days and hours that classes are in session and staff are
at their workplaces, the human vulnerability increases. However, in region-wide events this vulnerability may be shared with the homes and workplaces of members of the campus community and their families.

Certain campus populations will experience greater challenges to a post-flood / failure environment. Vulnerable populations will likely need to navigate through flood generated debris, face extreme health safety issues from flood waters, experience extreme stresses of a disaster, an inability to communicate to or gain access to support networks, and find difficulty in accessing equipment or supplies to aid in a specific need.

Estimate of Potential Losses

Estimates of potential losses will be influenced by a variety of factors. The volume and force of the water will determine the scale of damages affecting campus infrastructure, equipment, and other impacted features. The proximity to the failure and elevation above flood waters will affect the level of damage and individuals exposed. The time of the academic year, the day of week, and hour in which the failure was to occur will influence the number of people on campus and potential casualties. Losses will be generated by the physical damages, the loss of revenue, loss of academic research, loss of building contents, and community wide economic reductions.

Based on estimate replacement costs of facilities and structures on campus, the total replacement costs are $289,079,090. However, it is unlikely for a dam or levee failure event to cause catastrophic destruction at Sonoma State.

Vulnerability Assessment Conclusions

While the occurrence of dam and levee failures have not been historically relevant near the Sonoma State University campus, the potential for hazards related to the region’s levees and dams still exist. However, the presence of earthquake faults in proximity to the existing dam and levee structures presents a valid danger to downstream locations in the event of an earthquake. In the unlikely event of a high priority dam’s total failure, the consequences would be catastrophic to downstream communities The potential for dam or levee failure further generates the added potential for a number of cascading effects such as disruptions to the local economy, utility failures, disruptions to providing for the needs of the community, and development of public health hazards. These effects would be exacerbated by effects of seasonal flooding, ongoing heavy precipitation, or excessive run-off from the watershed contributing to the river system. The potential for widespread flooding and damage of structures due to the force of water has exponentially powerful impacts on particular populations among the campus community including those with access or functional needs, international students, the homeless, and students residing in the residence halls.
Identified Data Limitations

Data limitations include missing campus structural replacement costs, and an incomplete inventory of both building construction features and mitigation efforts to lessen the impact due to flood inundation.
**Drought**

Hazard Description

Drought is defined as a condition where moisture levels fall significantly below normal for an extended period of time over a large area that adversely affects plants, animal life, and humans. Drought is a gradual phenomenon. Although droughts are sometimes characterized as emergencies, they differ from typical emergency events. Most natural disasters, such as floods or forest fires, occur relatively rapidly and afford little time for preparing for disaster response. Droughts occur slowly, over a multi-year period, and it is often not obvious or easy to quantify when a drought begins and ends.

Throughout California, one dry year does not normally constitute a drought. California’s extensive system of water supply infrastructure (reservoirs, groundwater basins, and conveyance assets) mitigates the effect of short-term dry periods for most water users. Defining when a drought begins is a function of drought impacts to water users. Drought in one location may not constitute a drought for all water users, as some users in relative proximity may have a different water supply. For example, individual water suppliers may use a combination of sources such as rainfall/runoff, water in storage, or expected supply from a water wholesaler to define their water supply conditions.

Drought can be characterized as one or more of the four following types:

- **Meteorological drought** is defined on the basis of the degree of dryness (in comparison to some “normal” or average amount) and the duration of the dry period. A meteorological drought must be considered as region-specific since the atmospheric conditions that result in deficiencies of precipitation are highly variable from region to region.

- **Hydrological drought** is associated with the effects of periods of precipitation (including snowfall) shortfalls on surface or subsurface water supply (e.g., streamflow, reservoir and lake levels, ground water). The frequency and severity of hydrological drought is often defined on a watershed or river basin scale. Although all droughts originate with a deficiency of precipitation, hydrologists are more concerned with how this deficiency plays out through the hydrologic system. Hydrological droughts are usually out of phase with or lag the occurrence of meteorological and agricultural droughts. It takes longer for precipitation deficiencies to show up in components of the hydrological system such as soil moisture, streamflow, and ground water and reservoir levels. As a result, these impacts are out of phase with impacts in other economic sectors.

- **Agricultural drought** focus is on soil moisture deficiencies, differences between actual and potential evaporation, reduced ground water or reservoir levels, and so forth. Plant water demand depends on prevailing weather conditions, biological characteristics of the specific plant, its stage of growth, and the physical and biological properties of the soil.
Socioeconomic drought refers to when physical water shortage begins to affect health, well-being, and quality of life of people, or when the drought starts to affect the supply and demand of an economic product that relies on water.

The drought issue in California is further compounded by water rights. The central challenge is how to prioritize water usage among a broad variety of contexts. It is for this reason that water is a commodity possessed and utilized under a variety of legal doctrines. As such, many competing sets of interests create a dynamic prioritization process between, for example, farming and federally protected fish habitats and water supply for municipal/public use (including usage for SSU) versus water usage for wildfire abatement or natural resource protection.

Location of the Hazard

Drought conditions have been identified in Rohnert Park and Sonoma County, where SSU is located. Drought is not a location-specific hazard and affects the entire planning area equally. Drought location is not isolated to each campus footprint but occurs as a geographic sub-set of drought conditions occurring at larger scales. From 2000-2020, drought conditions existed continuously somewhere in the state, with 80-100% of the state impacted for 12 of the last 20 years. 32

Extent of the Hazard

Given the historical occurrence of drought impacts throughout the county and city surrounding the planning area, and the potential future impact exacerbated by climate change, the CSU Planning Committee recognizes that drought will continue to pose a high degree of risk statewide, potentially impacting crops, livestock, water resources, the natural environment at large, buildings and infrastructure (from land subsidence), and local economies. In addition, although drought affects the entire CSU system-wide planning area equally, the extent of the hazard is variable and specific to each campus/jurisdiction, depending on contextual factors such as the degree of assets and activities, historically impacted by drought within each jurisdiction. That said, the extent of the hazard on campus is reported to be Moderate due to a combination of prolonged drought periods and competition for water resources tied to an increase in development in the Sonoma region.

In addition, drought related land subsidence has occurred statewide and will continue in areas where the groundwater basin has been subject to overdraft and long-term recharge is inadequate to maintain the water table elevation, leaving underground voids. Subsidence levels have been measured up to 30-feet in California with subsidence bowls covering hundreds of square miles. As such, drought-related subsidence may result in serious structural damage to buildings, roads, irrigation ditches, underground utilities, and pipelines. Though these effects have not been

reported on campus, they remain issues of concern for the campus over the long term.

Although the campus planning team identifies the extent of the hazard as Moderate (qualitatively) which corresponds to D1 – D2 on the Extent scale (below), Sonoma County has experienced more severe drought conditions, including D4 levels during the statewide event from 2012-2017. As such, the campus planning team recognizes that while historic impacts shaping the extent of drought on campus have been minimal, the potential impacts are tied to trends across larger geographic areas, and, therefore, the committee recognizes that the extent of drought on campus has the potential to increase in the future.

The U.S. Drought Monitor developed tables of impacts reported during past droughts in California in order to depict the extent of drought risk for each level of drought on the U.S. These possible extent conditions for California complement the general impacts column of the U.S. Drought Monitor Classification Scheme.

Table 25-14: Impacts of Drought Levels as Determined by US Drought Monitor

<table>
<thead>
<tr>
<th>Category</th>
<th>Impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>D0</td>
<td>Soil is dry; irrigation delivery begins early</td>
</tr>
<tr>
<td></td>
<td>Dryland crop germination is stunted</td>
</tr>
<tr>
<td></td>
<td>Active fire season begins</td>
</tr>
<tr>
<td></td>
<td>Winter resort visitation is low; snowpack is minimal</td>
</tr>
<tr>
<td>D1</td>
<td>Dryland pasture growth is stunted; producers give supplemental feed to cattle</td>
</tr>
<tr>
<td></td>
<td>Landscaping and gardens need irrigation earlier; wildlife patterns begin to change</td>
</tr>
<tr>
<td></td>
<td>Stock ponds and creeks are lower than usual</td>
</tr>
<tr>
<td>D2</td>
<td>Grazing land is inadequate</td>
</tr>
<tr>
<td></td>
<td>Producers increase water efficiency methods and drought-resistant crops</td>
</tr>
<tr>
<td></td>
<td>Fire season is longer, with high burn intensity, dry fuels, and large fire spatial extent; more fire crews are on staff</td>
</tr>
</tbody>
</table>

| Wine country tourism increases; lake- and river-based tourism declines; boat ramps close |
| Trees are stressed; plants increase reproductive mechanisms; wildlife diseases increase |
| Water temperature increases; programs to divert water to protect fish begin |
| River flows decrease; reservoir levels are low and banks are exposed |

| Livestock need expensive supplemental feed, cattle and horses are sold; little pasture remains, producers find it difficult to maintain organic meat requirements |
| Fruit trees bud early; producers begin irrigating in the winter |
| Federal water is not adequate to meet irrigation contracts; extracting supplemental groundwater is expensive |
| Dairy operations close |
| Marijuana growers illegally tap water out of rivers |
| Fire season lasts year-round; fires occur in typically wet parts of state; burn bans are implemented |
| Ski and rafting business is low, mountain communities suffer |
| Orchard removal and well drilling company business increase; panning for gold increases |
| Low river levels impede fish migration and cause lower survival rates |
| Wildlife encroach on developed areas; little native food and water is available for bears, which hibernate less |
| Water sanitation is a concern, reservoir levels drop significantly, surface water is nearly dry, flows are very low; water theft occurs |
| Wells and aquifer levels decrease; homeowners drill new wells |
| Water conservation rebate programs increase; water use restrictions are implemented; water transfers increase |
| Water is inadequate for agriculture, wildlife, and urban needs; reservoirs are extremely low; hydropower is restricted |

| Fields are left fallow; orchards are removed; vegetable yields are low; honey harvest is small |
| Fire season is very costly; number of fires and area burned are extensive |
| Many recreational activities are affected |
| Fish rescue and relocation begins; pine beetle infestation occurs; forest mortality is high; wetlands dry up; survival of native plants and |
animals is low; fewer wildflowers bloom; wildlife death is widespread; algae blooms appear

Policy change; agriculture unemployment is high, food aid is needed

Poor air quality affects health; greenhouse gas emissions increase as hydropower production decreases; West Nile Virus outbreaks rise

Water shortages are widespread; surface water is depleted; federal irrigation water deliveries are extremely low; junior water rights are curtailed; water prices are extremely high; wells are dry, more and deeper wells are drilled; water quality is poor;

History of the Hazard

Historically, drought has been so prevalent in California that its presence is almost continuous. According to the US Drought Monitor, Time Series data, Sonoma County (including the CSU – Sonoma footprint) has experienced 6 periods of drought covering 10 of the last 21 years (2000 – 2021), including the statewide event from 2012-2017.

Figure 25-5: Periods of Drought in Sonoma County, California, 2000 – 2021

According to the National Drought Mitigation Center, over 3,500 reports and publications covering 370 drought-related events took place across the state (many of which were statewide events) between 2000-2020. In addition, the National Center for Environmental Information (NCEI) reports more than 500 events statewide during this same time period. These events produced a comprehensive range of impacts to water supply, regulations and allocations to businesses and municipalities, budgets and resources for firefighting, water law and policy, and physical impacts to built and natural environments. As such, data records of previous occurrences can be viewed as

separate time and event demarcations for a hazard almost continuously in effect across the state with cascading impact potential.

According to the Department of Water Resources, droughts exceeding three years are relatively common in Southern California, but relatively rare in Northern California - the region is the geographic source of much of the state’s developed water supply. The 1929-34 drought established the criteria commonly used in designing storage capacity and yield of large Northern California reservoirs.  

According to the US Drought Monitor’s time series data, from 2000-2021 (with the exception of a 2–3-month period in 2000 and 2011), some degree of drought conditions have been continuously in effect somewhere in California. In fact, 80% - 100% of the state has been subjected to drought conditions for 12 of the last 20 years, with the most severe drought being the 100% state-wide event from 2012-2017.

Given the extent of the drought risk in California, the following drought event was selected as an exemplar due to its broad and significant impacts on the state and on the CSU – Sonoma campus planning area:

Note: On campus, drought impacts to flora and landscaping have been reported by the campus planning committee.

2012 – 2017 – Drought produced severe impacts to water wells throughout the state of California, with a high number of wells running dry. Land subsidence due to increased groundwater pumping also occurred in numerous areas of the state such as the San Joaquin and Central Valleys. Crop damage was widespread as well. Water allotments were drastically reduced in many towns and water agencies, with extremely high costs for procuring water. In addition, job loss occurred with many families requiring


food supply assistance, and water supply assistance provided to home-owners with dry wells. According to a report released by UC Davis Center for Watershed Sciences, the 2012-2017 period of the California drought cost the state’s agriculture industry about $1 billion in lost revenue, with a total statewide economic cost of the drought calculated to be $2.2 billion. The report says, “it is responsible for the greatest water loss ever seen in California agriculture - about one third less than normal”. The report calls the groundwater situation in California "a slow-moving train wreck." Spring snowpack at Donner Summit reached record low levels in 2014, exceeded in 2015 by a remarkable April 1 snow-water-equivalent value of only 5% of average. Decreased precipitation since contributed to near-record low levels in the Shasta Reservoir. The ongoing drought has contributed to declines in crop values across the state. For example, crops including cotton, corn silage and barley (the field crop category) fell by 42 percent. 37

Potential Impacts of the Hazard

On campus, drought impacts to flora and landscaping have been reported by the campus planning committee. Drought impacts statewide are wide-reaching and may be economic, environmental, and/or societal. This assessment of its impact recognizes that historic impacts of drought throughout the city and county surrounding the planning area are a sub-set of larger and inter-connected regional droughts, and provide a sound basis for understanding potential (future) impacts on campus.

The most significant potential impact associated with drought across the campus planning area is a potential reduction in water availability for the municipal area tied to the campus. Other impacts include crop loss and damage to trees and other natural resources (See Tree Mortality below). The footprint of SSU to some extent includes these vulnerable resources based on the campus landscape (trees) and the presence (and footprint size) of any agricultural research crops and/or field stations.

As a secondary impact of drought, wildfire is directly attributable to dry atmospheric conditions. Wildfires almost always coincide with drought in California, though not limited to such. 38 However, the wildfire hazard is analyzed separately in this plan. See section below for coverage of the wildfire hazard.

In reviewing the occurrences of drought for Sonoma County, the US Drought Monitor and the National Drought Mitigation Center report that tens of millions of trees died during the (2012-2017) state-wide drought disaster. Though data sources do not provide data for tree mortality specific to campus, the broad geographic extent of the impact makes it likely that tree mortality occurred to some degree. Due to the lasting and ongoing effects of drought on the landscape, trees will continue to be impacted

within the municipalities, counties and regions wherein lies the CSU campus system as long as drought conditions continue to occur in the future.

Given the absence of data, in order for the CSU Committee to assess the impact of tree mortality, it is useful to view it as a risk sub-set to the probability, location, extent, severity and duration of the drought hazard within each campus located municipality, county and region. Regarding potential impacts, standing dead trees could fall, posing a risk to people, buildings, power lines, roads and other infrastructure. In addition, drought-impacted trees become susceptible to diseases and insect infestations (bark beetle) further adding to the risk of tree mortality and related potential impacts. No data is currently available for tree mortality on campus, however, the CSU Planning Team will pursue data on this issue in the future.

As a potential tertiary impact, prolonged and repeated drought conditions over time can produce land subsidence and the risk of damage to building foundations and infrastructure on campus resulting from ground instability and collapse. Land subsidence is defined as the vertical sinking of the land over manmade or natural underground voids. Subsidence is often the direct result of groundwater over-extraction in response to drought conditions, as well as oil and gas extraction. Weight can accelerate the process of subsidence resulting from surface development and infrastructure such as roads and buildings, vibrations from construction blasting and heavy truck or train traffic. For example, the State Water Project’s 444-mile-long California Aqueduct has required repairs such as the raising of canal linings, bridges, and water control structures on the Aqueduct – in the Central Valley a five-mile reach of the Eastside Bypass was impacted by subsidence, and the Department of Water Resources estimated that it may cost in the range of $250 million to acquire flowage easements and levee improvements to restore the design capacity of the subsided area.39

At present, drought related damage to campus buildings and infrastructure at Sonoma State has not been reported, but the potential for such impacts is possible. With regard to overall potential impact, water supply/availability for SSU is ultimately tied to broader inter-dependent, and more intensive modes of water use at local and regional scales such as agriculture and ranching, wildfire protection, larger metropolitan/municipal usage, manufacturing and commerce, tourism, recreation, and wildlife preservation. During drought periods, the State of California’s regulated water allocations are modified and often reduced, which can result in reduced water availability for all usage contexts. A reduction of electric power generation and water quality deterioration are also potential impact factors.

Table 25-15: Summary of Drought Impacts on Water Resources

<table>
<thead>
<tr>
<th>Resource</th>
<th>Type of Impact</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sea Level</td>
<td>Direct</td>
<td>Sea level is rising and will likely impact coastal areas</td>
</tr>
<tr>
<td>Soil Moisture</td>
<td>Direct</td>
<td>Prolonged dry seasons can lead to decreases in soil moisture; drier vegetation</td>
</tr>
<tr>
<td>Vegetation</td>
<td>Indirect</td>
<td>Longer and more intense fire season with increased extent of area burned</td>
</tr>
<tr>
<td>Stream Conditions</td>
<td>Direct</td>
<td>Increases in water temperature; potential effects on fish</td>
</tr>
<tr>
<td>Snowpack</td>
<td>Indirect</td>
<td>Increases in temperature will lead to decreases in snowpack</td>
</tr>
<tr>
<td>Runoff</td>
<td>Direct</td>
<td>Warmer temperatures are likely to lead to a shift in peak runoff from spring to winter and a likely decrease in summer base flow</td>
</tr>
<tr>
<td>Hydropower</td>
<td>Indirect</td>
<td>Decreased summer flows resulting from earlier snowmelt and a shift in peak runoff could affect hydropower generation during summer months</td>
</tr>
<tr>
<td>Precipitation</td>
<td>Direct</td>
<td>Warmer winter temperatures will result in a greater percentage of precipitation falling as rain rather than as snow</td>
</tr>
<tr>
<td>Groundwater</td>
<td>Indirect</td>
<td>Reduction in snowpack and extended periods of drought are likely to increase dependency on groundwater</td>
</tr>
</tbody>
</table>

Probability of Future Occurrence of the Hazard

**Highly Likely** — The US Drought Monitor’s time series data (2000-2020) indicates that some degree of drought has nearly a 100% probability of occurrence somewhere in the state in any given year. Given that SSU lies within a drought impacted region, it is

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prudent to extend the Highly Likely probability of occurrence to the planning area
even though past occurrences and impacts on campus have been minimal.

Vulnerability to the Hazard

In California, rising temperatures are projected to increase the average lowest
elevation at which snow falls, reducing water storage in the snowpack, particularly at
those lower mountain elevations which are now on the margins of reliable snowpack
accumulation. Higher spring temperatures will also result in earlier melting of the
snowpack. The shift in snow melt to earlier in the season is critical for California’s
water supply because flood control rules require that water be allowed to flow
downstream and that water cannot be stored in reservoirs for use in the dry season.
As such, state-level drought risk factors that have led to drought’s state-wide severity
and extent, and potential impacts also create drought vulnerabilities at the level of the
CSU – Sonoma campus. Specifically, the campus planning committee reports that
although their source water wells are healthy currently, an increase in development in
the Sonoma region has created competition for water resources. In response, the
campus is seeking funding to connect to city water to create a source redundancy to
reduce its vulnerability.

Moreover, climate change will likely adversely impact the vulnerability of watersheds
and ecosystems in their ability to deliver important ecosystem services. These
changes may limit the natural capacity of healthy forests to capture water and
regulate stream flows. Sierra Nevada mountain winters and springs are warming, and
on average, precipitation as snowfall relative to rain is decreasing. A warming climate
with reduced snowpack will result in earlier snowmelt and will subsequently reduce
downstream water availability during summer and early fall.

As such, the state and the SSU planning area’s stakeholders potentially have less
capacity to address future drought risks due to projected temperature increases and
shortages in water; ground-water withdrawals have been occurring at a deficit rate of
1 – 2-million-acre feet per year, where the impacts of drought include decreased
availability of water for agriculture and environmental uses. 41 In forested and other
vegetated areas, prolonged drought decreases the moisture content of forest fuels
and increases the risk of high severity wildfires.

California is the single most productive agricultural state and its agricultural industry
relies heavily on reservoir water supplied by snowmelt and rainfall runoff. Yearly
variations in snowpack depths have implications for water availability as snowmelt
from the winter snowpack feeds a network of reservoirs. Spring snowpack at Donner
Summit reached record low levels in 2014, exceeded in 2015 by a remarkable April 1

05.04.2021 from: https://frap.fire.ca.gov/data/assessment2010/pdfs/3.1water.pdf
snow-water-equivalent value of only 5% of average. Decreased precipitation since 2011 has contributed to near-record low levels in the Shasta Reservoir. 42

Vulnerability of Populations

The historical and potential impacts of drought on California’s population include agricultural sector job loss, secondary economic losses to local businesses and public recreational resources, increased cost to local and state government for large-scale water acquisition and delivery, and water rationing and water wells running dry for individuals and families. As drought is often accompanied by prolonged periods of extreme heat, negative health impacts such as dehydration can also occur, where children and elderly are most susceptible. Air quality often declines in times of drought which can affect those with respiratory ailments. These same vulnerabilities apply to the students, faculty and staff of the SSU campus over the long term.

Property Vulnerability

The historical and potential impacts of drought on property include crop loss, injury and death of livestock and pets, and damage to infrastructure, homes and other buildings resulting from the secondary drought impact of land subsidence. The related drought impacts of tree mortality and land subsidence pose risks to vulnerable critical infrastructure and property. These same vulnerabilities apply to the properties of the SSU campus over the long term.

Natural Environment Vulnerability

The core issue shaping drought vulnerability on campus and throughout California is water supply and demand. Several factors play into the issue including groundwater basins, surface water run-off, public and agricultural demand, and surface water storage water sheds. A USGS led analysis was first conducted in 2010 through the Forest and Rangeland Assessment and ongoing through the USGS Forest and Rangeland Ecosystem Science Center to identify threats and assets where water supply would benefit from environmental management designed to protect or enhance water resources, the key effort which, in part, both defines and mitigates the severity of drought risk and vulnerabilities.

With regard to overall threat and asset findings shaping the potential severity of drought, the watersheds in the Sierra region contribute most greatly to the state’s water supply, but are under threat from climate change, wildfire and development. In addition, groundwater basins in the San Joaquin Valley and Sacramento Valley bioregions are an abundant resource that is heavily threatened by over pumping.

Critical Facilities Vulnerabilities

Drought vulnerabilities for CSU – Sonoma’s critical facilities include water shortfalls for facility operations and critical functions, and potential structural destabilization and damage resulting from land subsidence over the long term.

Estimate of Potential Losses

An estimate of potential losses from drought has not been calculated for the campus or the CSU system as a whole. However, drought related losses to the City and county of Sonoma, and the surrounding region such as crop loss and cost increases for water resources have re-occurred over time. Please consult city and county level government, and/or state agricultural agencies for data on the financial impacts from drought.

Vulnerability Assessment Conclusions

The CSU Planning Committee understands that the high degree of vulnerability posed by drought will be exacerbated by greater climate variation in the future and therefore greater variation and uncertainty regarding the availability of water supplies which are already under tremendous stress. In response to such vulnerability, state legislation passed in 2014 requires local governments to regulate pumping and recharge to better manage groundwater supplies, and groundwater-dependent regions are required to halt overdraft and bring basins into sustainable levels of pumping and recharge by the early 2040s. That said, the Committee will continue to work with local, regional and state partners and stakeholders to explore solutions for mitigating the drought hazard on its campuses by accessing the best available data and resources on climate change and its relationship to drought.

Identified Data Limitations

Data are limited concerning campus-related agricultural assets as well as data on campus tree mortality.
Earthquake

Description of the Hazard

An earthquake is a sudden motion or shaking caused by the release of pressure accumulated along the edge of tectonic plates covering the earth. These huge plates are constantly moving and move ever so slowly under, over, or by passing one another. This movement is gradual however the plates may lock together accumulating enormous amounts of energy. When this energy builds, stress develops, and the adjoining plates will eventually break free and result in ground shaking – an earthquake.

Large earthquakes may result in fissuring, ground settlement, and/or vertical or horizontal displacement. Earthquakes occur without warning and can result in extensive damages and human casualties. Damages associated to earthquake generated ground shaking is normally confined to a narrow area along fault trend from the earthquake epicenter. However, seismic waves may generate ground shaking resulting in damages in areas outside of the fault trend.

Fault Rupture – The rupture of faults is the differential movement of the two sides of the earth’s plates at the point of the fault. Horizontal or vertical displacement may be significant and occur over great distances. The movement and energy that occurs along a fault is released in waves resulting in ground shaking. The intensity of ground shaking varies based on the magnitude of the earthquake, the proximity to the earthquake epicenter, the composition of the ground sediment or rock the waves travel through, and the depth of the earthquake.

Liquefaction – In addition to the primary fault rupture that occurs right along a fault during an earthquake, the ground many miles away can also fail during intense shaking. As seismic waves travel through saturated granular soil; the soil begins to liquefy and act as a fluid. Soil strength and stability is lost causing the effects of ground shaking to intensify and for ground deformation to occur. These water saturated soils when shaken quickly lose the ability to support buildings, bridges, utilities, and other structures. Areas susceptible to liquefaction include places where sandy sediments have been deposited by rivers along their course or by wave action along beaches. The greater the magnitude of an earthquake and longer duration of strong ground shaking will result in an enhanced potential for liquefaction to occur. Settlement can cause damage when the amount settlement varies significantly across the length of a structure. Lateral spreading occurs when liquefaction occurs on gently sloping ground and the liquefied material at depth allows the area to slide, often toward a vertical discontinuity or “free face” such as a creek or stream channel. Liquefaction can occur in susceptible soils below bodies of water, and settlement and lateral spreading can damage structures built on or adjacent to these areas. Transportation bridges across water bodies, wharves, piers and other structures at ports and harbors, and underwater utility lines can be severely damaged by this hidden hazard.
**Subsidence** - Changes in the local environment that cause subsidence or sinkholes are called triggering mechanisms. Water is the primary factor that affects the local environment and causes subsidence. Water level decline, changes in groundwater flow, increased loading, and deterioration (such as abandoned mines) are all triggering mechanisms. Water level decline may occur naturally, or it may be the result of human action. Factors that lead to water decline are pumping (from wells), localized drainage (for construction activities), dewatering, or drought. Changes in groundwater flow can result from an increase in the velocity of groundwater movement, and increase in the frequency of water table fluctuations, and changes in discharge (either increase or decrease). Increased loading can cause pressure in the soil, leading to the failure of underground cavities and space, such as caves. Vibrations from earthquakes, heavy machinery, and blasting may result in structural collapse, followed by surface resettlement.

**Location of the Hazard**

The State of California is particularly vulnerable to earthquake activity due to California’s location residing between two large tectonic plates. Sonoma State University is located in the northern area of the San Francisco Bay region. In general, fault systems surround and traverse throughout the Bay Area and Sonoma County including the area of Sonoma State University. Throughout the populated areas of Sonoma County and surrounding cities, the ground is saturated with sediment eroded from the hills by means of multiple stream channels. Liquefaction zones rated at moderate susceptibility exist on all sides of the campus.

The Pacific Plate and the North American Plate come together at the San Andreas Fault 19 miles west of the Sonoma State University campus. In addition to the San Andreas Fault, Sonoma County is home to or near additional fault systems with the potential to generate strong ground shaking. The campus is additionally in close proximity to two fault systems. The Rodgers Creek Fault traverses south to north along the eastern side of the Santa Rosa Valley less than 3 miles east of the Sonoma State University campus. The Bennett Valley Fault extends south to north 20 miles in length from Sonoma Valley to Santa Rosa 5 miles east of the Sonoma State University campus. The 27-mile long West Napa Fault connects Vallejo to St Helena 16 miles east of the campus. The entire San Francisco Bay Area is saturated with numerous additional faults mostly paralleling the San Andreas Fault to the northwest. These fault systems are located on each side of the campus.
The Sonoma State University campus resides on areas designated to be in liquefaction zones. All campus facilities are potentially located within a moderate liquefaction zone. The liquefaction zones generally appear along the western and eastern edges of Rohnert Park. Liquefaction zones additionally appear throughout much of the County along valley floors.

Extent of the Hazard

The extent or severity of earthquake damage is expressed in terms of magnitude and intensity. The amount of energy released during an earthquake is normally conveyed as a magnitude measured from a seismogram. Magnitude is expressed in numbers and decimals representing the physical size of the earthquake. The strength and effect of the shaking on the surface of the earth is classified as the intensity. Intensity is further defined from the effects the earthquake has on people, structures, and the natural environment. The intensity of an earthquake in terms of measuring magnitude and evaluating its effects is generally expressed using the Modified Mercalli (MM) Intensity Scale. Duration is the length of time the earthquake’s energy is released.
The Richter magnitude scale was developed in 1935 by Charles F. Richter of the California Institute of Technology as a mathematical device to compare the size of earthquakes. The Richter Scale is the best-known scale for measuring the magnitude of earthquakes. The magnitude value is proportional to the logarithm of the amplitude of the strongest wave during an earthquake. A recording of 7, for example, indicates a disturbance with ground motion 10 times as large as a recording of 6. The energy released by an earthquake increases by a factor of 31 for every unit increase in the Richter scale.

Table 25-16: Earthquake Intensity/Frequency Comparisons

<table>
<thead>
<tr>
<th>Magnitude</th>
<th>Mercalli Intensity</th>
<th>Potential Damage</th>
<th>Global Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 2.0</td>
<td>I</td>
<td>None</td>
<td>Continually</td>
</tr>
<tr>
<td>2.0 - 2.9</td>
<td>I to II</td>
<td></td>
<td>&gt; IM per year</td>
</tr>
<tr>
<td>3.0 - 3.9</td>
<td>II to IV</td>
<td></td>
<td>&gt; 100,000 per year</td>
</tr>
<tr>
<td>4.0 - 4.9</td>
<td>IV to VII</td>
<td>Light</td>
<td>10K to 15 K per year</td>
</tr>
<tr>
<td>5.0 - 5.9</td>
<td>VI to VII</td>
<td>Moderate</td>
<td>1K to 1,500 per year</td>
</tr>
<tr>
<td>6.0 - 6.9</td>
<td>VII to X</td>
<td>Heavy</td>
<td>100 to 150 per year</td>
</tr>
<tr>
<td>7.0 - 7.9</td>
<td>VII &lt;</td>
<td>Very Heavy</td>
<td>10 - 20 per year</td>
</tr>
<tr>
<td>8.0 - 8.9</td>
<td>VII &lt;</td>
<td></td>
<td>1 per year</td>
</tr>
<tr>
<td>&gt; 9.0</td>
<td>VII &lt;</td>
<td></td>
<td>1 per 10-50 years</td>
</tr>
</tbody>
</table>

The Modified Mercalli Intensity Scale provides descriptive values of earthquake intensity that may provide greater meaning to the broader population as the description of intensity refers to the effects actually experienced. This scale uses an arbitrary ranking based on observed earthquake effects. The scale is composed of increasing levels of intensity ranging from shaking that is not recognizable to intense shaking resulting in catastrophic damages and casualties. The Modified Mercalli Intensity Scale is demonstrated below:

Table 25-17: Modified Mercalli Intensity Scale

<table>
<thead>
<tr>
<th>Intensity</th>
<th>Shaking</th>
<th>Description / Damage</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Magnitude</th>
<th>Quality</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Not felt</td>
<td>Not felt except by a very few under especially favorable conditions.</td>
</tr>
<tr>
<td>II</td>
<td>Weak</td>
<td>Felt only by a few persons at rest, especially on upper floors of buildings.</td>
</tr>
<tr>
<td>III</td>
<td>Weak</td>
<td>Felt quite noticeably by persons indoors, especially on upper floors of buildings. Many people do not recognize it as an earthquake. Standing motor cars may rock slightly. Vibrations similar to the passing of a truck. Duration estimated.</td>
</tr>
<tr>
<td>IV</td>
<td>Light</td>
<td>Felt indoors by many, outdoors by few during the day. At night, some awakened. Dishes, windows, doors disturbed; walls make cracking sound. Sensation like heavy truck striking building. Standing motor cars rocked noticeably.</td>
</tr>
<tr>
<td>V</td>
<td>Moderate</td>
<td>Felt by nearly everyone; many awakened. Some dishes, windows broken. Unstable objects overturned. Pendulum clocks may stop.</td>
</tr>
<tr>
<td>VI</td>
<td>Strong</td>
<td>Felt by all, many frightened. Some heavy furniture moved; a few instances of fallen plaster. Damage slight.</td>
</tr>
<tr>
<td>VII</td>
<td>Very strong</td>
<td>Damage negligible in buildings of good design and construction; slight to moderate in well-built ordinary structures; considerable damage in poorly built or badly designed structures; some chimneys broken.</td>
</tr>
<tr>
<td>VIII</td>
<td>Severe</td>
<td>Damage slight in specially designed structures; considerable damage in ordinary substantial buildings with partial collapse. Damage great in poorly built structures. Fall of chimneys, factory stacks, columns, monuments, walls. Heavy furniture overturned.</td>
</tr>
<tr>
<td>IX</td>
<td>Violent</td>
<td>Damage considerable in specially designed structures; well-designed frame structures thrown out of plumb. Damage great in...</td>
</tr>
</tbody>
</table>
substantial buildings, with partial collapse. Buildings shifted off foundations.

Extreme

Some well-built wooden structures destroyed; most masonry and frame structures destroyed with foundations. Rails bent.

The graph below illustrates the increasing intensity of energy that is released and as the measured magnitude increases. While each whole number increases in magnitude represents a tenfold increase in the measured amplitude, it represents an increasing rate of 32 times more energy released in the same increase in magnitude. As the magnitude of an earthquake is measured higher, the intensity of the earthquake worsens progressively from one category to the next.
Based on the earthquake shaking potential in the Sonoma County area, the campus residing within a liquefaction zone, its proximity to eight fault systems and the extensive history of occurrence and severe impacts in the area, the extent of the earthquake risk is considered **Moderate to High**.

### History of the Hazard

The State of California has a long history of chronic and destructive earthquakes throughout the state. On average, earthquakes strong enough to result in structural damages occur three to four times a year in California, while earthquakes Magnitude 6.0 to 6.9 occur once every two to three years. Likewise, Sonoma County also has a long history of earthquake activity. The entire area of Sonoma County is at risk to seismic activity and has a history of significant earthquakes resulting in damages.

Table 25-18: Historic Earthquakes Near Rohnert Park, CA

<table>
<thead>
<tr>
<th>Date</th>
<th>Location</th>
<th>Magnitude</th>
<th>Damages</th>
</tr>
</thead>
<tbody>
<tr>
<td>10/21/1868</td>
<td>Hayward</td>
<td>6.8</td>
<td>Extensive destruction; 20-mile rupture</td>
</tr>
</tbody>
</table>

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45 Sonoma County Local Hazard Mitigation Plan Update, April 2017
<table>
<thead>
<tr>
<th>Date</th>
<th>Location</th>
<th>Magnitude</th>
<th>Impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>4/18/1906</td>
<td>San Francisco</td>
<td>7.9</td>
<td>Extensive destruction; 3000 fatalities</td>
</tr>
<tr>
<td>10/1/1969</td>
<td>Santa Rosa</td>
<td>5.7</td>
<td>Moderate, $8 million</td>
</tr>
<tr>
<td>4/24/1984</td>
<td>Morgan Hill</td>
<td>6.2</td>
<td>$8 million</td>
</tr>
<tr>
<td>10/17/1989</td>
<td>Loma Prieta</td>
<td>6.9</td>
<td>$5.9 billion, 63 fatalities</td>
</tr>
<tr>
<td>9/3/2000</td>
<td>Yountville</td>
<td>5.0</td>
<td>Minor</td>
</tr>
<tr>
<td>10/30/2007</td>
<td>Alum Rock</td>
<td>5.6</td>
<td>Minor</td>
</tr>
<tr>
<td>8/24/2014</td>
<td>American Canyon</td>
<td>6.0</td>
<td>$400 million</td>
</tr>
</tbody>
</table>

The April 18, 1906 San Francisco Earthquake became one of the most well-known earthquakes in California history. The earthquake caused extensive damage to buildings, bridges, water systems, and critical facilities. Damage was experienced well beyond San Francisco including areas such as Monterey and Santa Cruz. 3,000 people were killed and thousands more injured. The San Francisco Earthquake was found to shift the course of northern California rivers. The shaking was felt from Oregon to Los Angeles.

The October 17, 1989 Loma Prieta Earthquake shook a large part of northern California, especially the San Francisco Bay Area. The earthquake caused $5.9 billion in damages, most extensively in San Francisco, the East Bay, and South Bay areas. The earthquake resulted in extensive infrastructure damages, 12,000 displaced, 3,757 injuries, and 63 fatalities. The earthquake was provided a federal disaster declaration (DR-845).

**Potential Impacts of the Hazard**

The shaking of the ground from earthquakes can result in building collapse, bridge failure, utility disruptions and other structural collapse. Large earthquakes can additionally cause natural gas lines to break resulting in structure fires. The proximity to the unstable soils on the campus and surrounding the campus presents a potential for liquefaction creating greater ground instability during seismic events. A major earthquake in Sonoma County area would likely result in region-wide social disruptions in addition to structural damages. The region-wide structural damages may disrupt lifelines and supply chain routes limiting the campus from effective evacuation routes and receiving necessary supplies or equipment.

Most injuries resulting from earthquakes are from collapsing walls, flying glass, or other objects moved by ground shaking. The lack of warning allows individuals minimal time to react and find areas of safety. A moderate earthquake occurring near Rohnert Park and Santa Rosa could cause injuries or fatalities to members of the campus community or support networks the campus relies on. These earthquake effects might be aggravated by collateral incidents such as fire, flooding, hazardous material spills, dam/levee compromises, and other cascading events. A catastrophic earthquake near Sonoma County could result in extensive casualties, expansive
structure damages, panic, widespread utility outages, communication failures, and secondary emergencies such as fire. A catastrophic earthquake would certainly affect the broader northern San Francisco Bay region limiting immediate assistance that the campus may normally expect.

Local impacts to the Sonoma State University campus caused by an earthquake could include:

- Potential hazardous material releases on and off campus
- Infrastructure damage to freeway and roadway system
- Compromised transportation routes for access, supplies, services, and evacuation
- Structural damage to bridges
- Damage to flood control and drainage system
- Environmental damage to waterways and streams
- Structural damage to levees
- Potential isolation of campus from community
- Potential isolation among on-campus residents
- Damage to on-campus utility infrastructure
- Damage to campus reclaimed water system and capability to support fire suppression system
- Release of airborne asbestos from damaged older buildings
- Structural damage to campus academic and support buildings
- Structural damage to residence halls resulting in displaced student populations
- Structural damage to nearby apartment complexes and residences
- Community members arriving on campus for refuge from damaged homes
- Damaged university communications, computer systems, and networks
- Considerable stress and fear among community
- Closure or reduction of service to campus operations
- Reduction of campus revenue

Probability of Future Occurrence of the Hazard

The Working Group on California Earthquake Probabilities (WGCEP), a collaboration between the United States Geological Survey (USGS), the Southern California Earthquake Center (SCEC), and the California Geological Survey (CGS) develops Uniform California Earthquake Forecasts (UCERFs) using the best currently available science and technology. The UCERF version 3 provides a three-dimensional view of the likelihood a region in California will experience a Magnitude 6.7 or greater earthquake in the next 30 years. The likelihood for the Sonoma County fault systems surrounding the North Bay region is included in the following table.

Table 25-19: Major Potentially Active Faults in Proximity to Sonoma State University

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46 Sonoma County Hazard Mitigation Plan Update, April 2017
The Sonoma County Hazard Mitigation Plan Update describes the probability of an earthquake Magnitude of 6.7 or greater in the San Francisco Bay Area over the next 30 years is 72%. The Plan further demonstrates that these estimations are being updated continuously to address updated analyses. There is a 76% probability of one or more magnitude 7.0 earthquakes striking Northern California within 30 years beginning in 2014.48

Based on the earthquake shaking potential in the Sonoma County area, the proximity to the fault systems illustrated above, the probability of seismic ground shaking that would generate damage is considered **Possible**.

**Vulnerability to the Hazard**

A considerable challenge regarding earthquakes is they generally occur without warning. The fault systems surrounding the region all cross major transportation routes potentially reducing the availability of access and the supply chain. The geographic location of Sonoma State University places the campus in a suburban community near residential, commercial, and industrial areas that is moderately populated. Earthquake effects experienced in the neighboring local community will likely spill over onto the campus.

The known fault systems generating the threat to the San Francisco Bay region generally surround the area and some cross near the Sonoma State University

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48 California Earthquake Authority, California Earthquake Risk Map & Faults By County, [https://www.earthquakeauthority.com/California-Earthquake-Risk/Faults-By-County](https://www.earthquakeauthority.com/California-Earthquake-Risk/Faults-By-County)
campus. The campus resides in a region that is exposed to fault systems on all sides. The proximity and potential for large earthquake development from these surrounding systems expose significant vulnerabilities. The potential for earthquake damaged structures being left uninhabitable including campus residence halls will result in numerous displaced individuals and households. The lack of earthquake insurance will cause extreme financial burdens on those affected.

Elements of the vulnerability to a major earthquake on the Sonoma State University campus will vary depending on when the earthquake were to strike. The risk to the campus population will be lessened during periods when classes are not in session or during periods of breaks. Conversely, during the days and hours that classes are in session and staff are at their workplaces, the human vulnerability increases. Generally, people are safer when at home in wood frame structures as earthquakes tend to generate less structural damage to wood construction than in commercial or industrial facilities. The greater number of people on campus at the time of an earthquake will result in more people being exposed to effects from damaged campus facilities or equipment and require greater evacuation assistance. However, in region-wide events this vulnerability may simply shift to the homes and workplaces of members of the campus community and their families.

The aftermath of a major earthquake will likely result in widespread search and rescue operations for trapped and injured individuals. The demand on emergency services will be great, potentially requiring the campus community to be prepared for these scenarios and initiate response actions as needed. There will be needs for emergency medical care, shelter, water, and food for individuals who have been displaced by the earthquake. In earthquakes causing significant damages, there may be a necessity to provide assistance with identification and support to local agencies in mass fatality management.

There may be a need to evacuate members of the campus community from the campus and to other locations that are deemed to be safer locations. This may be heightened in the southwestern portions of the campus as this area has been identified as being within a liquefaction zone. As the Sonoma State University campus is downstream from dam facilities, the decision to evacuate will need to take into account whether flood control facilities are filled with water and the actual threat to the dam or levees.

The San Francisco Bay Area and Rohnert Park in particular are moderately populated and attract commuter employees to the commercial cores. The road and freeway network becomes easily congested in normal situations. Sonoma County relies on US Highway 101 as a primary overland transportation route with minimal state highway alternatives. A major earthquake has the potential for rendering these critical lifelines and supply routes inoperable and forcing the campus community to be self-reliant for a period of time.

Certain campus populations will experience greater challenges to a post-earthquake environment. Vulnerable populations including those that rely on specific services,
require electrical power, homeless students, experience disabilities, non-English speakers, those whose age make evacuating difficult, and others will be most affected. These individuals will likely need to navigate through earthquake generated debris, extreme stresses of a disaster, an inability to communicate to or gain access to support networks, and find difficulty in accessing equipment or supplies to aid in a specific need.

**Estimate of Potential Losses**

Estimates of potential losses will be influenced by a variety of factors. The intensity of the earthquake will determine what scale of damages affecting campus infrastructure, equipment, and other impacted features. Losses will be generated by the physical damages, the loss of revenue, loss of academic research, loss of building contents, and community wide economic reductions.

Based on estimate replacement costs of facilities and structures on campus, the maximum total replacement costs due to earthquake are $289,079,090.

Table 25-21: HAZUS Peak Ground Acceleration Zone (PGA) Estimated Losses

<table>
<thead>
<tr>
<th>PGA Zone Designation</th>
<th>Intensity</th>
<th>No of Buildings</th>
<th>Maximum Replacement Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Extreme</td>
<td>X+</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Violent</td>
<td>IX</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Severe</td>
<td>VIII</td>
<td>37</td>
<td>$289,079,090</td>
</tr>
<tr>
<td>Very Strong</td>
<td>VII</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Strong</td>
<td>VI</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Moderate</td>
<td>V</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Light</td>
<td>IV</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Weak</td>
<td>II-III</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Not Felt</td>
<td>I</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>NA</td>
<td>NA</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>No Building Value</td>
<td>NA</td>
<td>8</td>
<td>Unknown</td>
</tr>
</tbody>
</table>

*Buildings with no value defined are also included in the respective Zones they are found in.

The table above includes 1 facility located at the Petaluma based Sonoma State University Housing. The provided cost estimates for the university housing in Petaluma are unknown.

**Vulnerability Assessment Conclusions**

It is difficult to predict the severity of casualties, property, and cascading impacts generated by future seismic events affecting the greater San Francisco Bay region, the North Bay, and the Sonoma State University campus. Each of the earthquake generated effects will vary widely based on the intensity of the earthquake, location of the epicenter, proximity to people and development, time of day and year, the soil composition under the impacted structures, building construction, among others. In
any case, the potential for a major earthquake exists affecting the campus and causing extensive challenges to the Sonoma State University campus and community.

In the event that a major earthquake was to strike along the many fault systems surrounding Rohnert Park and Santa Rosa, the effects could be significant to the campus community and campus operations. The widespread impacts generated by a major earthquake would extend the effects of casualties, damages, and other impacts to the broader San Francisco Bay region creating large-scale regionwide needs for critical assistance and a heavy demand on limited emergency resources. The threat and impacts presented to the campus will be shared with the campus community from their homes and places of work. The campus will likely be required to address critical needs independently during early phases of the disaster.

The campus population is additionally vulnerable to the effects of major ground shaking that are far reaching. The psychological and social impacts a major earthquake will give rise to will potentially harm individuals and cause tremendous fear. The willingness to return indoors may be hampered especially as after-shocks continue. These effects are magnified for populations having specific vulnerabilities or access limitations. Populations having various limitations or specific needs may be vulnerable to reduced or eliminated access to essential services that have been rendered incapable to respond.

Identified Data Limitations

Data limitations include missing campus structural replacement costs, and lack of a complete inventory of building construction types to include status of earthquake retrofitting. HAZUS generated analysis is focused on the broader community level versus fine-tuning the analysis to the micro-level for facilities such as a university campus.
Erosion

Description of the Hazard
The US Geological Survey (USGS) defines erosion as “the process whereby materials of the earth’s crust are loosened, dissolved, or worn away and simultaneously moved from one place to another”. 49 Erosion may occur in areas of streams and rivers, along bluffs, around immovable objects (such as buildings or bridge abutments), or as a cascading result of other natural hazards, such as earthquakes or wildfires. When erosion occurs along bodies of water, the removal of material causes the shore to move further landward.

Forces such as sea level rise and changes in sediment supply impact erosion gradually and can be difficult to recognize. In contrast, the impacts of short-term events, such as storms and flooding, can be severe and are immediately recognizable.

Location of the Hazard
Erosion is a relatively non-spatial hazard that can occur in any location with conducive soil structure and a source of movement such as water or wind. As such, for the purpose of this campus-level analysis, the erosion hazard poses a consistent risk across the terrain of the Sonoma State University (SSU) campus with erosion-prone characteristics. That said, no specific sites on campus have been identified as at risk. An area’s potential for erosion is determined by several factors, including rainfall, topography, soil characteristics, and vegetative cover. Streambank and bluff erosion can occur near any riverine area.

Extent of the Hazard
There is no published scale of severity or extent for this geologic hazard. If conditions are favorable, erosion is likely to occur. Given no historical occurrence of erosion on campus nor any data identifying specific sites on campus at risk, the planning committee ranks the extent of this hazard as Low.

History of the Hazard
Copeland Creek has been monitored for erosion since 2011, and SSU has conducted and maintained several erosion mitigation projects along the length of the creek. However, no erosion has been identified on campus.

Potential Impacts of the Hazard
Erosion causes instability in soil. During high-intensity rain events, for example, eroded areas will continue to erode, resulting in additional loss of soil and ground stability in the area. This removal of sediment can result in damage to infrastructure, public health, and safety. On campus, areas of erosion can create pedestrian and transportation hazards, and structures may become unsafe if erosion is not controlled.

Erosion of soil also results in the loss of fertile land, increased pollution and sedimentation in water ways, and can worsen flooding. At Sonoma State’s Fairfield Osborn Center, soil erosion can create concerns for research and natural resource management.

**Probability of Future Occurrence of the Hazard**

Erosion is an on-going and dynamic process that occurs regularly. As climate change induces more frequent and intense weather events, such as wildfires and flooding, erosion may generally become more widespread or severe. These events can cause erosion or exacerbate areas already experiencing erosion. As a result, and in consideration of the potential extent of erosion, the probability of future occurrence is high. That said, with regard to the SSU campus, given the lack of historical events or existing conditions favorable to erosion, the probability of future occurrence is Low. However, conditions could emerge in the future which increase the probability, precipitated by climate change, changes in land-use or other factors.

**Vulnerability to the Hazard**

Topography, soil structure, land use, and precipitation are all factors of erosion. Sonoma State’s infrastructure and buildings located on steep slopes, in areas with little vegetation, or in areas with conducive soil types are more vulnerable to erosion. CSU leadership should consider performing an analysis to identify such at-risk buildings, infrastructure, slopes and soil types in the future.

In the wider Sonoma community, erosion vulnerabilities include agricultural sector job loss, degradation of riverine ecosystems, and loss of water quality.

**Estimate of Potential Losses**

The historic and potential impacts of erosion on property statewide include reduced agricultural productivity, lower surface water quality, and damaged drainage networks.

Current modeling is not precise enough to allow for an assessment of potential losses to buildings and infrastructure on campus.

**Vulnerability Assessment Conclusion**

While the ability to predict future erosion on the SSU campus is limited, the core issues shaping erosion vulnerability on campus are flora and landscaping. If left unchecked, erosion can cause significant damage to campus infrastructure and the surrounding environment.

**Identified Data Limitations**

The complex interactions between soil erosion factors make predictive modeling, determination of hazard areas, and quantification of loss difficult. Localized data on this hazard is also limited, resulting in more generalized findings.
Extreme Temperatures (Includes Extreme Cold and Extreme Heat)

Heat

Description of the Hazard

What is considered an excessively hot temperature varies according to the normal climate for that region. However, when temperatures are extremely high, people are at higher risk for heat-related illnesses, such as dehydration, heat exhaustion, heat stroke, and in severe cases, death.50

Hazards from extreme heat are made worse when high temperatures are accompanied by high levels of humidity, which is defined as the amount of moisture in the air.51 As the temperature climbs, the air is able to hold more moisture. High humidity prevents the human body from cooling down naturally, which leads people to perceive that the temperature “feels” hotter. The combination of temperature and humidity is known as the heat index.52

Heat stroke, the most serious heat-related illness, occurs when the body is unable to control its temperature. Body temperature rises rapidly, the sweating mechanism fails, and the body cannot cool down.53 In extreme causes, heat stroke can cause confusion and unconsciousness, so the victim is unable to seek treatment without assistance.

There are several groups of people who are uniquely vulnerable to the effects of extreme heat, such as infants and children, older adults aged 65 and up, athletes and outdoor workers, low-income households, and individuals with certain chronic medical conditions.54

Location of the Hazard

Extreme heat events are a non-spatial hazard and may occur throughout the Sonoma State campus.

Extent of the Hazard

Extreme heat has a wide range of extent and severity markers and characteristics. Monthly average maximum temperatures in June through October range approximately from the high 70s to the low 80s in the City of Rohnert Park. According to data from the National Climatic Data Center (NCDC), the highest daily temperature recorded in Sonoma County was 112° F on June 14, 2000. This temperature was

52 Ibid.
reached during a historic heat wave that affected much of the state of California, causing record-high temperatures.

The National Weather Service issues a Heat Advisory when the heat index value is expected to reach 100° – 104° F within the next 12 to 24 hours. Excessive Heat Warnings are issued when there is an anticipated heat index of 105° F or greater that will last for two (2) or more hours. Excessive Heat Warnings are issued by the county when any location in the county is expected to reach that criteria.\textsuperscript{55} In anticipation of an Excessive Heat Warning, an Excessive Heat Watch may be issued 1 to 2 days in advance, when the Heat Warning criteria is 50 – 79% likely to occur.

Figure 25-9 (following) depicts the National Weather Service’s methodology for determining the heat index, using the % humidity and the actual temperature.

Figure 25-9: Methodology for Determining Heat Index

As the heat index rises, so does the potential danger to people and animals. Table xx (following) shows the health hazards associated with extreme heat.

\textsuperscript{55} National Weather Service. Heat. Retrieved 01.29.21 from: https://www.weather.gov/bgm/heat
Table 25-20: Health Risks Associated with Heat Index

<table>
<thead>
<tr>
<th>Category</th>
<th>Heat Index</th>
<th>Health Hazards</th>
</tr>
</thead>
<tbody>
<tr>
<td>Extreme Danger</td>
<td>130° F or higher</td>
<td>Heat stroke / sunstroke is likely with continued exposure.</td>
</tr>
<tr>
<td>Danger</td>
<td>105° – 129° F</td>
<td>Sunstroke, heat cramps, and/or heat exhaustion is likely with prolonged exposure and/or physical activity.</td>
</tr>
<tr>
<td>Extreme Caution</td>
<td>90° – 104° F</td>
<td>Sunstroke, heat cramps, and/or heat exhaustion is possible with prolonged exposure and/or physical activity.</td>
</tr>
<tr>
<td>Caution</td>
<td>80° – 89° F</td>
<td>Fatigue is possible with prolonged exposure and/or physical activity.</td>
</tr>
</tbody>
</table>

History of the Hazard

Data gathered from the National Centers for Environmental Information (NCEI) Storm Events Database show that there have only been four heat events that have affected Sonoma County since 1950, and that there have been no excessive heat events.

Potential Impacts of the Hazard

During an excessive heat event, Sonoma State may experience impacts from extreme heat due to cancelled classes or postponed outdoor events in order to protect students, faculty, and staff from the weather.

In addition to the threat extreme heat poses to humans, high temperatures also pose a threat to utility production, which in turn threaten facilities and operations that rely on utilities. As temperatures rise, more people stay indoors, increasing the demand for air conditioning, fans, and other electronics. This puts a strain on the electrical grid, which can cause temporary outages. These outages can impact operations throughout campus, resulting in interruptions and delays in service. Outages may also negatively impact research efforts on campus, as the inability to maintain a steady, constant temperature may impact research specimens and experimental results.

Probability of Future Occurrence of the Hazard

As the City of Rohnert Park (where the main Sonoma State campus is located) has had no excessive heat events in the past 70 years, it is unlikely that the hazard will occur

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annually. The City of Rohnert Park, excluded excessive heat as a profiled hazard in its 2018 Local Hazard Mitigation Plan, but concluded that it might be a risk in the future.57

Vulnerability to the Hazard

When dealing with an extreme heat event, the most common impacts are those generally felt by the people living in the targeted area. For people in particular, heat can kill when the body is pushed beyond its limits. Most heat disorders occur because the victim has been overexposed to heat. As discussed, the major human risks associated with extreme heat include dehydration, sunburn, fatigue, heat exhaustion, heat stroke, and in severe cases, death.

Some portions of the population are more at risk to the effects of extreme heat. The very young, the elderly, and certain groups with chronic medical conditions (such as asthma or other pulmonary illnesses, heart disease, poor blood circulation, neurological illnesses, and obesity) are generally more vulnerable to the effects of extreme heat, and are more likely to suffer illness or death as a result.58 This is especially true if exposure is extended for a period of time and preventative measures are not taken immediately. All that said, due to the infrequency of extreme heat and the mild average daily temperatures from June to October ranging from the 70’s to the 80’s, the campus’ vulnerability to this hazard is minimal.

Similar to the City of Rohnert Park, Sonoma State excludes the hazard of extreme heat in its Emergency Plan, instead choosing to address other forms of extreme weather such as floods, high winds, and severe winter storms.

Estimate of Potential Losses

Based on the previous historical occurrences, annualized losses are considered to be negligible. In an extreme heat event, loss of human life or health impacts are a greater concern than is property damage.

Vulnerability Assessment Conclusions

It is difficult to predict the likelihood of future heat events at the Sonoma State campus, however, the effects of climate change may provide some information. According to the Environmental Protection Agency (EPA), Northern California has warmed about 1 – 1.5 degrees on average over the last century, with less rainfall. This may lead to stronger and more frequent heat events, drought, and an increased risk of wildfires.59

Cold

Description of the Hazard

What is considered an excessively cold temperature varies according to the normal climate for that region. However, when temperatures are far below normal, with higher wind speeds, heat leaves the human body more rapidly, which increases the possibility of negative effects from these extreme temperatures.60

The greatest danger from extreme cold is to people, as prolonged exposure can cause frostbite or hypothermia, and can become life threatening. When someone is suffering from hypothermia, body temperatures can become so low that they affect the brain, making it difficult for the victim to think clearly or move well. In the case of frostbite, the frozen tissue becomes numb and the victim may be unaware that anything is wrong until someone else notices.61 This makes hazards from extreme cold particularly dangerous, as people may not understand what is happening to them or what to do about it.

The primary hazards from extreme cold are frostbite and hypothermia. Frostbite is caused by freezing of the skin and underlying tissue. It causes a loss of feeling and color in the affected areas of the body, and most often affects the nose, chin, fingers, or toes.62 It can be permanently damaging if not treated promptly and can lead to infection, nerve damage, or amputation in severe cases.63 The risk of frostbite is increased in people with preexisting conditions, the elderly, people with reduced blood circulation, and people who are not dressed warmly enough for the conditions.

Hypothermia occurs when the body loses heat faster than it can produce heat, causing a dangerously low body temperature. A normal body temperature is around 98.6° F. Hypothermia occurs when your body temperature falls below 95° F.64 As this happens, the heart and other essential organs cannot work properly. If hypothermia is not treated, it can lead to heart failure, respiratory failure, and eventually to death.

Excessive or extreme cold can accompany severe winter weather, or it can occur without severe weather. For this reason, extreme cold is a separate hazard from severe winter storms.

63 Ibid.
Location of the Hazard

Extreme cold events are a non-spatial hazard, and may occur throughout the Sonoma State campus.

Extent of the Hazard

Extreme cold has a wide range of extent and severity markers and characteristics. Average nighttime winter temperatures in the City of Rohnert Park typically range from the high 30s to low 40s. According to data from the National Climatic Data Center (NCDC), the lowest daily temperature recorded in Sonoma County was 13° F on December 22, 1990.

The National Weather Service issues Extreme Cold Warnings when the temperature feels like it is -30° F or colder across a wide area for a period of at least several hours. When possible, these advisories are issued a day or two in advance of the conditions.65

The most common extent/severity marker for extreme cold is the Wind Chill scale. Figure 25-10 (following) depicts the National Weather Service’s methodology for determining the wind chill, using wind speed and actual temperature. Although wind chill is not necessarily related to extreme cold as a single cause, the advisory system that the NWS currently uses relies on wind chill to relay warning and advisory information to the public. Extreme cold severity is a function of wind chill and other factors, such as precipitation amount (rain, sleet, ice, and/or snow). Given the historical and potential occurrence of freezing temperatures, but a low probability of extreme cold, the planning committee ranks the extent of the hazard as Low to Moderate.

In 2011, the National Weather Service introduced an experimental program that issued warnings for extreme cold events, independent of other severe weather warnings. The test areas included North and South Dakota and Minnesota. However, in 2012, after a single season of use, the program was abandoned, based on reports of confusion among test audiences.66

History of the Hazard

Based on data gathered from the National Centers for Environmental Information (NCEI) Storm Events Database, Sonoma County has had six frost/freeze events, as well as two extreme cold/wind events on January 16, 2013 and April 8, 2017. [Records for this hazard were first recorded in 1996].

Potential Impacts of the Hazard

Should an extreme cold event occur, Sonoma State might experience impacts due to cancelled classes.

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In addition to the threat posed to humans, extreme cold weather poses a significant threat to utility production, which in turn threatens facilities and operations that rely on utilities, specifically climate stabilization. As temperatures drop and stay low, increased demand for heating places a strain on the electrical grid, which can lead to temporary outages. These outages can impact operations throughout the campus, which can result in interruptions and delays in services. These outages may also negatively impact research efforts throughout the campus, as the inability to maintain a steady, constant temperature may result in unintended effects on research specimens.

Probability of Future Occurrence of the Hazard

Sonoma County has experienced 6 freeze/frost events as well as 2 extreme cold/wind events since 1996, or approximately one event every three years. It is therefore possible that this hazard may occur annually.

Vulnerability to the Hazard

When dealing with an extreme cold event, the most common impacts are those generally felt by the people living in the targeted area. For people in particular, extreme cold can kill when the body is pushed beyond its limits. Most danger due to the cold is because the victim has been overexposed to low temperatures. As discussed, the major human risks associated with extreme cold include frostbite, hypothermia, and in severe cases, death.

Some portions of the population are more at risk to the effects of extreme cold. The elderly, those with certain preexisting conditions (hypothyroidism, diabetes, and high blood pressure, just to name a few), those with poor blood circulation, and people who are not dressed warmly enough for the cold are generally more vulnerable and are more likely to suffer illness or death as a result. Sonoma State addresses the potential for frost/freeze and high wind events in its campus Emergency Plan. The most likely cause of cold weather for the campus would be a severe winter storm with high winds and rain, which can cause flooding, extended power outages, and road closures. The campus regularly monitors weather conditions in order to prepare before a storm hits. If conditions are dangerous, the campus will close and cancel classes.

Power outages are also a concern for the university. The university is on the main power grid and power is supplied by Pacific Gas & Electric (PG&E). A number of facilities are equipped with back-up generators that can allow for partial function.

68 Sonoma State University Emergency Plan. 11.7 Severe Weather and Environmental Flood. Retrieved 03.24.21 from http://emergency.sonoma.edu/planning-operations/emergency-plan#weather
during outages, but long-lasting outages may threaten the safety of well water for drinking as well as the use of telecommunication systems.\textsuperscript{69}

Although this may be a hazard that Sonoma State faces, the campus has plans in place to handle the risks and vulnerabilities.

**Estimate of Potential Losses**

Based on the previous historical occurrences of extreme heat events, annualized losses are considered to be negligible. In an extreme heat event, loss of human life or health impacts are a greater concern than is property damage.

**Vulnerability Assessment Conclusions**

While the ability to predict future extreme cold events at the Sonoma State campus is limited, the effects of climate change may provide some information. According to the Environmental Protection Agency (EPA), areas in Northern California have warmed approximately 1 – 1.5 degrees on average over the last century, with less rainfall. This may lead to fewer frost/freeze events in the future.\textsuperscript{70}

**Identified Data Limitations**

Numerous public and private actors conduct research, acquire data and disseminate meteorological information and forecasting to the general public, including the CSU university system. Currently, it is assumed that, apart from regular access to climate change models on changes to temperature extremes over time, the CSU community maintains sufficient access to the data needed to plan for, respond to, and mitigate the effects of extreme heat and cold.

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**Flood**

**Description of the Hazard**

The incredible geographic diversity in California presents tremendous challenges for flood planning and response. The state is home to extensive mountain ranges such as the Sierra Nevada, Cascades, Klamath, Coastal Ranges, and the Southern California Transverse Range all creating tremendous watersheds. Large river systems drain the mountains traveling through populated communities including the Sacramento and San Joaquin Rivers draining into the California Delta. The state has a complex system of reservoirs, dams, and levees providing water storage and flood protection. Finally, California’s 840-mile coastline exposes the coastal regions to tidal influences.


Floods are characterized by the rising and overflowing of excess water from a water source such as a stream, river, lake, canal, or coastal body onto an area of normally dry floodplain. A floodplain is a lowland area downstream and adjacent to water bodies that are subject to flood events. Flooding is a naturally occurring event that become hazardous when populations and property are affected.

Flooding can result from excessive precipitation from weather systems generating prolonged rainfall, excessive snowmelt from watersheds upstream from the floodplain, infrastructure failure, exceeding the capacity of dams or levees, tidal influences, or a combination from any of the previous factors.

Flooding represents one of the costliest and most frequent natural disasters that influences human suffering and economic impact in the United States. Flooding will likely result in significant damage to structures, infrastructure, utilities, landscapes, and the environment. Erosion of stream banks, roadways, other feature may result from the movement of flood waters. The saturated ground resulting from standing flood waters may cause ground instability, collapse, erosion, or other damages. Further, floods will often generate substantial debris that will accumulate and be deposited throughout the flooded areas.

Flooding can be either slow-rise or rapid onset floods. With slow rise floods, there is often warning preceding water rise by hours or days before dangerous conditions present themselves. Slow rise floods that are expected to enter into populated areas generally allow for some time to initiate evacuation and sand bagging efforts. Flooding that occurs rapidly conversely are water events that present with extremely limited warning times and a limited ability to take response actions until flooding has already begun to occur.

Flooding may take on different forms:

- **Flash Flooding** – Flash flooding is typically characterized by a rapid rise, short duration, and large volume of water in a localized area. Heavy rainfall in areas that have limited drainage capacities often contribute to flash flooding conditions. These flooding events frequently occur with limited notice requiring immediate evacuation or rapid response efforts such as sand bagging. Flash flooding may arrive with fast moving water creating added hazardous conditions.

- **Riverine Flooding** – Riverine flooding is usually caused by prolonged rainfall or rainfall combined with heavy snowmelt. When soils are already saturated, the ability for the ground to absorb water is minimized. In a riverine flood, the water way exceeds channel capacity and extends into areas outside of the channel, often in developed communities. In California, riverine flooding is most likely to occur from November through April. The duration of riverine floods may vary from a period of hours to weeks.

- **Localized Flooding** – Localized flooding is commonly the result of stormwater drainage systems being overwhelmed by unusually heavy rainfall. These flooding events frequently occur in areas that are urbanized or developed with greater
amounts of impervious surfaces not allowing ground absorption. This generates added runoff into the drainage systems and onto roadways creating backups.

- **Infrastructure Failure** – Failures of dams or levees presents a serious flooding concern for areas downstream from the compromised structure. This situation may result in a catastrophic flood with limited warning time and widespread areas affected.

- **Coastal Flooding** – Coastal flooding can occur in multiple areas along the California coastline. Flooding may result from intense storms coming from the Pacific Ocean that generate elevated water levels or storm surge. The size, duration, winds generated, and intensity of the storm will influence the effect the waves will have on the shoreline. Periods of high tide can aggravate the conditions allowing greater wave impingement into coastal areas.

**Atmospheric Rivers**

California, including the location of this campus, is subject to the effects of a phenomenon referred to as atmospheric rivers. These weather events consist of long, narrow regions in the atmosphere transporting tremendous amounts of water vapor from the tropics. These weather regions behave like rivers in the sky. They can carry heavy volumes of water vapor compared to the amount of water flow at the mouth of the Mississippi River. As these atmospheric rivers arrive into California they tend to generate significant rain and snow.

Atmospheric rivers can arrive in many different shapes and sizes. The larger events are able to generate extreme rainfall amounts resulting in flooding. They can stall over watersheds vulnerable to flooding, often saturated with heavy snow amounts. The atmospheric rivers known as a “Pineapple Express” coming from the tropics and arriving with warmer air may produce heavy rains that will melt ground snow adding to the water volume that will be added in the flood runoff.

These events can produce heavy amounts of precipitation creating extensive damages. However, these events may present as weaker systems that produce precipitation that is enough to be beneficial for the local water supply. At the higher elevations in the California mountains, these events have the potential to generate a tremendous snowpack providing a source of water during the dry summer months.
Location of the Hazard

Rohnert Park is located in Sonoma County on the north side of the San Francisco Bay area. Sonoma County can experience flooding from overflowing rivers and streams in addition to heavy precipitation events in low lying areas. These areas often experience shallow flooding impacting roadways and other areas where drainage is inadequate. The central portions of Sonoma County are within the Santa Rosa Plain where a series of creeks and rivers traverse in route to the Pacific Ocean. The communities in central Sonoma County are populated with extensive residential neighborhoods surrounded by open or agricultural fields. The campus is adjacent to both residential neighborhoods and agricultural fields.

71 National Oceanic and Atmospheric Administration, “What are atmospheric rivers?”, https://www.noaa.gov/stories/what-are-atmospheric-rivers
The Sonoma State University campus is located on the valley floor of the Santa Rosa Plain allowing for the flooding potential in low-lying areas. The campus has Copeland Creek traverse through the northern portions of the campus. There are a series of low rising hills 3 miles to the east of the campus providing drainage for precipitation events. The entire Sonoma State University campus sits within a Special Flood Hazard Area (SFHA) Zone X: Area of Minimal Flood Risk designation on the Flood Insurance Rate Map. The exception is the area that Copeland Creek traverses through the campus which is designated as Zone AE: 1% Annual Chance Flood Hazard.

Extent of the Hazard

The Sonoma State University campus is entirely located in a designated Zone X: Area of Minimal Flood Hazard. The access routes into and out of the campus servicing locations in all directions are also found in areas primarily designated as Zone X: Area of Minimal Flood Hazard. The campus has no history of flood events, though minor isolated ponding on campus has occurred during heavy rainfall events. Given that the area surrounding the Sonoma State University campus does not generally promote
conditions for flood waters to accumulate, the planning committee ranks the extent of the hazard on campus as **Low**. In support of the NFIP, FEMA identifies those areas that are more vulnerable to flooding by producing Flood Hazard Boundary Maps (FHBM), Flood Insurance Rate Maps (FIRM), and Flood Boundary and Floodway Maps (FBFM). Several areas of flood hazards are commonly identified on these maps, including the 1% annual chance flood zone. Flood zones are further delineated by risk and are assigned a letter signifier. The flood zone designations are defined and described in the following table.

Table 25-21: Flood Zone Designations and Descriptions

<table>
<thead>
<tr>
<th>Zone Designation</th>
<th>Percent Annual Chance of Flood</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Zone V</td>
<td>1%</td>
<td>Areas along coasts subject to inundation by the 1% annual chance of flooding with additional hazards associated with storm-induced waves. Because hydraulic analyses have not been performed, no BFEs or flood depths are shown.</td>
</tr>
<tr>
<td>Zones VE and V1-30</td>
<td>1%</td>
<td>Areas along coasts subject to inundation by the 1% annual chance of flooding with additional hazards associated with storm-induced waves. BFEs derived from detailed hydraulic analyses are shown within these zones. (Zone VE is used on new and revised maps in place on Zones V1-30.)</td>
</tr>
<tr>
<td>Zone A</td>
<td>1%</td>
<td>Areas with a 1% annual chance of flooding and a 26% chance of flooding over the life of a 30-year mortgage. Because detailed analyses are not performed for such areas, no depths or base flood elevations are shown within these areas.</td>
</tr>
<tr>
<td>Zone AE</td>
<td>1%</td>
<td>Areas with a 1% annual chance of flooding and a 26% chance of flooding over the life of a 30-year mortgage. In most instances, base flood elevations derived from detailed analyses are shown at selected intervals within these zones.</td>
</tr>
</tbody>
</table>
Areas with a 1% annual chance of flooding where shallow flooding (usually areas of ponding) can occur with average depths between one and three feet.

Areas with a 1% annual chance of flooding, where shallow flooding average depths are between one and three feet.

Represents areas between the limits of the 1% annual chance flooding and 0.2% annual chance flooding.

Areas outside of the 1% annual chance floodplain and 0.2% annual chance floodplain, areas of 1% annual chance sheet flow flooding where average depths are less than one (1) foot, areas of 1% annual chance stream flooding where the contributing drainage area is less than one (1) square mile, or areas protected from the 1% annual chance flood by levees. No Base Flood Elevation or depths are shown within this zone.

History of the Hazard
Flooding in Rohnert Park and the broader Sonoma County region have typically occurred during the winter months when Pacific storms are more common. The occurrences of significant flooding typically have been the result of successive intense storms with heavy precipitation. The region has experienced flood events that have caused tens of millions of dollars in damages and numerous fatalities. The following provides insight into information of past flooding events that are significant to the Sonoma State University campus.

Table 25-22: - Historic Flooding Events in Sonoma County

<table>
<thead>
<tr>
<th>Date</th>
<th>Event</th>
<th>Declaration</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>February 1970</td>
<td>Flood; Winter Storms</td>
<td>DR-283-CA</td>
<td>Countywide</td>
</tr>
<tr>
<td>December 1982</td>
<td>Flood</td>
<td>DR-651-CA</td>
<td>Countywide</td>
</tr>
<tr>
<td>February 1986</td>
<td>Flood; Winter Storms</td>
<td>DR-758-CA</td>
<td>Countywide</td>
</tr>
</tbody>
</table>

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<table>
<thead>
<tr>
<th>Date</th>
<th>Event Description</th>
<th>DR Number</th>
<th>Affected Area</th>
</tr>
</thead>
<tbody>
<tr>
<td>January 1993</td>
<td>Flood; Winter Storms</td>
<td>DR-979-CA</td>
<td>Countywide</td>
</tr>
<tr>
<td>January 1995</td>
<td>Flood; Heavy Rains</td>
<td>DR-1044-CA</td>
<td>Countywide</td>
</tr>
<tr>
<td>March 1995</td>
<td>Flood; Heavy Rains</td>
<td>DR-1046-CA</td>
<td>Countywide</td>
</tr>
<tr>
<td>January 1997</td>
<td>Flood</td>
<td>DR-1155-CA</td>
<td>Countywide</td>
</tr>
<tr>
<td>February 1998</td>
<td>Flood; Winter Storms</td>
<td>DR-1203-CA</td>
<td>Countywide</td>
</tr>
<tr>
<td>December 2005</td>
<td>Flood; Winter Storms</td>
<td>DR-1628-CA</td>
<td>Countywide</td>
</tr>
<tr>
<td>March 2006</td>
<td>Flood; Heavy Rains</td>
<td>DR-1646-CA</td>
<td>Countywide</td>
</tr>
<tr>
<td>January 2008</td>
<td>Winter Storms</td>
<td>DR-1301-CA</td>
<td>State</td>
</tr>
<tr>
<td>January 2017</td>
<td>Flood; Winter Storms</td>
<td>DR-4301-CA</td>
<td>Countywide</td>
</tr>
<tr>
<td>February 2017</td>
<td>Flood; Winter Storms</td>
<td>DR-4308-CA</td>
<td>Countywide</td>
</tr>
<tr>
<td>February 2019</td>
<td>Flood; Winter Storms</td>
<td>DR-4434-CA</td>
<td>Countywide</td>
</tr>
</tbody>
</table>

Potential Impacts of the Hazard

A flood will potentially result in extensive amounts of water entering onto developed areas. The force and volume of water that is generated by a flood may cause extensive structural damage in areas subject to standing or moving water. The effects of flooding may spread over significant distances covering large areas of land. The extent of the impacts would vary based on a number of factors such as the volume of water flooding, the time of the flood event, the amount of warning provided, the location and extent of the flood boundary, facility elevation, and distance from the flood source.

- Potential impacts resulting from flooding include:
  - Injuries or loss of life
  - Property destruction or damage
  - Loss of property contents
  - Infrastructure damage including roadways, bridges, other transportation means
  - Public health hazards resulting from mold, mildew, and disease due to flood water
  - Flooded or destroyed lifelines/supply routes including US Highway 101
  - Damaged or destroyed utilities, including on campus power generation
  - Loss of community economic base
  - Employment losses
  - Agricultural (crops and livestock) damages or destruction
  - Environmental damage
  - Prolonged periods of necessary dewatering
  - Flooding erosion may alter natural drainage channels
  - Threat, inundation, or damage to on campus childcare facilities and occupants
  - Societal and community impacts
  - Psychological impacts of impacted populations
  - Disruptions to education delivery to community

Additionally, individuals who were unable to evacuate in time or refused to leave will likely need assistance or rescue from the flooded area. Remaining in or being trapped
by flood waters places individuals in significant risk of injury or death. The impacts extend beyond the danger placed upon the affected individual and places greater resource demands on agencies and organizations making efforts to rescue trapped individuals.

**Probability of Future Occurrence of the Hazard**

The area surrounding the Sonoma state University campus does not generally promote conditions for flood waters to accumulate. There are specific buildings and areas of the campus that have a greater risk for isolated flooding. The Sonoma State University campus is located within a Zone X Special Flood Hazard Area (Minimal Flood Hazard). The Copeland Creek runs along the northern border of the campus and is classified as Zone AE Special Flood Hazard Area (Area Inundated by 1% Annual Chance of Flooding) within the creek channel. However, there is a historic record of isolated urban or street flood events provides a demonstration of potential flood activity.

The probability of future occurrence for flooding is **Possible**.

**Vulnerability to the Hazard**

The Sonoma State University campus is subject to the effects of flooding primarily resulting from potential urban flooding due to heavy precipitation that overwhelms drainage systems on campus, based on excessive precipitation during isolated heavy storms, river/levee overflow, or a combination of these. The vulnerability to flood among the people and infrastructure is reduced as the campus is located in an area designated as having a minimal flood risk.

There is a more remote potential for flooding and damage on campus and surrounding residential and commercial areas of the campus or Rohnert Park due to overflow or damage to drainage or flood control systems. The flood control channels and drainage systems that surround the campus have limited storage or volume capacities. Vulnerability to flooding on the Sonoma State University campus will vary depending on when the flood was to occur. The risk to the campus population will be lessened during periods when classes are not in session or during periods of breaks.

It is unlikely, but should an urban flood occur, impacts may pertain to campus equipment, communication systems, protected documents, artwork, academic materials, computer systems, research, and other critical activities on lower levels of buildings.

Sonoma State University is in a location adjacent to surrounding residential communities that have the potential for flooding. When these areas are inundated with flood water, the potential for access barriers, contaminant release into flood waters, and creating physical isolation presenting vulnerabilities to individuals from the campus community regarding challenges to health and safety. The area surrounding the campus is filled with agricultural land uses, flooding of these areas may result in agricultural contaminants to be released into flood waters.
During low probability, severe flood events, all campus buildings and infrastructure would be vulnerable to large-scale flooding reaching the university. Campus utilities and communication capabilities would be impacted by flood waters rendering them disabled. A low probability flood covering a large portion of the city would likely affect communication capabilities well beyond the boundaries of the campus. Remaining flood waters will leave behind molds and other health concerns in affected campus buildings and facilities likely requiring extensive restoration or demolishing. The residents of the on-campus residence halls may have transportation limitations requiring evacuation and alternative housing procedures to be implemented if populated. Flood waters may result in damage to campus equipment, communication systems, protected documents, artwork, academic materials, computer systems, research, and other critical activities on lower levels of buildings.

Finally, certain campus populations will experience greater challenges to a post-flood / failure environment. Vulnerable populations will likely need to navigate through flood generated debris, face extreme health safety issues from flood waters, experience extreme stresses of a disaster, an inability to communicate to or gain access to support networks, and find difficulty in accessing equipment or supplies to aid in a specific need. Students remaining on campus such as those residing in the residence halls would be particularly vulnerable especially those without access to adequate transportation.

**Estimate of Potential Losses**

Estimates of potential losses will be influenced by a variety of factors. The volume and force of the water will determine the scale of damages affecting campus infrastructure, equipment, and other impacted features. The location and elevation above flood waters will affect the level of damage and individuals exposed. The time of the academic year, the day of week, and hour in which the flooding was to occur will influence the number of people on campus and potential casualties. The severity of the storms producing precipitation, the speed of the storms moving across the area, the level of snowpack in the higher elevations, and amount of resulting snowmelt will produce varying effects on damages produced and costs incurred. Losses will be generated by the physical damages, the loss of revenue, loss of academic research, loss of building contents, and community wide economic reductions.

Based on estimate replacement costs of facilities and structures on campus, the maximum total replacement costs due to flood are $289,079,090. However, it is unlikely for flood to cause destructive losses to the entire campus.
Table 25-23: Special Flood Hazard Area (SFHA) Estimated Losses

<table>
<thead>
<tr>
<th>Zone Designation</th>
<th>No of Buildings</th>
<th>Maximum Replacement Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Zone V</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Zone VE &amp; V 1-30</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Zone A</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Zone AE</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Zone AH</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Zone AO</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Zone X .2%</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Zone X Minimal Risk</td>
<td>37</td>
<td>$289,079,090</td>
</tr>
<tr>
<td>Not in a SFHA</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>No Building Value Data</td>
<td>8</td>
<td>Unknown</td>
</tr>
</tbody>
</table>

*Buildings with no value defined are also included in the respective Zones they are found in.

Vulnerability Assessment Conclusions

The primary vulnerabilities to flood are exposed people and campus assets (e.g., low-lying buildings, open building sites, and structures with exposed generators, HVAC, critical control systems, or other key components) mostly by localized flooding from isolated or large-scale storms that produce heavy amounts of precipitation directly over the campus and surrounding neighborhoods. While the Sonoma campus is removed from designated flood zones, the campus remains vulnerable to localized floods due to heavy rains or overflow of campus creeks.

Identified Data Limitations

Data limitations include missing campus structural replacement costs, and an incomplete inventory of both building construction features and mitigation efforts to lessen the impact due to flood inundation. HAZUS generated analysis is focused on the broader community.
level versus fine-tuning the analysis to the micro-level for facilities such as a university campus.
Hazardous Materials

Description of the Hazard

A hazardous material is defined in California’s State Hazardous Materials Incident Contingency Plan (1991) as “a substance or combination of substances which, because of quantity, concentration, physical, chemical, or infectious characteristics may: cause, or significantly contribute to an increase in deaths or serious illnesses; and/or pose a substantial present or potential hazard to humans or the environment.”73 Hazardous materials are one or more of the following: flammable, corrosive or an irritant, oxidizing, explosive, toxic (poisonous or infectious), thermally unstable or reactive, or radioactive. Hazardous materials are ubiquitous in modern society and may be found at all stages of production, consumption, and disposal.

Federal and state laws permit the intentional release of some hazardous materials into the environment such that the risk to human health and the environment is thought to be acceptable. However, sometimes releases are unintentional, resulting from leaks, accidents, or natural hazards. This section focuses on such accidental releases and fall into the following key categories:

Fixed Hazardous Materials Incident: A fixed hazardous materials incident is the accidental release of chemical substances or mixtures during production or handling at a fixed facility.

Transportation Hazardous Materials Incident: A transportation hazardous materials incident is the accidental release of chemical substances or mixtures during highway, waterway or air transport. Populations, built and natural environments are potentially impacted.

Pipeline Incident: A pipeline transportation incident occurs when a break in a pipeline creates the potential for an explosion or leak of a dangerous substance (oil, gas, etc.) possibly requiring evacuation. An underground pipeline incident can be caused by environmental disruption, accidental damage, or sabotage. Incidents can range from a small, slow leak to a large rupture where an explosion is possible. Inspection and maintenance of the pipeline system along with marked gas line locations and an early warning and response procedure can lessen the risk to those near the pipelines.

Hazardous materials can also be classified according to worker safety and health.74 Information provided by California Division of Safety and Health includes guidelines related to:

- **Safety hazards**: fire and fire byproducts, electricity, flammable gases, unstable structures, demolition, sharp or flying objects, excavations

- **Health hazards**: carbon monoxide ash, soot and dust; asbestos; hazardous liquids; other hazardous substances; heat illness

**Natural-Technological Incidents (Natechs)**: During the past two decades, increasing attention has been given to hazardous materials releases resulting from Natechs or a natural disaster event that triggers a technological hazard event. Natechs are of particular concern for the following reasons:

- They can produce a simultaneous effect on many industrial facilities
- Can overwhelm response capacity
- Containment systems may fail
- May produce cascading disasters
- Response may be hindered by a disaster’s impact on the physical environment

**Location of the Hazard**

Hazardous materials and infrastructure such as fuel tanks, rail lines, chemicals, hazardous waste sites and gas pipelines to varying degrees are located within the CSU system and/or within its surrounding communities. The planning committee indicates that chemicals are located in the science lab on campus, and asbestos is located in various buildings. Mapping indicates two hazardous waste sites and a rail line are about one mile from the campus. At larger scales (beyond the campus planning area) hazardous materials and infrastructure are located throughout the city and county of Sonoma, and reflect different types, configurations and scales dispersed across these geographic areas.

**Extent of the Hazard**

There is no comprehensive statewide vulnerability assessment available at this time. As such, the true extent of the hazardous materials risk in California and its communities is not known, meaning no overarching conclusions have been reached which have been able to integrate all qualitative and quantitative risk factors to produce a comprehensive measure of the extent of the hazard.

For the Sonoma State planning committee, chemicals are managed in the campus science lab while asbestos in various buildings requires ongoing abatement. Chemical spills may have taken place, though not verified. Also, the rail line potentially imposes risk long-term, though currently it is used for passenger transport only. Based on

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these factors, along with the close proximity of hazardous waste sites within 1/4 mile, the extent of the hazard for the CSU – Sonoma campus is Low to Moderate. That said, it is prudent to consider worst case scenarios as the main driver of policy in order to fully mitigate all possible hazardous materials event outcomes.

For example, according to the 2018 CA State Hazard Mitigation Plan, 400 hazardous materials problems are tied to 32 past earthquakes, including over 150 problems from the Loma Prieta Earthquake alone. That said, the plan indicates that it is likely that many such hazardous materials releases have received little attention in the past because public authorities, the media, and the public have overlooked them in the rush to address and recover from immediate disaster threats, and that responsible parties may have an incentive to understate the extent of releases or not to report them at all.

History of the Hazard

According to the CA Governor’s Office of Emergency Services’ Hazardous Materials Spill Report, the state experiences from 10 to 30 spill events daily. As of April 20th, 2021 already 2096 spill events had occurred. Such events have occurred in all the cities and/or counties where CSU campuses are located.

According to the 2018 CA State Hazard Mitigation Plan, with regard to natural-technological hazard events (Natechs), 400 hazardous materials events are tied to 32 past earthquakes, including over 150 Natech events from the Loma Prieta Earthquake alone.

For more details on specific hazmat events, please refer to the local, county and/or multi-jurisdictional hazard mitigation plans where CSU campuses are located at: https://www.caloes.ca.gov/cal-oes-divisions/hazard-mitigation/hazard-mitigation-planning/local-hazard-mitigation-program

According to the campus planning committee, chemical spills may have taken place though not verified. Asbestos present in buildings requires abatement/removal, and while it poses risks does not constitute a hazmat incident.

Potential Impacts of the Hazard

A large hazardous materials release could affect an entire community or city under certain conditions related to direction of air flow (air-based chemical release) and population density or the contamination of a community’s main water supply. Either type of release could necessitate large scale evacuation. By contrast, in the rural unincorporated areas where population densities are low, even in the event of a large release, the number of homes that may need to be evacuated would be significantly


lower than in an urban environment. The occurrence of a hazmat incident can also result in the shut-down of transportation corridors which can last for hours at a time while the impacted area is stabilized.

The release of some toxic gases may cause immediate death, disablement, or sickness if absorbed through the skin, injected, ingested, or inhaled. Contaminated water resources become unsafe and unusable, depending on the amount of contaminant. Some chemicals cause painful and damaging burns if they come in direct contact with skin. Prolonged and concentrated exposure to such chemicals can produce severe long-term impacts to respiratory, endocrine and nervous systems, heart and brain health.

The potential impacts of chemicals and toxic gases discussed here also to some degree apply to the students, staff and environment on the CSU – Sonoma campus.

With regard to the natural environment overall, contamination of air, ground, or water may result in harm to fish, wildlife, livestock, and crops. The release of hazardous materials into the environment may cause debilitation, disease, or birth defects over a long period of time. Loss of livestock and crops may lead to economic hardships within the community.

Recent California examples include the 2016 Aliso Canyon methane gas leak, which caused evacuation of nearby residents, many of whom experienced temporary health problems such as difficulty breathing and eye irritation; and the 2016 Fruitland metal recycle plant fire in Maywood, which released heavy metals such as lead, magnesium, copper, aluminum, antimony, calcium, iron, sulfur, tin, potassium, and zinc which pose severe risks to public health. Health effects from exposure to these metals included short-term symptoms such as irritation to the eyes, nose, throat, and lungs.

Potential Impact of the Hazard (Natechs)

Natural disasters, including earthquake, flood, and fire also pose risks to public health and the environment. For example, following the Northridge Earthquake, California State University (CSU) Northridge laboratories and chemical storage rooms experienced multiple chemical spills. Such incidents, triggered by a natural disaster, pose a significant risk to students, faculty, staff, and first responders. At a minimum, all CSU campuses with a science lab (including CSU – Sonoma) is at risk of potential impact from a natural-technological (combined impact) event.

In a severe flood event, floodwaters are often contaminated with hazardous materials posing a threat to public and animal health, groundwater, and other parts of the environment. These hazardous materials may be released from damaged or flooded

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81 Source: 2018 California State Hazard Mitigation Plan, section 9.2.
underground tank sites (e.g., gas stations or chemical storage facilities), propane
tanks, manure or human waste handling facilities, fertilizer and pesticide storage,
agricultural sites, and household hazardous waste.

In a fire event, (such as the October 2017 Northern California firestorms which
destroyed approximately 6,000 residences) entire neighborhoods can be burned to the
ground. Hazardous material release creates public health concerns which can delay
the initial steps of fire recovery, including reopening burned areas to residents and
initiating debris removal activities. The post-fire “toxic sweep” poses a risk of coming
into contact with toxic substances due to the presence of synthetic and hazardous
materials. 82

Probability of Future Occurrence

The probability of occurrence for a hazmat event on the CSU – Sonoma campus can
be viewed in two different ways: the history of occurrence serves as a sound predictor
of future probability assuming current risk and vulnerability factors remain somewhat
constant. For the purposes of the current estimate, no current data clearly indicates
otherwise. As such, the probability of occurrence is Low - the campus has experienced
no verified chemical spills in the science lab, and asbestos abatement is being
addressed. In addition, hazardous waste sites are in fairly close proximity which may
increase vulnerability and the probability of a campus-related event. Hazmat
occurrences are largely based on human error, and any changes in risk and
vulnerability factors such as a decreased vigilance in materials oversight and handling
practices or changes in the amount of material or exposure will likely increase the
probability on campus.

Assessment of Vulnerability

Hazardous materials pose a risk to the CSU – Sonoma campus. As identified by the
campus planning committee and on the hazmat map, the following vulnerabilities are
present on campus: chemicals in the science lab, and asbestos in various buildings
pose health risks. Mapping indicates two hazardous waste sites and a rail line and a
gas pipeline grouped about ¼ mile and 1 mile from campus respectively. While the
rail is passenger only, that could change in the future. As such, due to their somewhat
close proximity, gases and chemicals or hazardous waste, if spilled or released, could
impact human health and campus operations.

Although it is quite difficult to produce a quantitative measure of vulnerability because
(unlike natural hazards) the probability of occurrence is dependent on human error,
which itself is variable based upon a fluctuating set of interrelated factors, some of
which lack prediction or control, given the complexity of how all natural and built
environments and hazmat risks factors interrelate at the local or campus level, it is

82 Source: 2018 California State Hazard Mitigation Plan, section 9.2.
prudent to assume for planning purposes that the campus’ vulnerability is a sub-set of the larger community’s vulnerability. As such, the CSU – Sonoma leadership maintains vigilance to mitigate the campus’ vulnerabilities identified above at a minimum.

Estimate of Potential Losses

As discussed previously, it is difficult if not impossible to produce an accurate quantitative measure of vulnerability because of the variable nature of a hazardous materials spill. For example, the release of a toxic airborne chemical in a populated area has severe impact potential, whereas the impact potential of a small chemical spill in a remote or rural area is most likely limited to remediation of soil. And, in both cases, the probability of occurrence is dependent on human error, which itself is variable based upon a fluctuating set of interrelated factors, some of which lack prediction or control. In all cases, different types and amounts of hazardous materials interact with fluctuating combinations of human error to produce different event outcomes with variable impact costs.

Vulnerability Assessment Conclusions

It is well understood that with regards to hazmat vulnerability, each campus and its surrounding community (including Sonoma State) operates through a complex and dynamic interaction between industrial and commercial inputs and outputs and the natural and built environment. Such activity produces hazardous materials that move through the environment along both convergent and divergent routes and across all levels of land-use from site to campus to city and county and beyond. It is also clear from a review of the Sonoma County hazard mitigation plan and Cal OES’ records of hazardous material spills, that such events occur with great frequency and varying degrees of severity across jurisdictions statewide. As such, in assessing the vulnerability of the CSU – Sonoma campus, campus-level risks and vulnerabilities are not discreet or isolated but can become exacerbated or augmented through connections to broader community-level hazmat risks and vulnerabilities.

Finally, in order to draw conclusions on vulnerability, it should be noted that any identified vulnerabilities at the campus level and/or community level are circumscribed and potentially reduced by targeted policy and program interventions. Numerous policies and programs have been established in recent years in response to California’s widespread and complex and integrated hazardous materials risks - California established the Unified Program which consolidates and integrates the administrative requirements, permits, inspections, and enforcement activities of the following environmental and emergency response programs: the Aboveground Petroleum Storage Act (APSA) Program, Area Plans for Hazardous Materials Emergencies, the California Accidental Release Prevention (CalARP) Program, the Hazardous Materials Release Response Plans and Inventories (Business Plans), Hazardous Material Management Plan (HMMP) and Hazardous Material Inventory Statement (HMIS) requirements (California Fire Code), the Hazardous Waste
Generator and Onsite Hazardous Waste Treatment (tiered permitting) Programs, and the Underground Storage Tank Program.

Identified Data Limitations

The Sonoma State planning committee has provided information on campus-level hazmat materials and risks. Data limitations pertain to a comprehensive understanding of human activity and error related to materials control over the long term.

Landslide

Description of the Hazard

A landslide is a down-slope movement of soil, rock, or other debris, and can also be referred to as a mass movement or slope failure. These geological hazards can range in size from a few feet to over a mile in length and width and, when heavy and rapidly moving, can cause serious damage and loss of life.

Landslides are classified based on the type of material and type of movement involved. They can range from slow-moving earth flows to fast-moving debris flows, though many large slope failures involve more than one type of movement. The primary natural triggers of slope failures are water, seismic activity, and volcanic activity. Slope saturation by water can occur from intense rainfall, snowmelt, changes in ground-water levels, and surface-water level changes along coastlines. In winter months, El Nino storms or other high rainfall events may saturate soils and trigger slope failure.

Deep-Seated Landslides

Deep-seated landslides, ranging in depth from ten to several hundred feet, occur as a result of geologic and hydraulic changes, such as earthquakes or increased levels of groundwater. These landslides can move slowly or quickly and can cause extensive property damage, but rarely result in loss of life.

Debris Flows Related to Shallow Landslides

Shallow landslides may mobilize into rapidly moving debris flows and typically occur after sudden saturation of the ground. These types of debris flows are typically more dangerous because they move rapidly, causing both property damage and loss of life.

Debris flows may also occur as a result of post-fire conditions, where wildfires have left barren ground exposed to heavy rainfall. Intense rainfall, generally greater than .5 inch per hour, has the potential to trigger a post-fire debris flow.11 These landslides may impact lives and properties within the deposition zone and can result in

downstream flooding. Post-fire debris flows often occur during the fall and winter following major summer fires.

Location of the Hazard

The susceptibility of an area to landslides depends on several variables, including magnitude of slope gradients, water content, ground cover, presence of erosion, and slope material and structure. However, landslides are most prevalent in terrain with weak material and steep slopes, and the highest risk is found in areas with high rainfall or high earthquake potential. Slope failures are also most likely to occur in areas where they have occurred in the past. In California, the most landslide-prone areas are found along the coast and in the northern Franciscan Formation.

General landslide vulnerability can be estimated from the distribution of weak rocks and steep slopes as seen in Figure 25-14. Based on the Figure below, the CSU-Sonoma campus is located close to areas susceptible to landslide.
**Extent of the Hazard**

In Sonoma County, landslides are more likely to occur in the steep slopes outside of the metropolitan area. The hills and canyons surrounding Rohnert Park contribute to widespread landslide hazard and the indirect impacts of landslides may cover a larger geographical exten, possibly including the campus. Based on the campus’ proximity to the landslide hazard zone, and the history of significant impacts in the Sonoma area, the planning committee ranks the extent of the landslide hazard for the campus as *Moderate.*

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History of the Hazard
Sonoma County has a high number of historic debris flows recorded by NOAA, with sixty on record between 2006 and 2019. Most of these landslides have occurred north and west of Santa Rosa in the foothills, although two of these occurred just outside of Rohnert Park. FEMA has declared 10 major disasters since 1982 that include landslides or mudslides, all triggered by storms or flooding. No landslides have occurred on or immediately adjacent to the campus.

Potential Impacts of the Hazard
CSU Sonoma may be impacted by the disruption of services as a result of landslides in the region. Landslides can result in physical damage to buildings and property and have the potential to significantly effect infrastructure. As a landslide moves, it distresses structural foundations by settlement, cracking, and tilting. Fast-moving flows can remove entire structures in one instance, while other types of flows can cause damage gradually.

Transportation and utility infrastructure are particularly vulnerable to landslides, since the failure of any component can disrupt service over a large area. The loss of power and communication and disruption of transportation can have cascading effects throughout an area, including impaired disposal of sewage, contamination of water supplies, and the release of flammable fuels. Transportation routes are also often expensive to clean up, and prolonged obstruction can disrupt the movement of people and goods for long periods of time.

Probability of Future Occurrence of the Hazard
Slope failures are often triggered by other natural hazards such as heavy rainfall and earthquakes, so landslide frequency is often related to the frequency of these other hazards. As climate change impacts the frequency and intensity of triggers such as rain events, fires, and coastal erosion, landslides may generally occur more often. Historically, landslides have occurred frequently in Sonoma County and therefore are highly likely to occur in the future. Rohnert Park, however, is relatively flat and has little risk of future landslides. Impacts from landslides outside of city limits are expected to be indirect and minor. Given the location of the campus somewhat close to the landslide zone, the planning committee ranks the probability of the landslide hazard in some way affecting the campus as Possible.

Vulnerability to the Hazard
The vulnerability of the built environment to landslides depends on exposure and is more likely to incur damage as a result of proximity, rather than inferior structural design. The structures most vulnerable to landslides are buildings and utility/transportation lifelines, which can be impacted by either impact or ground
deformation. Utilities and transportation infrastructure are particularly vulnerable, due to their geographic extent and susceptibility to physical distress.

Any population proximal to a landslide when it occurs is vulnerable to its impacts. The campus does not exhibit structural vulnerabilities, though transportation routes surrounding the campus remain vulnerable.

**Estimate of Potential Losses**

There are no current models for estimating potential losses from a landslide directly impacting the campus.

Although the economic impact of landslide damage can exceed that of the direct repair costs, there are currently no applicable methods for estimating indirect costs related to CSU Sonoma.

**Vulnerability Assessment Conclusions**

Community exposure to landslides varies depending on their physical locations – whether in flat plains or on steep hillsides – and on their dependence on critical infrastructure located in landslide hazard zones.

Landslides could impact the campus primarily related to indirect impacts to transportation and utilities. Utility outages can impact health, particularly for vulnerable populations, and can cause interruptions in operations. Interruptions may impact student and employee’s ability to travel to campus and the delivery of classes and events.

**Identified Data Limitations**

The ability to predict future landslides at the CSU Sonoma campus is limited. However, the USGS estimates that climate change-induced shifts in weather will increase the frequency of post-wildfire landslides, which are expected to occur almost every year in California.

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**Power Outage**

**Description of the Hazard**

Rohnert Park, is a town in Sonoma County, California. It is the home of Sonoma State University.

Most aspects of modern life, and almost all aspects of urban life, rely on the availability of reliable utilities, such as electricity, water, and natural gas. An interruption in the supply or distribution of these commodities can leave populated areas like Rohnert Park without basic service, such as electricity or sanitation. These interruptions can be cascading effects from other hazard events, such as windstorms, floods, wildfires and earthquakes, or they can be caused by intentional disruptions of transmission lines.
A power outage event can interrupt day-to-day operations of the Sonoma State campus, like in-person classes, impede or limit digital, telephonic, or radio communications, create traffic jams around the busy avenues and boulevards surrounding the campus, close the student health center, and close restaurants around campus and outside the campus. Additionally, thousands of Sonoma State student residents in on-campus housing would also be affected by a power outage on campus and in the area. A severe outage to Sonoma County or the City of Rohnert Park would also directly affect the campus and the community.

Electric power disruptions and outages fall into two categories: intentional and unintentional.

The four types of intentional disruptions are:

- Planned: Some disruptions are intentional and can be scheduled based on maintenance or upgrading needs.
- Unscheduled: Some intentional disruptions must be done "on the spot" in response to an emergency.
- Demand-Side Management: Some customers (i.e., on the demand side) have entered into an agreement with their utility provider to curtail their demand for electricity during periods of peak system loads.
- Load Shedding: When the power system is under extreme stress due to heavy demand and/or failure of critical components, it is sometimes necessary to intentionally interrupt the service to selected customers to prevent the entire system from collapsing. These intentional interruptions result in rolling blackouts.

Unintentional or unplanned disruptions are outages that come with essentially no advance notice or warning. This type of disruption is the most problematic. The following are categories of unplanned disruptions:

- Accident by the utility, utility contractor, or others.
- Malfunction or equipment failure.
- Equipment overload (utility company or customer).
- Reduced capability (equipment that cannot operate within its design criteria).
- Tree contact other than from storms.
- Vandalism or intentional damage.
- Weather, including lightning, wind, earthquake, flood, and broken tree limbs taking down power lines.
- Wildfire that damages transmission lines.

Location of the Hazard

Although power outages can take place within a certain area, it has the potential to affect the entire planning area equally.

Extent of the Hazard
In order to anticipate outage conditions and reduce impacts, campus facility managers and others keep track of conditions and data provided by the media, municipal utilities and the California Independent System Operator (CAISO). CAISO is tasked with managing the power distribution grid that supplies most of California, except in areas served by municipal utilities, and is thus the entity that coordinates statewide flow of electrical supply. CAISO uses a series of “stage alerts” to the media based on system conditions. The alerts are as follows:

- Stage 1 - reserve margin falls below 7 percent.
- Stage 2 - reserve margin falls below 5 percent.
- Stage 3 - reserve margin falls below 1.5 percent.

Rotating blackouts become a possibility when Stage 3 is reached. Utility agencies aim to advise affected areas approximately 48 hours in advance of a potential PSPS event and will attempt notification again approximately 24 hours before power is shut off. Campus staff respond accordingly.

Given the prevalence of rolling blackouts and other power outages in California, the campus maintains safety precautions, situational awareness, access to emergency power generators and other protocols for managing campus power outages. Given that recorded outages have taken place on campus, the planning committee ranks the extent of the power outage hazard as Moderate.

History of the Hazard

Sonoma State has experienced power outages due to wildfires created by high wind extreme heat events. In 2019, during the Kincaid fire PSPS was used to reduce the impact of the disaster to the area. Due to the challenges PSPS may bring in the future, developing a solar microgrid may prove to be highly necessary for campus resilience.

Potential Impacts of the Hazard

Instructors, campus residents, staff, and administration rely on electricity for basic operations. During a widespread power failure, it may take anywhere from several hours to days to restore operations if a significant event occurs. Electrical power may be the only cooling source for many individuals around the campus and its community, and long-term outages can potentially put people’s health and life at risk. Disruptions in the supply of heating fuel may put people and property at risk during extremely cold weather if it relies on electric generation or heating mechanisms instead of gas. Additionally, many medical devices, communications devices, and security rely on power to maintain their functions.

Climate Change and Energy Shortage

Climate change is expected to bring more frequent and intense natural disasters. These changes have created variability at a rate that makes historical data a poor predictor of future climate. For example, the warmest years on record in California occurred in 2014, 2015, and 2016. The 2016-2017 year broke the record as the wettest ever recorded in the northern Sierra Nevada Mountains.
Changes in temperatures, precipitation patterns, extreme events, and sea-level rise have the potential to decrease the efficiency of thermal power plants and substations, decrease the capacity of transmission lines, render hydropower less reliable, spur an increase in electricity demand, and put energy infrastructure at risk of flooding.

With climate warming, higher costs from increased demand for cooling in the summer are expected to outweigh the decreases in heating costs in the cooler seasons. Hotter temperatures in California will mean more energy (typically measured in “cooling-degree days”) needed to cool homes and businesses both during heat waves and on a daily basis, during the daytime peak of the diurnal temperature cycle. During future heat waves, historically cooler coastal cities (e.g., San Francisco and Los Angeles) are projected to experience greater relative increases in temperature, such that areas that never before relied on air conditioning will experience new cooling demands.

Secondary impacts of energy shortages are most often felt by vulnerable populations. For example, those who rely on electric power for life-saving medical equipment, such as respirators, are extremely vulnerable to power outages. Also, during periods of extreme heat emergencies, the elderly and the very young are more vulnerable to the loss of cooling systems requiring power sources.

**Probability of Future Occurrence of the Hazard**

The probability of California experiencing a power outage can be difficult to quantify but is a hazard that occurs annually during the same seasonal periods of temperature variance throughout the calendar year. Sonoma county experiences such outages. As such, the probability ranking for the Sonoma area is **Likely**. Since the campus has also recorded power outage events, it is prudent to assign this same ranking for the campus.

Climate models suggest summer global temperatures are likely to increase while changes between temperature extremes would be more pronounced. As such, it is expected that power outages will occur more frequently in the future.

**Vulnerability to the Hazard**

Based on the data available, and in consideration of the increasing effects of climate change, the probability of future occurrences prompting intentional outages and creating unintentional power outages the hazard is high for the county in different areas but not specifically influencing Sonoma State. Nonetheless, as discussed campus leadership works to reduce vulnerabilities through consistent use of safety and operational protocols and emergency power sources to ensure it is able to mitigate an interruption to electrical power.

Although the campus has specific power outage protocols, an outage can impact the operations of the university depending on the severity of the outage. During daytime hours, the University may remain open and business and instructional operations will remain on-going at the maximum extent possible. It will be expected that the areas surrounding the campus, including streetlights, will have also experienced a blackout.
During dark hours staff, students and faculty are to remain on campus for fifteen minutes in the event that power returns. In the event that the power returns business and instructional operations will resume. If power is not restored, instruction will stop, and business operations will stop for the remainder of the evening. Classes and university operations and projects utilizing hazardous materials are required to immediately stop to avoid additional hazards.

Estimate of Potential Losses

The data provided by Sonoma State does not report any value for potential losses due to power outage.

Vulnerability Assessment Conclusions

Elevators, entry ways, air filtration systems and lighting provide the campus community with the necessary infrastructure and systems to function and navigate through the campus and to maintain a safe campus environment and visibility during nighttime hours. The primary concern for campus leadership is that a loss of power can lead to potential hazards to students, faculty, and staff at Sonoma State. Vulnerable populations (especially students with physical disabilities) may be the most heavily affected by loss of power, as they rely on elevators, entry ways with automatic doors, and locks and lights; a power outage would impede a disabled student’s ability to travel and utilize the campus and its structures safely. The use of communication devices, billing, records, and electrical tools may also become unusable due to a loss of electricity. Many records and billing items may have to revert to “by-hand” procedures and paper copies may be needed for continuity of operations. Additionally, classrooms may not be usable if lighting equipment is not functioning impacting a semester or quarter’s progress for the academic year.

Identified Data Limitations

Sonoma State did not report any monetary or life losses due to a power outage. Also, the campus did not report any incidents involving a power outage directly affecting the campus community and operations.

**Volcano (Associated Air Quality)**

Description of the Hazard

The US Geological Service defines volcanoes as “openings or vents where lava, tephra (small rocks), and steam erupt on to the Earth’s surface. Through a series of cracks within and beneath the volcano, the vent connects to one or more linked
storage areas of molten or partially molten rock (magma). This connection to fresh magma allows the volcano to erupt over and over again in the same location”. 85

A volcanic eruption occurs when magma, lighter than surrounding rock, is driven upwards by its buoyancy and by pressure from the dissolved gases contained within it. Gases are released from magma as it reaches the surface and pressure decreases. Magma can be erupted in several ways and violent eruptions typically cause tiny pieces of tephra (ash) to be carried away by the wind. This ash is hard, does not dissolve in water, is extremely abrasive and mildly corrosive, and conducts electricity when wet. 86 The gases released in an eruption include carbon dioxide, sulfur dioxide, hydrogen sulfide, and hydrogen halides. Depending on their concentration, these are potentially hazardous to people, animals, agriculture, and property.

Location of the Hazard
There are eight volcanic areas located throughout California. Seven of these - Medicine Lake Volcano, Mount Shasta, Lassen Volcanic Center, Clear Lake Volcanic Field, Long Valley Volcanic Region, Coso Volcanic Field, and Salton Buttes – are considered active volcanoes. No portion of CSU Sonoma or Sonoma County is located within a volcano hazard zone.

Extent of the Hazard
Volcanic hazards are most severe within a few miles of the volcano vent and the severity generally decreases with distance. Ash impact zones can range from tens to hundreds of miles from the vent source. The US Geological Survey has estimated zones surrounding active volcanoes wherein 2 inches or more of ashfall following an eruption is possible. While Sonoma State does not fall within an estimated ashfall zone, lighter dustings of ash outside of those areas may directly or indirectly impact the campus. As such, the planning committee ranks the extent of the hazard for the campus as Low.

The dashed lines in Figure 25-15 enclose areas where two inches or more of ashfall are possible. However, it should be noted that hazard maps are dynamic and updated periodically as research adds new information.

History of the Hazard

No historical eruption events in California have affected the campus. Over the last 1,000 years, there have been at least 12 eruptions in California. The most recent volcanic eruption in California occurred at Lassen Peak about 100 years ago, when a major explosion delivered windborne ash over 275 miles away.

Potential Impacts of the Hazard

The specific impacts vary widely and depend on which type of volcano erupts, the style of explosion, the volume of lava, the eruption duration, and the local water conditions. As Sonoma State is not proximal to an active volcano, only the potential impacts of ashfall and gases have been detailed. While both these hazards can be
widespread, their most severe impacts are generally seen closer to the volcanic source.

Although ashfall is typically a nonlethal volcanic hazard, it is the most widespread and disruptive. Falling ash can damage crops, electronics, and machinery. It can also impact human health by irritating the respiratory tract, eyes, and skin. The particles may enter drinking water and structures and may cause structure failure if it is thick and heavy enough. Even a fine layer of ash can disrupt utilities. A portion of California’s major electric transmission lines, aerial telecommunication lifelines, transportation corridors, and water storage and conveyance lie within the state’s volcano hazard zones. Impacts to any of these can impact operations at CSU Sonoma.

The potential impacts of gases released during volcanic eruptions are as follows:

- Carbon dioxide typically becomes diluted very quickly and is not life threatening. However, it can become trapped in higher concentrations in low-lying areas and has the potential to be fatal.
- Sulfur dioxide can cause acid rain and air pollution downwind of a volcano.
- Hydrogen sulfide can cause irritation of the upper respiratory tract. At high concentrations it can cause unconsciousness and death.
- Hydrogen halides can coat ash particles and, once deposited, poison drinking water, agricultural crops, and grazing land.

Probability of Future Occurrence of the Hazard

The US Geological Survey, based on the record of volcanic activity in California, estimates that the probability of another small- to moderate-sized eruption in the next thirty years is about 16 percent. As such, the planning committee ranks the annual probability of future occurrence as Unlikely.

Vulnerability to the Hazard

Populations living near volcanoes are the most vulnerable to eruptions and lava flows. However, volcanic ash can travel and affect populations miles away. The location and thickness of ash in any given area is a function of the severity of the eruption and wind speed and direction. For Sonoma State, there is low vulnerability to the immediate impacts of volcanic eruptions due to the limited area affected and remote potential of an eruption. In the event of a widespread ashfall event, the elderly, infants, and populations with existing respiratory disease will be at higher risk.

Estimate of Potential Losses

Impacts to critical infrastructure, agriculture, and property from ashfall have the potential to cause widespread disruption, damage, and economic loss throughout the state. In the event of a widespread ashfall event, impacts will be immediate.

Current modeling is not precise enough to allow for an assessment of potential losses from ashfall to structures or infrastructure on or surrounding the campus.

Vulnerability Assessment Conclusions
Sonoma State is unlikely to experience the direct impacts of a volcanic event. While the campus may be indirectly impacted by ashfall elsewhere in the state, direct ashfall impacts are generally unlikely but possible in a widespread event. However, the likelihood of any volcanic eruption in the state impacting the campus is very low.

Identified Data Limitations

Not all active volcanoes in California have been zoned for hazards by the US Geological Survey. This, together with the infrequent occurrence of volcanic explosions and number of factors determining type and extent of impacts, make the quantification of potential loss difficult.

Wildfire

Description of the Hazard

While wildfires are a natural part of California’s ecosystem, wildfires in California represent a hazard that presents one of the greatest probabilities of destruction along with a demonstrated history of catastrophic fire events in recent years. The destructive fire seasons of 2017 to 2020 illustrated the destructive forces fire presents to communities across the state. Wildfires may result in the structural loss, infrastructure loss, dangerous air quality, environmental damages, economic impacts, injuries, and loss of life. In many communities throughout California, wildfire presents greatest risk to human life and property.

Wildfires have been defined as any free burning vegetation fire that initiates from an unplanned ignition, whether natural or human caused demanding fire suppression actions to contain. These fires are prone to become uncontrolled, spreading through vegetative fuels rapidly exposing people and structures to harm. Wildfires present a significant risk to communities across the state, as evidenced by increasing trends of structural losses from wildland fires. This risk is elevated in areas where development and community growth has intersected, also known as the wildland-urban interface (WUI). In the interface setting, development itself can provide additional fuel for large fires. Recent fires have also demonstrated the ability of fire to consume populated areas in extreme conditions.

California’s Mediterranean climate in combination with its geography and vast population create a combination of factors that promotes an optimal environment for large fire growth and consequences. As there is great diversity of geographic characteristics across the state, the risks and potential consequences of wildfire must be assessed locally. The physical location, weather patterns, local fuel types and volume, extent of the WUI, topography, and additional factors will factor differently from part of the state to another.

The behavior of wildfires in California is significantly influenced by three distinct geographic factors. These factors will help shape the size, direction of spread, rate of

87 State of California Hazard Mitigation Plan, September 2018
combustion, fire intensity, and ability to pre-heat fuels. The physical factors contributing to wildfire behavior include:

- **Topography** – The rate in which wildfires spread increases with greater slopes in topography. The greater the slope will result in more pre-heating of fuel above the advancing fire. The direction that a slope faces will also influence fire behavior as south facing slopes receive greater solar radiation and thus drier vegetation that is more susceptible to combustion. Ridgetops often denote the end of fire spread as fire has greater difficulty spreading downhill.

- **Weather** – Weather factors substantially in influencing the behavior of wildfires. Wind, temperature, humidity, lightning, and lack of precipitation all contribute to a fire’s ability or inability to spread and intensify. California routinely experiences conditions in which these factors are in alignment to contribute to extreme fire behavior during the summer and fall seasons. High winds, low humidity, and high temperatures provide an environment promoting extreme fire activity.

- **Fuels** – Certain types of vegetation are increasingly prone to igniting and promote more intense burning. Areas with greater “fuel loading” (amount of fuel present in terms of weight of fuel per unit of area) increases the amount of fuel to fuel a fire. Greater volumes of dead or dry vegetation compared to live plants is a critical factor. Vegetation during drought conditions will experience decrease in moisture content increasing the conditions for combustion. Fuels close proximity to one another allows for rapid spread through contact or radiant exposures.

A risk assessment for wildfires should be implemented within a geospatial context focusing on the specific location features and incorporates the three components of the wildfire risk triangle – likelihood, intensity, and susceptibility.

**Location of the Hazard**

Substantial portions of the State of California are exceptionally vulnerable to wildfire activity or reside in a wildland-urban interface (WUI) area due to the vast open spaces, rangelands, forests and other lands with high susceptibility to fire occurring throughout the state. The Sonoma State University campus is located in a suburban setting in the Santa Rosa Plain. This plain is surrounded by hills largely covered in moderate to high fuel density areas. In general, areas considered to be within Local Fire Hazard Severity Zones defined by the Fire and Resource Assessment Program (FRAP) within the California Department of Forestry and Fire Protection (CalFire) occur east and west of the campus. These hills surrounding Sonoma County communities can be topographically diverse, contain heavier vegetative fuels, and often have residential development interspersed.

The Sonoma State University campus is located in the eastern portion of the City of Rohnert Park. The area immediately surrounding the campus is predominately developed with residential land uses. Residential neighborhoods exist to the south and west of the campus. The campus has open agricultural fields to the east and north of the campus. The area to the east of campus is designated as a Local High Fire
Hazard Severity Zone. To the north of the campus, are residential neighborhoods and a valley containing Ward Creek containing heavy fuels.

The CSU Easy Bay, Concord campus is located in the hills of Concord near the base of Mt. Diablo. The area immediately surrounding the campus is predominately developed with residential neighborhoods. The campus has open fields containing short grasses and moderate fuels to the south and west of the campus. The area to the south of campus is designated as a Local High Fire Hazard Severity Zone. To the north of campus are agricultural fields and residential neighborhoods across Rohnert Park Expressway, however dense vegetation and trees line Copeland Creek between the campus and the road.

Figure 25-15: Sonoma County Fire Hazard Severity Zones

Extent of the Hazard

While the threat to fire directly affecting the campus is considerable, the direct effect of fire generated smoke is also likely to occur. Fires are likely to occur in close
proximity to the campus generating smoke that could envelop the campus in the right atmospheric conditions. Fires that are large enough to generate volumes of smoke to cover great distances have the potential to affect the air quality of the Sonoma County area including the campus. This will especially be the case in weather conditions creating strong off-shore winds. The potential for this impact has been demonstrated during the summers of 2018, 2019, and 2020 as fires burned across the state and spread smoke over vast distances. Fires burning well outside of the Sonoma County region have the potential to distribute smoke onto the Sonoma State University campus.

Given the occurrence of 5 Federal Declarations in Sonoma County from 2003 to the present (with 4 of those declarations made since 2015), along with the fact that Fire Hazard Severity Zones are found throughout the hillsides surrounding the campus, the planning committee ranks the extent of the wildfire hazard for the campus as High. The National Fire Danger Rating System (NFDRS) is the current system in use for rating and classifying the potential danger of fire. The NFDRS tracks the effects of previous weather events on both dead and live fuel loads and adjusts accordingly based on future or predicted weather conditions. These complex relationships and equations are computed, and the outputs are expressed in terms that users can quickly and easily understand. The current NFDRS is used by all federal and most state agencies to assess fire danger conditions.

The following table depicts the NFDRS, from the US Forest Service’s Wildland Fire Assessment System.

<table>
<thead>
<tr>
<th>Rating</th>
<th>Basic Description</th>
<th>Detailed Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>CLASS 1: Low Danger (L)</td>
<td>Fires not easily started</td>
<td>Fuels do not ignite readily from small firebrands. Fires in open or cured grassland may burn freely a few hours after rain, but wood fires spread slowly by creeping or smoldering and burn in irregular fingers. There is little danger of spotting.</td>
</tr>
<tr>
<td>COLOR CODE: Green</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CLASS 2: Moderate Danger (M)</td>
<td>Fires start easily and spread at a moderate rate</td>
<td>Fires can start from most accidental causes. Fires in open cured grassland will burn briskly and spread rapidly on windy days. Woods fires spread slowly to moderately fast. The average fire is of moderate intensity, although heavy concentrations of fuel -- especially draped fuel -- may burn hot. Short-distance spotting may occur but is not</td>
</tr>
<tr>
<td>COLOR CODE: Blue</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>CLASS 3: High Danger (H)</th>
<th>Fires start easily and spread at a rapid rate</th>
<th>All fine dead fuels ignite readily, and fires start easily from most causes. Unattended brush and campfires are likely to escape. Fires spread rapidly and short-distance spotting is common. High intensity burning may develop on slopes or in concentrations of fine fuel. Fires may become serious and their control difficult, unless they are hit hard and fast while small.</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>CLASS 4: Very High Danger (VH)</th>
<th>Fires start very easily and spread at a very fast rate</th>
<th>Fires start easily from all causes and immediately after ignition, spread rapidly and increase quickly in intensity. Spot fires are a constant danger. Fires burning in light fuels may quickly develop high-intensity characteristics - such as long-distance spotting - and fire whirlwinds when they burn into heavier fuels. Direct attack at the head of such fires is rarely possible after they have been burning more than a few minutes.</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>CLASS 5: Extreme (E)</th>
<th>Fire situation is explosive and can result in extensive property damage</th>
<th>Fires under extreme conditions start quickly, spread furiously, and burn intensely. All fires are potentially serious. Development into high intensity burning will usually be faster and occur from smaller fires than in the Very High Danger class (4). Direct attack is rarely possible and may be dangerous, except immediately after ignition. Fires that develop headway in heavy slash or in conifer stands may be unmanageable while the extreme burning condition lasts. Under these conditions, the only effective and safe control action is on the flanks, until the weather changes or the fuel supply lessens.</th>
</tr>
</thead>
</table>

Due to the impacts of wildfires on public health, agencies across the nation have adopted the use of the Air Quality Index (AQI) to communicate and provide a consistent approach to air quality measurements and categorization. The AQI primarily focuses on the health effects caused by pollutants in the air such as smoke.
The goal of the AQI is to provide advisories to assist the public in determining when to reduce exposures to inhalation of air pollution as pollution levels rise.
Table 25-25: Historic Sonoma County Large-Scale Fires

<table>
<thead>
<tr>
<th>Date</th>
<th>Fire</th>
<th>Declaration</th>
<th>Damages</th>
</tr>
</thead>
<tbody>
<tr>
<td>9/21/1964</td>
<td>Hanley</td>
<td>NA</td>
<td>52,700 acres, 108 Structures</td>
</tr>
<tr>
<td>9/1964</td>
<td>Nuns Canyon</td>
<td>NA</td>
<td>10,400 acres, 27 structures</td>
</tr>
<tr>
<td>7/1978</td>
<td>Creighton Ridge</td>
<td>NA</td>
<td>11,405 acres, 64 structures</td>
</tr>
<tr>
<td>1988</td>
<td>Cloverdale</td>
<td>NA</td>
<td>1,833 acres, 100 structures</td>
</tr>
<tr>
<td>10/1988</td>
<td>Geysers</td>
<td>FM-2554-CA</td>
<td>12,000 acres, 6 structures</td>
</tr>
<tr>
<td>9/2015</td>
<td>Valley</td>
<td>FM-5112-CA, DR-4240-CA</td>
<td>76,067 acres, 1,955 structures, 4 fatalities</td>
</tr>
<tr>
<td>10/2017</td>
<td>Nuns</td>
<td>FM-5220-CA, DR-4344-CA</td>
<td>54,000 acres*, 1,355 structures, 3 fatalities</td>
</tr>
<tr>
<td>10/2017</td>
<td>Tubbs</td>
<td>FM-5215-CA, DR-4344-CA</td>
<td>36,807 acres, 5,636 structures, 22 fatalities</td>
</tr>
<tr>
<td>10/2019</td>
<td>Kincade</td>
<td>FM-5295-CA</td>
<td>77,758 acres, 374 structures</td>
</tr>
</tbody>
</table>

*Includes acreage across two counties (Sonoma and Napa)

Fire has contributed significantly to Sonoma County’s hazard and disaster history. Some particular fires that have shaped the way fire plays into preparedness, planning, response, recovery, and mitigation efforts are described in the following.

The October 2017 Tubbs Fire would become the most destructive wildfire in California history at the time. Strong winds, drought, low humidity, heavy fuels, and inadequate separations between fuels and structures allowed a fire to ignite and rapidly spread. The fire was one of multiple fires that was simultaneously burning in Northern California. This fire clearly demonstrated the challenges faced in a wildland urban interface environment. The loss of thousands of homes in northern Santa Rosa resulted as the fire developed into a fast-moving fire with extreme fire behaviors. The fire required a massive mutual aid effort forced the evacuation of tens of thousands of residents, burned 5,643 structures, killed 22 people, and resulted in $1.4 billion in damages.

Potential Impacts of the Hazard

The location of the Sonoma State University campus surrounded by areas designated as Very High Fire Hazard Severity Zones places a threat of flame, ember, and smoke exposure from wildfire to the campus. There is potential for fire to occur on three sides of the campus and in the surrounding hillsides composed of light to moderate fuels. The threat of these neighboring hillsides to campus structures is substantial.

Potential impacts to the campus community resulting from wildfires include:

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90 Sonoma County Hazard Mitigation Plan Update, April 2017
- Injuries or loss of life
- Campus property destruction of damage
- Residential property destruction or damage
- Commercial property destruction or damage
- Loss of property contents
- Infrastructure damage
- Damaged or destroyed lifelines/supply routes
- Damaged or destroyed utilities
- Damaged or destroyed critical facilities supporting campus emergency support needs
- Loss of community economic base
- Employment losses
- Loss to ground supporting vegetation on hillsides resulting in erosion or landslides in future precipitation events
- Agricultural (crops and livestock) damages or destruction
- Environmental damage
- Societal and community impacts
- Damage to organizations and facilities providing support services to vulnerable populations
- Greater evacuation challenges for those most vulnerable
- Psychological impacts of impacted populations
- Disruptions to education delivery to community

Potential impacts resulting from wildfire generated smoke include:

- Dangerous levels of air pollution
- Human Health Effects
  - Similar health impacts to pets
- Air conditioning systems overwhelmed
- Greater demands on air filtration systems
- Greater demands on healthcare systems
- Reduced outdoor work productivity
- Closures of academic sessions

Additionally, there remains a number of secondary impacts from wildfires that could affect the campus community. Utilities feeding areas of Sonoma County including the campus may be damaged resulting in power outages. Fire related damage in the watersheds will likely cause future landslides, degradation to plants supporting hillsides, and impact the hydroelectric power capabilities. Fires may present threats to areas of recreation, scenic value, and wildlife that are a part of the culture of the campus community. Finally, the campus may experience effects of evacuated individuals arriving on campus from other areas as a location of refuge.

Probability of Future Occurrence of the Hazard
Based on the wildfire threat potential in the area on and surrounding the Sonoma State campus, including the immediate proximity to hillsides with extensive vegetative growth, including the immediate proximity to Fire Hazard Severity Zones listed as “Moderate” to “High”, and the historic occurrences of fires, the probability of wildfire related damage is considered **Likely**.

Based on the wildfire threat potential in the area surrounding the campus and the San Francisco East Bay region, including the volume of areas in elevated Fire Hazard Severity Zones throughout the Sonoma, Marin, and Napa Counties, the past occurrences of wildfire generated smoke from areas beyond Sonoma County, the probability of wildfire generated smoke impacts to air quality is considered **Possible**.

**Vulnerability to the Hazard**

The Sonoma State University campus is subject to direct impact from wildfire due to the campus location within a wildland-urban interface zone. The campus is identified to reside near a designated local High Fire Hazard Severity Zone. The campus is surrounded on by hillsides and open lands containing combustible vegetation combined with residential development. Additionally, vulnerabilities to the effects of wildfire would lie within the campus community who may reside or work in locations that are exposed to the Fire Hazard Severity Zones in other parts of the surrounding region. Wildfires occurring in other areas of the region may result in the displacement of large numbers of people. These effects may spill onto the campus in the form of evacuees or facility support to emergency resources.

Fire directly threatening the campus would likely take the form of vegetation fires along the hillsides and extending onto the campus or localized fires involving single structures or small areas. Smaller vegetation fires are possible surrounding the campus in the urban forest or fields surrounding the city. These incidents would likely have significant impact to the campus.

The primary basis of vulnerability is based on the population affected and the built environment exposed. In general, newer construction will be more fire resistant than older buildings as building and fire codes and construction technology have improved. Density of buildings and proximity of fuels to buildings or equipment at risk of combustion would additionally influence the fire’s ability to spread to structures. Structures with vegetation and other combustibles near the structure increases the ability of fire to spread to buildings.

Access to the north and south using Petaluma Hill Road and US Highway 101 servicing access to Santa Rosa or San Francisco could become cutoff during fire incidents. Routes to the east are smaller roadways exiting the back of campus that would also likely be impacted by fire making them impassible. The university is limited by these routes for access to and from the campus. Access for supplies, equipment, and emergency services in addition to evacuation away from the campus would likely be forced to use alternative routes into Santa Rosa or south to the Bay Area.
Additional concerns regarding vulnerabilities to wildfire are related to the smoke that fires in the area would produce. The recent summer seasons have clearly demonstrated the reality of large wildfires producing enough smoke to fill the Bay Area even from substantial distances away. These recent fires have displayed how the effects of this smoke impact the general population and especially vulnerable populations. Sonoma State University students, faculty, and staff both on campus and off campus face these same vulnerabilities related to smoke filled air.

Individuals with existing health problems such as respiratory or cardiac illnesses are increasingly vulnerable to wildfire generated smoke. Staff who work in roles requiring outdoor activity will be increasingly exposed during days where the air quality index is considered unhealthy or worse. Student athletes participating in outdoor sports and engaging in aerobic activities are increasingly vulnerable to the effects of wildfire.

The vulnerability to members of the campus community in which wildfire generated smoke on the Sonoma State University campus will vary depending on when the air quality was to reach unhealthy levels. The risk to the campus population will be lessened during periods when classes are not in session or during periods of breaks. Conversely, during the days and hours that classes are in session and staff are at their workplaces, the human vulnerability increases. However, in region-wide events this vulnerability may be shared with the homes and workplaces of members of the campus community and their families.

Vulnerable populations will likely face disproportionate health safety issues from smoke filled air, experience increased stresses, may require the need to remain away from the campus enclosed at home, and may find difficulty in accessing equipment or supplies to aid in a specific need.

Estimate of Potential Losses

Estimates of potential losses will be influenced by a variety of factors. Costs would also be likely to include mitigation or repairs of HVAC systems, sealing of doors and windows, and other methods of keeping smoke from entering buildings. Secondary costs would include lost academic days during campus closures, lost staff on campus productivity, and health and medical interventions for affected members of the campus community.

Based on estimate replacement costs of facilities and structures on campus, the maximum total replacement costs due to wildfire are $289,079,090. However due to the lack of a complete inventory of building and facility costs, the total replacement estimate is likely much higher.

Table 25-26: Wildfire Hazard Potential (WHP) Zone Estimated Losses

<table>
<thead>
<tr>
<th>WHP Zone</th>
<th>No of Buildings</th>
<th>Maximum Replacement Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Extreme</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Very High</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>
High | 12 | $100,561,078 
Moderate | 4 | $1,521,367 
Low | 2 | $62,868 
Very Low | 0 | 0 
Non-Burnable | 19 | $186,933,777 
No Building Value Data Provided* | 8 | Unknown

*Buildings with no value defined are also included in the respective Zones they are found in.

Vulnerability Assessment Conclusions

The occurrence of wildfires has been a frequent event in Sonoma County, including wildfire incidents that have threatened or caused damages near the Sonoma State University campus. The location of the Sonoma State University campus surrounded by open hillsides with light to moderate vegetative fuels along the entire eastern edges presents a threat of fire to the campus community and campus assets. The foothills and mountains surrounding Sonoma County host environments that are ideal for the development of wildfire activity. The consequences of fires in these areas would present primary and secondary consequences to the Sonoma State University campus and expose vulnerabilities on the campus and to the campus community.

The topography of the valley surrounded by mountains allows for smoke filled air to linger in the valleys of Sonoma County area with the potential for unhealthy air quality depending on wind conditions. Fires in the watersheds of the surrounding mountains and tributaries may damage vegetation stabilizing hillsides and result in increased sediments to be discharged into the river system and reservoirs reducing their capacity and effectiveness.

Communities located within or near the Wildland Urban Interface may be subject to damaging fires. These same communities may be home to members of the campus community. The potential for large-scale wildfires in the region further generates the added potential for a number of cascading effects such as disruptions to the local economy, utility failures, disruptions to providing for the needs of the community, and development of public health hazards. The potential for large-scale wildfires and resulting damage of homes and businesses has exponentially powerful impacts on particular populations among the campus community including those with access or functional needs, international students, the homeless, and students residing in the residence halls.

Identified Data Limitations

Data limitations include missing campus structural replacement costs, and lack of both a complete inventory of building construction types and mitigation efforts to lessen the impact due to fire activity. HAZUS generated analysis is focused on the broader community level versus fine-tuning the analysis to the micro-level for facilities such as a university campus.
Severe Weather (Wind, Tornado, Hail, and Lightning)

Description of the Hazard

Severe weather can be described as a variety of weather or climate events that are beyond or near the ends of the range of observed weather patterns and behavior. These events can include high or extreme winds, storms, lightning, hail, tornadoes, heat waves, unusually cold temperatures, extreme rainfall, and flooding. According to the Intergovernmental Panel on Climate Change (IPCC), to be classified as severe (or extreme), the occurrence of each value of a climate or weather variable (e.g., wind, hail, lightning, tornado, etc.) must be “above (or below) a threshold value near the upper (or lower) ends of the range of observed values of the variable.”

Severe weather in California can be generated by local, regional, and/or global weather and climate influences. From the individual thunderstorm to the Santa Ana wind event to the strong El Niño, damaging weather elements that are produced by and accompany severe weather and climate phenomena (e.g., damaging winds, hail, lightning, and tornadoes) occur throughout California and the California State University (CSU) system.

Global Scale Influences on Severe Weather in California: El Niño, La Niña, and ENSO

The El Niño-Southern Oscillation (ENSO) is a recurring climate pattern involving changes in the temperature of waters in the central and eastern tropical Pacific Ocean. On periods ranging from about three (3) to seven (7) years, the surface waters across a large swath of the tropical Pacific Ocean warm or cool by anywhere from 1°C to 3°C, compared to normal. This oscillating warming and cooling pattern, referred to as the ENSO cycle, directly affects rainfall distribution in the tropics and can have a strong influence on weather across the United States and other parts of the world.

El Niño and La Niña are extreme phases of the ENSO cycle, with a third phase occurring between them called the Neutral phase. The El Niño phase is characterized by unusually warm ocean temperatures and weaker-than-normal east winds in the Equatorial Pacific, while the La Niña phase is characterized by unusually cold ocean temperatures and stronger-than-normal east winds in the Equatorial Pacific.

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93 Retrieved on 07.18.2021 from https://www.weather.gov/mhx/ensowhat
lead to significant differences from the average ocean temperatures, winds, surface pressure, and rainfall across parts of the tropical Pacific. The Neutral phase indicates that conditions are near their long-term average.95

The extreme ENSO phases affect the frequency and intensity of weather events across the world, including in California.96 On average, areas across California experience exceptionally stormy winters with increased precipitation under El Niño conditions, but experience less stormy and drier winters under La Niña conditions.97 This variability in storminess and precipitation brought on by El Niño and La Niña events affects the both the frequency and intensity of severe weather conditions experienced by all CSU campuses, including Sonoma State University.

**Regional Climate Influences on Severe Weather across California**

Most of the weather in California is influenced by the wet-winter/ dry-summer Mediterranean climate pattern. In the summer months, Pacific storm tracks are deflected north due to the position of the Pacific High (i.e., a large-scale atmospheric circulation over the Northeast Pacific Ocean), preventing Pacific storms from reaching California. As a result, most summer storms are generated due to the incursion of moist air from the Gulf of Mexico or the Gulf of California, and occur as scattered, locally heavy showers in the desert and mountain regions of the state. In the winter months, the Pacific High decreases in intensity and moves south, permitting powerful Pacific storms to move into and across the state; these storms can produce extreme winds, heavy rains (including “atmospheric river” events), and widespread coastal and inland flooding. (Please see the Flood Hazard profile in this document for information on Floods.) As a result, storm events accompanied by precipitation in California are far more frequent in the winter months than they are in the summer months.98

While the Mediterranean climate pattern influences the seasonal frequency, intensity, geographic spread, and type of some severe weather events CSU campuses experience (including Sonoma State), other severe weather phenomena may occur in California at any time of the year. For example, near the coast and over the Central Valley, there appears to be no defined seasonality to thunderstorms, and these storms are usually light and infrequent. Thunderstorms are more intense and more frequent in the intermediate and higher elevations of the Sierra Nevada, and occur with greater frequency during the summer months.99

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95 Retrieved on 07.17.2021 from https://www.climate.gov/news-features/understanding-climate/el-ni%C3%B1o-and-la-ni%C3%B1a-frequently-asked-questions
96 Retrieved on 07.16.2021 from https://www.pmel.noaa.gov/elnino/what-is-el-nino
98 Retrieved on 07.17.2021 from https://wrcc.dri.edu/Climate/narrative_ca.php
Types of Storms in California

The 2018 California State Hazard Mitigation Plan (SHMP) defines a storm as a violent atmospheric disturbance occurring over land and/or water that is distinguished by its strength, characteristics, and the scale of the resulting damage.\textsuperscript{100} The SHMP also lists the following types of storms that produce hazardous conditions and potential damage throughout the state of California.\textsuperscript{101} These storms affect (in varying degrees) all CSU campuses, including Sonoma State.

- **Thunderstorm**: A rain-bearing cloud that also produces lightning. Thunderstorms can produce some of nature’s most destructive and deadly weather including tornadoes, hail, strong winds, lightning and flooding.\textsuperscript{102} Thunderstorms are caused by an atmospheric imbalance from warm unstable air rising rapidly into the atmosphere. Lightning, which occurs during all thunderstorms, can strike anywhere.\textsuperscript{103} Thunderstorms can produce some of nature’s most destructive and deadly weather including tornadoes, hail, strong winds, lightning and flooding.\textsuperscript{104} *Severe thunderstorms* are more intense, violent, and dangerous thunderstorms. The National Oceanic and Atmospheric Administration (NOAA) defines a severe thunderstorm as any storm that produces one or more of the following elements: Damaging winds or speeds of 58 mph (50 knots) or greater, hail 1 inch in diameter or larger, and/or a tornado.\textsuperscript{105,106}

- **Hailstorm**: a type of storm that precipitates round chunks of ice. Hailstorms usually occur during regular thunderstorms.\textsuperscript{107}

- **Wind storm**: marked by high wind with little or no precipitation.\textsuperscript{108}

\textsuperscript{102} Retrieved on 07.14.2021 from https://www.weather.gov/phi/ThunderstormDefinition
\textsuperscript{104} Retrieved on 07.14.2021 from https://www.noaa.gov/explainers/severe-storms
\textsuperscript{105} Retrieved on 07.15.2021 from https://www.noaa.gov/explainers/severe-storms
\textsuperscript{106} Retrieved on 07.15.2021 from https://www.weather.gov/safety/thunderstorm
- **Winter storm**: A storm that can produce a combination of freezing rain, sleet, heavy snow, and/or strong winds.\textsuperscript{109}
- **Coastal storm**: Large wind-driven waves and/or storm surge that strike the coastal zone.\textsuperscript{110}
- **Ice storm**: Ice storms are one of the most dangerous forms of winter storms. When surface temperatures are below freezing, but a thick layer of above-freezing air remains aloft, rain can fall into the freezing layer and freeze upon impact into a glaze of ice. In general, 8 millimeters (0.31 inch) of accumulation is all that is required, especially in combination with breezy conditions, to start downing power lines as well as tree limbs. Ice storms also make unheated road surfaces too slick to drive on. Ice storms can vary in time range from hours to days and can cripple small towns and large urban centers alike.\textsuperscript{111}
- **Snowstorm**: A heavy fall of snow accumulating at a rate of more than 5 centimeters (2 inches) per hour that lasts several hours. Snowstorms, especially ones with a high liquid equivalent and breezy conditions, can down tree limbs, cut off power, and paralyze travel over a large region.\textsuperscript{112}

### Severe Weather Hazard Elements: Wind Hazards, Hail, and Lightning

This hazard profile concentrates on the following types of severe weather hazards: wind hazards (including tornadoes), hail, and lightning. These hazards are produced by a variety of weather phenomena, including thunderstorms, coastal storms, winter storms, and topographically-enhanced downslope winds. While storm and downslope wind hazards are responsible for severe weather events across the CSU system, only the wind, tornado, hail, and lightning elements generated by these hazards are covered in this profile. (Storm-related hazards such as flooding and extreme temperatures are covered in other sections of this document.)

#### Wind Hazards

Wind is the horizontal movement of air past any given point. Wind begins with differences in air pressures; pressure that is higher at one point than another sets up a

force, pushing the high towards the low pressure.\textsuperscript{113} Wind gusts are defined as “rapid fluctuations in the wind speed with a variation of 10 knots or more between peaks and lulls.” \textsuperscript{114}

Wind hazards in California take several forms: High Wind, Strong Winds, Thunderstorm Winds, Mountain-Valley (Downslope) Winds, and Tornadoes. These hazards are encountered across California, and have the potential to cause harm to or loss of life and/or property throughout California and the CSU system (including Sonoma State).

**High Winds, Strong Winds, and Thunderstorm Winds**

The National Weather Service reports three (3) types of wind events that occur areas over land: High Winds, Strong Winds, and Thunderstorm Winds. Collectively, these reports are used to determine the frequency with which wind hazard events have affected areas across the U.S., including California.

**High Winds**

High winds are defined as sustained non-convective winds of 35 knots (40 mph) or greater lasting for 1 hour or longer, or gusts of 50 knots (58 mph) or greater for any duration (or otherwise locally/regionally defined). In some mountainous areas, the above numerical values are 43 knots (50 mph) and 65 knots (75 mph), respectively.\textsuperscript{115}

**Strong Winds**

Strong winds are defined as non-convective winds gusting less than 50 knots (58 mph), or sustained winds less than 35 knots (40 mph), resulting in a fatality, injury, or damage.\textsuperscript{116}

**Thunderstorm Winds**

Thunderstorm winds are winds that arise from thunderstorm convection (occurring within 30 minutes of lightning being observed or detected), with speeds of at least 50 knots (58 mph). They can also be winds of any speed (non-severe thunderstorm winds below 50 knots (58 mph)) producing a fatality, injury, or damage.\textsuperscript{117}

Please note: **Straight-line wind** is a term used to define any thunderstorm wind that is not associated with rotation. It is used mainly to differentiate from the rotational winds found in tornado-producing storms.\textsuperscript{118} However, it is not a term used in the NCEI Storm Events Database, and therefore cannot be used to determine severe weather history of or potential impacts to CSU campuses.

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\textsuperscript{114} Retrieved on 07.15.2021 from https://forecast.weather.gov/glossary.php?word=wind%20gust
\textsuperscript{115} Retrieved on 07.17.2021 from https://www.nws.noaa.gov/directives/sym/pd01016005curr.pdf
\textsuperscript{118} Retrieved on 07.15.2021 from https://www.nssl.noaa.gov/education/svrwx101/wind/types/
Tornadoes

A tornado is an extreme severe weather wind hazard. A tornado is a rapidly rotating column of air extending from a thunderstorm to the surface of the Earth. This column extends between cloud and the Earth’s surface. The damage from tornadoes comes from the strong winds they contain and the flying debris they create. It is generally believed that rotational wind speeds can be as high as 300 mph in the most violent tornadoes. On a local scale, tornadoes are the most violent and most destructive of all atmospheric phenomena.


Santa Ana Winds. A type of wind hazard that is peculiar to Southern California is called a Santa Ana Wind. Santa Ana winds are strong, topographically-enhanced, extremely dry downslope winds that originate inland and affect coastal southern California and northern Baja California (Mexico). They occur when air from a region of high pressure over the dry, desert region of the southwestern U.S. flows westward towards low pressure located off the California coast. This creates dry winds that flow east to west through the mountain passages in Southern California. These winds have a strong seasonal component; they are most common during the cooler months of the year, occurring from September through May. Santa Ana winds typically feel warm (or even hot) because as the cool desert air moves down the side of the mountain, it is compressed, which causes the temperature of the air to rise. If strong enough, Santa Ana winds can cause major property damage, and may present difficulties for airborne and seagoing transportation. They also may increase wildfire risk because of the dryness of the winds and the speed at which they can spread a flame across the landscape. (Note: The Wildfire hazard is profiled elsewhere in this document.)

Figure below illustrates the mechanisms involved in the generation of Santa Ana winds across Southern California.

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119 Retrieved on 07.15.2021 from https://www.earthnetworks.com/tornado/
120 Retrieved on 07.15.2021 from https://www.nssl.noaa.gov/education/syrwx101/tornadoes/faq/
121 Retrieved on 07.15.2021 from https://www.weather.gov/bgm/severedefinitions
**Diablo Winds.** The Diablo wind is another type of topographically-enhanced downslope wind phenomenon that occurs in the North-Central areas of California. Diablo winds are offshore wind events that flow northeasterly over Northern California’s Coast Ranges, often creating high wind speeds downwind of major canyons and over ridges, and extreme fire danger for the San Francisco Bay Area. Diablo winds are driven by a surface pressure gradient that forms in response to an inverted pressure trough that develops over California.\(^\text{125}\)

**Sundowner Winds.** Sundowner winds are significant and potentially damaging downslope wind and warming events that periodically occur along a short segment of the southern California coast in the vicinity of Santa Barbara, CA. The unique topography of this coastal region promotes the development of Sundowner wind events: over a length of about 100 km, the coastline is oriented approximately west–east, with the adjoining narrow coastal plain bounded by a steeply rising (to elevations greater than 1200 m) and

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\(^{124}\) Retrieved on 07.14.2021 from [https://twitter.com/nwslosangeles/status/933049473034579968](https://twitter.com/nwslosangeles/status/933049473034579968)

\(^{125}\) Retrieved on 07.13.2021 from [https://www.fireweather.org/diablo-winds](https://www.fireweather.org/diablo-winds)
coast-parallel mountain range. Called Sundowner winds because they often begin in the late afternoon or early evening, their onset is typically associated with a rapid rise in temperature and decrease in relative humidity, and the winds tend to blow from the north from the Santa Ynez Mountains to the coast of Santa Barbara County, California. During the more intense Sundowner wind events, wind speeds can be of gale force 39-54 miles per hour) or higher, and can even reach hurricane force (≥ 74 miles per hour) in the most extreme cases. Temperatures over the coastal plain, and even at the coast itself, can rise significantly above 37.8°C (100°F). Seasonally, Sundowner winds peak in March, April, and May, with a minimum during summer and a secondary peak in winter that often corresponds with Santa Ana winds. In addition to causing a dramatic change from the more typical marine-influenced local weather conditions, Sundowner wind episodes have produced significant wind-related property and agricultural damage, as well as conditions of extreme fire danger.\(^{126}\)\(^{127}\)\(^{128}\)

**Hail**

Hail is a form of precipitation consisting of solid ice that forms inside thunderstorm updrafts.\(^{129}\) It is roughly round in shape and at least 0.2‘ in diameter. Hail develops in the upper atmosphere as ice crystals that are bounced about by high velocity updraft winds; the ice crystals accumulate frozen droplets and fall after developing enough weight. The size of hailstones varies and is a direct consequence of the severity and size of the storm that produces them – the higher the temperatures at the Earth’s surface, the greater the strength of the updrafts and the amount of time hailstones are suspended, and therefore the greater the size of the hailstone.\(^{130}\)

**Lightning**

Lightning is an electrical discharge produced by a thunderstorm. Lightning rapidly heats the air in its immediate vicinity to about 50,000°F - about five times the temperature of the surface of the sun. This compresses the surrounding air and creates a supersonic shock wave, which decays to an acoustic wave that is heard as thunder.\(^{131}\)

The discharge may occur within or between clouds, between the cloud and air, between a cloud and the ground, or between the ground and a cloud.\(^{132}\) Lightning that is produced

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from thunderstorms in which precipitation evaporates before reaching the ground is called “dry lightning.”

Location of the Hazard

Severe weather is a non-spatial hazard, and can occur anywhere in the CSU system, including on the Sonoma State campus. No one area of the campus – or of the surrounding community – is subject to experiencing severe weather more than any other area.

There is geographic variability among the different types of mountain and valley wind events (as a sub-category of the severe weather hazard). Santa Ana winds occur in Southern California, Diablo winds occur in North-Central California, and Sundowner winds occur almost exclusively in Santa Barbara County, California.

Extent of the Hazard

Severe weather hazards are non-spatial hazards that potentially affect all Sonoma State campus areas equally. However, the smallest geographic unit of measurement for almost all official severe weather event data is at the county level. Because the severe weather data used do not exist at the campus level, it is assumed that the same (or similar) severe weather risks to Sonoma State reflect those of the surrounding community and County. As a result, all assets and people at Sonoma State are at risk from the effects of severe weather and can expect to experience at least some (or the complete range of) endemic severe weather hazards. In consideration of the campus’ design, layout, and operations, the severe weather history and degree of severity in the Rohnert Park area, and the history and degree of severity of each severe weather sub-type identified by the extent scales (below), the campus planning committee ranks the overall extent of the Severe Weather hazard as MODERATE. See each sub-hazard below for the planning committee’s sub-type extent ranking.

Wind Hazard: Non-Rotational

The Beaufort Scale is an empirical measure that relates wind speed to observed conditions at sea or on land. Its full name is the Beaufort wind force scale. First developed in 1805, it is still used today to estimate wind strengths.

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133 Retrieved on 07.15.2021 from https://www.rmets.org/resource/beaufort-scale
## Table 25-27: Beaufort Wind Force Scale

<table>
<thead>
<tr>
<th>Force</th>
<th>Speed (mph)</th>
<th>Speed (knots)</th>
<th>Description</th>
<th>Specifications for use at sea</th>
<th>Specifications for use on land</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0-1</td>
<td>0-1</td>
<td>Calm</td>
<td></td>
<td>Sea like a mirror.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Calm; smoke rises vertically.</td>
</tr>
<tr>
<td>1</td>
<td>1-3</td>
<td>1-3</td>
<td>Light Air</td>
<td>Ripples with the appearance of scales are formed, but without foam crests.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Direction of wind shown by smoke drift, but not by wind vanes.</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>4-7</td>
<td>4-6</td>
<td>Light Breeze</td>
<td>Small wavelets, still short, but more pronounced. Crests have a glassy appearance and do not break.</td>
<td>Wind felt on face; leaves rustle; ordinary vanes moved by wind.</td>
</tr>
<tr>
<td>3</td>
<td>8-12</td>
<td>7-10</td>
<td>Gentle Breeze</td>
<td>Large wavelets. Crests begin to break. Foam of glassy appearance. Perhaps scattered white horses.</td>
<td>Leaves and small twigs in constant motion; wind extends light flag.</td>
</tr>
<tr>
<td>4</td>
<td>13-18</td>
<td>11-16</td>
<td>Moderate Breeze</td>
<td>Small waves, becoming larger; fairly frequent white horses.</td>
<td>Raises dust and loose paper; small branches are moved.</td>
</tr>
<tr>
<td>5</td>
<td>19-24</td>
<td>17-21</td>
<td>Fresh Breeze</td>
<td>Moderate waves, taking a more pronounced long form; many white horses are formed.</td>
<td>Small trees in leaf begin to sway; crested wavelets form on inland waters.</td>
</tr>
<tr>
<td>6</td>
<td>25-31</td>
<td>22-27</td>
<td>Strong Breeze</td>
<td>Large waves begin to form; the white foam crests are more extensive everywhere.</td>
<td>Large branches in motion; whistling heard in telegraph wires; umbrellas used with difficulty.</td>
</tr>
<tr>
<td>7</td>
<td>32-38</td>
<td>28-33</td>
<td>Near Gale</td>
<td>Sea heaps up and white foam from breaking waves begins to be blown in streaks along the direction of the wind.</td>
<td></td>
</tr>
</tbody>
</table>

135 Retrieved on 07.15.2021 from [https://www.weather.gov/mfl/beaufort](https://www.weather.gov/mfl/beaufort)
<p>| | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>8</td>
<td>39-46</td>
<td>34-40</td>
<td>Gale</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Whole trees in motion; inconvenience felt when walking against the wind.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Moderately high waves of greater length; edges of crests begin to break into spindrift. The foam is blown in well-marked streaks along the direction of the wind.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Breaks twigs off trees; generally impedes progress.</td>
</tr>
<tr>
<td>9</td>
<td>47-54</td>
<td>41-47</td>
<td>Severe Gale</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>High waves. Dense streaks of foam along the direction of the wind. Crests of waves begin to topple, tumble and roll over. Spray may affect visibility</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Slight structural damage occurs (chimney-pots and slates removed)</td>
</tr>
<tr>
<td>10</td>
<td>55-63</td>
<td>48-55</td>
<td>Storm</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Very high waves with long overhanging crests. The resulting foam, in great patches, is blown in dense white streaks along the direction of the wind. On the whole the surface of the sea takes on a white appearance. The tumbling of the sea becomes heavy and shock-like. Visibility affected.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Seldom experienced inland; trees uprooted; considerable structural damage occurs.</td>
</tr>
<tr>
<td>11</td>
<td>64-72</td>
<td>56-63</td>
<td>Violent Storm</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Exceptionally high waves (small and medium-size ships might be for a time lost to view behind the waves). The sea is completely covered with long white patches of foam lying along the direction of the wind. Everywhere the edges of the wave crests are blown into froth. Visibility affected.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Very rarely experienced; accompanied by widespread damage.</td>
</tr>
<tr>
<td>12</td>
<td>73+</td>
<td>64+</td>
<td>Hurricane</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>The air is filled with foam and spray. Sea completely white with driving spray; visibility very seriously affected.</td>
</tr>
</tbody>
</table>

Based on those extent ranking factors identified (above), the planning committee ranks the extent of non-rotational wind hazards as **MODERATE**.
Extent: Tornado

Tornadoes have their own severity/extent scale. Until 2007, tornadoes were measured and described according to the Fujita Scale.136

In February 2007, use of the Fujita Scale was discontinued. In its place, the Enhanced Fujita (EF) Scale is used. The Enhanced Fujita scale considers how most structures are designed and is thought to be a much more accurate representation of the surface wind speeds in the most violent tornadoes. Like the original Fujita scale, the Enhanced Fujita scale is a set of wind estimates (not measurements) based on damage.

It is important to note the date that a tornado occurred. Tornadoes that occurred prior to February, 2007 are classified using the original Fujita scale and will not be converted to the Enhanced Fujita Scale.

Table below illustrates the Fujita Scale in use prior to February 2007.

Table 25-28: Fujita Tornado Scale (Pre-February 2007) 137

<table>
<thead>
<tr>
<th>F-Scale Number</th>
<th>Intensity Phrase</th>
<th>Wind Speed</th>
<th>Type of Damage</th>
</tr>
</thead>
<tbody>
<tr>
<td>F0</td>
<td>Gale tornado</td>
<td>40-72 mph</td>
<td>Some damage to chimneys; breaks branches off trees; pushes over shallow-rooted trees; damages sign boards.</td>
</tr>
<tr>
<td>F1</td>
<td>Moderate tornado</td>
<td>73-112 mph</td>
<td>The lower limit is the beginning of hurricane wind speed; peels surface off roofs; mobile homes pushed off foundations or overturned; moving autos pushed off the roads; attached garages may be destroyed.</td>
</tr>
<tr>
<td>F2</td>
<td>Significant tornado</td>
<td>113-157 mph</td>
<td>Considerable damage. Roofs torn off frame houses; mobile homes demolished; boxcars pushed over; large trees snapped or uprooted; light object missiles generated.</td>
</tr>
<tr>
<td>F3</td>
<td>Severe tornado</td>
<td>158-206 mph</td>
<td>Roof and some walls torn off well-constructed houses; trains overturned; most trees in forest uprooted.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>F4</th>
<th>Devastating tornado</th>
<th>207-260 mph</th>
<th>Well-constructed houses leveled; structures with weak foundations blown off some distance; cars thrown and large missiles generated.</th>
</tr>
</thead>
<tbody>
<tr>
<td>F5</td>
<td>Incredible tornado</td>
<td>261-318 mph</td>
<td>Strong frame houses lifted off foundations and carried considerable distances to disintegrate; automobile sized missiles fly through the air in excess of 100 meters; trees debarked; steel reinforced concrete structures badly damaged.</td>
</tr>
<tr>
<td>F6</td>
<td>Inconceivable tornado</td>
<td>319-379 mph</td>
<td>These winds are very unlikely. The small area of damage they might produce would probably not be recognizable along with the mess produced by F4 and F5 wind that would surround the F6 winds. Missiles, such as cars and refrigerators would do serious secondary damage that could not be directly identified as F6 damage. If this level is ever achieved, evidence for it might only be found in some manner of ground swirl pattern, for it may never be identifiable through engineering studies.</td>
</tr>
</tbody>
</table>

Table below illustrates the Enhanced Fujita (EF) Scale, currently in use. Tornadoes that have occurred since February, 2007 are classified using the Enhanced Fujita Scale.
Table 25-29: Enhanced Fujita Scale (February 2007 and Later)  

<table>
<thead>
<tr>
<th>Enhanced Fujita Category</th>
<th>Wind Speed</th>
<th>Potential Damage</th>
</tr>
</thead>
<tbody>
<tr>
<td>EF0</td>
<td>65-85 mph</td>
<td>Light damage. Peels surface off some roofs; some damage to gutters or siding; branches broken off trees; shallow-rooted trees pushed over.</td>
</tr>
<tr>
<td>EF1</td>
<td>86-110 mph</td>
<td>Moderate damage. Roofs severely stripped; mobile homes overturned or badly damaged; loss of exterior doors; windows and other glass broken.</td>
</tr>
<tr>
<td>EF2</td>
<td>111-135 mph</td>
<td>Considerable damage. Roofs torn off well-constructed houses; foundations of frame homes shifted; mobile homes completely destroyed; large trees snapped or uprooted; light-object missiles generated; cars lifted off ground.</td>
</tr>
<tr>
<td>EF3</td>
<td>136-165 mph</td>
<td>Severe damage. Entire stories of well-constructed houses destroyed; severe damage to large buildings such as shopping malls; trains overturned; trees debarked; heavy cars lifted off the ground and thrown; structures with weak foundations blown away some distance.</td>
</tr>
<tr>
<td>EF4</td>
<td>166-200 mph</td>
<td>Devastating damage. Well-constructed houses and whole frame houses completely leveled; cars thrown and small missiles generated.</td>
</tr>
<tr>
<td>EF5</td>
<td>&gt;200 mph</td>
<td>Incredible damage. Strong frame houses leveled off foundations and swept away; automobile-sized missiles fly through the air in excess of 100 m (107 yd); high-rise buildings have significant structural deformation; incredible phenomena will occur.</td>
</tr>
</tbody>
</table>

Based on the extent ranking factors identified (above), the planning committee ranks the extent of tornados as **LOW**.

**Extent: Hail**

The National Oceanic and Atmospheric Administration and the Tornado and Storm Research Organization (TORRO) have combined efforts to create the Hailstorm Intensity Scale. Table below provides details of this scale.

Table 25-30: Combined NOAA/TORRO Hailstorm Intensity Scale

<table>
<thead>
<tr>
<th>Size Code</th>
<th>Intensity Category</th>
<th>Typical Hail Diameter</th>
<th>Approximate Size</th>
<th>Typical Damage Impacts</th>
</tr>
</thead>
<tbody>
<tr>
<td>H0</td>
<td>Hard Hail</td>
<td>Up to 0.33”</td>
<td>Pea</td>
<td>No damage</td>
</tr>
<tr>
<td>H1</td>
<td>Potentially Damaging</td>
<td>0.33” – 0.60”</td>
<td>Marble or Mothball</td>
<td>Slight damage to plants and crops</td>
</tr>
<tr>
<td>H2</td>
<td>Potentially Damaging</td>
<td>0.60” – 0.80”</td>
<td>Dime or grape</td>
<td>Significant damage to fruit, crops, and vegetation</td>
</tr>
<tr>
<td>H3</td>
<td>Severe</td>
<td>0.80” – 1.20”</td>
<td>Nickel to Quarter</td>
<td>Severe damage to fruit and crops, damage to glass and plastic</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>H4</th>
<th>Severe</th>
<th>1.20” – 1.60”</th>
<th>Half Dollar to Ping Pong Ball</th>
<th>Widespread glass damage, vehicle body damage</th>
</tr>
</thead>
<tbody>
<tr>
<td>H5</td>
<td>Destructive</td>
<td>1.60” – 2.0”</td>
<td>Silver Dollar to Golf Ball</td>
<td>Wholesale destruction of glass, damage to tiled roofs, significant risk of injuries</td>
</tr>
<tr>
<td>H6</td>
<td>Destructive</td>
<td>2.0” – 2.4”</td>
<td>Lime or Egg</td>
<td>Aircraft body dented; brick walls pitted</td>
</tr>
<tr>
<td>H7</td>
<td>Very Destructive</td>
<td>2.4” – 3.0”</td>
<td>Tennis Ball</td>
<td>Severe roof damage, risk of serious injuries</td>
</tr>
<tr>
<td>H8</td>
<td>Very Destructive</td>
<td>3.0” – 3.5”</td>
<td>Baseball to Orange</td>
<td>Severe damage to aircraft body</td>
</tr>
</tbody>
</table>
Based on those extent ranking factors identified (above), the planning committee ranks the extent of the hail hazard as **LOW**.

**Extent: Lightning**

The National Weather Service (NWS) uses a Lightning Activity Level (LAL) scale to indicate the frequency and character of cloud-to-ground (C/G) lightning. The scale uses a range of 1 – 6, with 6 being the high end of the scale. Table 25-XX provides details of the LAL scale.

Table 25-31: Lightning Activity Level (LAL) Scale

<table>
<thead>
<tr>
<th>Rank</th>
<th>Cloud and Storm Development</th>
<th>Areal Coverage</th>
<th>Counts C/G per 5 Minutes</th>
<th>Counts C/G per 15 Minutes</th>
<th>Average C/G per Minute</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>No Thunderstorms</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
</tr>
</tbody>
</table>

---

140 Retrieved on 07.19.2021 from [https://graphical.weather.gov/definitions/defineLAL.html](https://graphical.weather.gov/definitions/defineLAL.html)
## Lightning Activity Level Scale

<table>
<thead>
<tr>
<th>Rank</th>
<th>Cloud and Storm Development</th>
<th>Areal Coverage</th>
<th>Counts C/G per 5 Minutes</th>
<th>Counts C/G per 15 Minutes</th>
<th>Average C/G per Minute</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>Cumulus clouds are common but only a few reaches the towering stage. A single thunderstorm</td>
<td>&lt;15%</td>
<td>1-5</td>
<td>1-8</td>
<td>&lt;1</td>
</tr>
<tr>
<td></td>
<td>must be confirmed in the rating area. The clouds mostly produce virga, but light rain will</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>occasionally reach ground. Lightning is very infrequent.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Cumulus clouds are common. Swelling and towering cumulus cover less than 2/10 of the sky.</td>
<td>15% to 24%</td>
<td>6-10</td>
<td>9-15</td>
<td>1-2</td>
</tr>
<tr>
<td></td>
<td>Thunderstorms are few, but 2 to 3 occur within the observation area. Light to moderate rain</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>will reach the ground, and lightning is infrequent.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Swelling cumulus and towering cumulus cover 2-3/10 of the sky.</td>
<td>25% to 50%</td>
<td>11-15</td>
<td>16-25</td>
<td>2-3</td>
</tr>
<tr>
<td></td>
<td>Thunderstorms are scattered but more than three must occur within the observation area.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Moderate rain is commonly produced, and lightning is frequent.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Towering cumulus and thunderstorms are numerous. They cover more than 3/10 and occasionally</td>
<td>&gt;50%</td>
<td>&gt;15</td>
<td>&gt;25</td>
<td>&gt;3</td>
</tr>
<tr>
<td></td>
<td>obscure the sky. Rain is moderate to heavy, and lightning is frequent and intense.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### Lightning Activity Level Scale

<table>
<thead>
<tr>
<th>Rank</th>
<th>Cloud and Storm Development</th>
<th>Areal Coverage</th>
<th>Counts C/G per 5 Minutes</th>
<th>Counts C/G per 15 Minutes</th>
<th>Average C/G per Minute</th>
</tr>
</thead>
<tbody>
<tr>
<td>6</td>
<td>Dry lightning outbreak. (LAL of 3 or greater with majority of storms producing little or no rainfall.)</td>
<td>&gt;15%</td>
<td>None</td>
<td>None</td>
<td>None</td>
</tr>
</tbody>
</table>

Based on those extent ranking factors identified (above), the planning committee ranks the extent of the lightening hazard as **LOW**.

*Extent: Thunderstorms that Generate Wind, Tornado, Hail, and Lightning Hazard Events*

Thunderstorms are not explicitly identified as a severe weather category for this hazard profile. However, they are responsible for most tornado, lightning, and hail hazard events – as well as a significant number of wind hazard events – across California and the CSU system. While individual thunderstorms affect relatively small areas, there are many instances in which thunderstorms can cluster together and/or travel in a line over long distances, producing significant damage over large geographic areas.

A thunderstorm is classified as “severe” when certain meteorological parameters within the thunderstorm are reached (i.e., damaging winds or speeds of 58 mph (50 knots) or greater, hail 1 inch in diameter or larger, and/or a tornado). However, there is currently no established, objective severity scale for thunderstorms.\(^{141}\) \(^{142}\) That said, according to the *Glossary of Meteorology* published by the American Meteorological Society (AMS), a thunderstorm is reported as *light, medium, or heavy* according to following five (5) characteristics:

- the nature of the lightning and thunder;
- the type and intensity of the precipitation, if any;
- the speed and gustiness of the wind;
- the appearance of the clouds; and
- the effect upon surface temperature.\(^ {143}\)

\(^{141}\) Retrieved on 07.15.2021 from [https://www.noaa.gov/explainers/severe-storms](https://www.noaa.gov/explainers/severe-storms)

\(^{142}\) Retrieved on 07.15.2021 from [https://www.weather.gov/safety/thunderstorm](https://www.weather.gov/safety/thunderstorm)

A thunderstorm may also be classified by the nature of the overall weather situation in which the thunderstorm is produced, including:

- **Airmass Thunderstorm**: A thunderstorm produced by local convection within an unstable air mass.\(^{144}\)

- **Frontal Thunderstorm**: An individual thunderstorm the initiation of which results from rising motion associated with a front, or a thunderstorm within a convective system generated and organized by frontal rising motion.\(^{145}\)

- **Squall-line Thunderstorm**: An individual thunderstorm included within a squall line (i.e., a continuous or broken line of active deep moist convection frequently associated with thunder).\(^{146}\) \(^{147}\)

Based on the extent ranking factors identified (above) in relation to campus layout and operations, and past event low degree of severity, the planning committee ranks the extent of the thunderstorm hazard as **LOW**.


History of the Hazard

Severe weather hazards have been an annual occurrence in Sonoma and on the Sonoma State campus. Historical data for these hazards are presented below.

Historical Storm Data Collection: NCEI Storm Events Database

Historical information regarding severe weather hazards can be found using The National Centers for Environmental Information (NCEI) Storm Events Database. The Storm Events Database contains searchable, archived National Weather Service (NWS) storm data from January 1950 to April 2021, as entered by NOAA’s National Weather Service (NWS). Due to changes in the data collection and processing procedures over time, there are unique periods of record available depending on the event type.\textsuperscript{148} For example, from 1950 through 1954, only tornado events were recorded; from 1955 through 1995, only tornado, thunderstorm wind, and hail events were introduced into the database; from 1996 to present, 45 additional event types are recorded, including high wind, strong wind, and lightning events.\textsuperscript{149} To obtain the most accurate portrayal of severe weather event frequency, searches of the Storm Events Database are conducted using data collected since 01/01/1996. As a reminder, all official severe weather event data is at the county level. Severe weather data do not exist at the campus level. That said, it may be the case that the campus to some degree experiences the severe weather events reported for the surrounding community and County.

Wind Hazards (excluding Tornadoes)

Information obtained from the NCEI Storm Event Database website shows the number of events (or occurrences) of wind hazard events in Sonoma County since 1996.\textsuperscript{150} Here, wind hazard events include all “High Wind,” “Strong Wind,” and “Thunderstorm Wind” storm reports.\textsuperscript{151}

- **High Wind**: at least 90 events, or approximately 3.55 events per year\textsuperscript{152}

\textsuperscript{150} National Climatic Data Center. Storm Events Database. Retrieved 07.19.2021 from https://www.ncdc.noaa.gov/stormevents/
\textsuperscript{151} National Climatic Data Center. Storm Events Database. Retrieved 07.19.2021 from https://www.ncdc.noaa.gov/stormevents/
\textsuperscript{152} National Climatic Data Center. Storm Events Database. Retrieved 07.31.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28Z%29+High+Wind&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=SONOMA%3A97&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA
- **Strong Wind:** at least 219 events, or 8.64 events per year\(^{153}\)
- **Thunderstorm Wind:** at least 7 events, or approximately 0.28 events per year\(^{154}\)
- **All Wind Hazard events** (excluding Tornadoes): at least 310 events, or approximately 12.24 events per year.\(^{155}\) (Note: This was determined by conducting a simultaneous search of the component wind hazards of high wind, strong wind and thunderstorm wind.)

Overall, in Sonoma County, there have been at least 310 wind hazard events since 1996, excluding tornadoes.\(^{156}\) That translates to an approximate average historical frequency of occurrence of **12.24** wind hazard events per year.

Please note: Differences between the sums of individual component severe weather hazard event Database searches (i.e., 316 events) and simultaneous Database searches of all severe weather hazard events (i.e., 310 events) may be due to the following factors: (1) multiple event types are in the same record (e.g., "Thunderstorm Wind/Hail" or "Hail/Tornado;" and/or (2) severe weather hazard events such as “Thunderstorm Wind” or “Hail” that are reported for Sonoma County have actually taken place hundreds of miles away, but are erroneously recorded as events that have occurred in the County.\(^{157}\) When such a discrepancy arises, the more conservative aggregate hazard wind event value (i.e., 310 events) is used to determine the historical frequency of occurrence for the severe weather hazard. The origin of this discrepancy is unknown at this time.

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\(^{153}\) National Climatic Data Center. Storm Events Database. Retrieved 07.31.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28Z%29+Strong+Wind&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=SONOMA%3A97&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA

\(^{154}\) National Climatic Data Center. Storm Events Database. Retrieved 07.31.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Thunderstorm+Wind&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=SONOMA%3A97&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA

\(^{155}\) National Climatic Data Center. Storm Events Database. Retrieved 07.31.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28Z%29+High+Wind&eventType=%28Z%29+Strong+Wind&eventType=%28C%29+Thunderstorm+Wind&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=SONOMA%3A97&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA

\(^{156}\) National Climatic Data Center. Storm Events Database. Retrieved 07.31.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28Z%29+High+Wind&eventType=%28Z%29+Strong+Wind&eventType=%28C%29+Thunderstorm+Wind&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=SONOMA%3A97&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA

Historical Wind Hazard Losses for Sonoma County since 1996

According to the NCEI Storm Events Database, the wind hazard events that Sonoma County has experienced since 1996 have been costly. There have been 5 deaths and 5 injuries, and property damage estimates have totaled approximately $3,859,000; there have been no crop damages reported.158

Tornado Wind Hazards

Information from the NCEI Storm Events Database indicates that since 1996, there have been 6 reported events of tornadoes in Sonoma County, which translates to approximately 0.24 tornado events per year.159 The majority of tornadoes that have occurred in Sonoma County have been rated at the F1/EF1 severity level, with the remaining tornadoes rated at the F0/EF0 severity level.160

Historical Tornado Hazard Losses for Sonoma County since 1996

According to the NCEI Storm Events Database, the tornado hazard events that Sonoma County has experienced since 1996 have been costly. While there have been no tornado-related deaths, there has been 1 injury, and property damage estimates have totaled approximately $1,204,000; crop damage estimates have been minimal (i.e., $500).161

Hail

Information from the NCEI Storm Events Database indicates that since 1996, there have been 21 reported events of hail in Sonoma County, which translates to approximately 0.83 hail events per year.162 (Note: The NCEI Storm Event Database search results for hail

158 National Climatic Data Center. Storm Events Database. Retrieved 07.31.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28Z%29+High+Wind&eventType=%28Z%29+Strong+Wind&eventType=%28C%29+Thunderstorm+Wind&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=SONOMA%3A97&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA
159 National Climatic Data Center. Storm Events Database. Retrieved 07.31.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Tornado&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=SONOMA%3A97&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA
160 National Climatic Data Center. Storm Events Database. Retrieved 07.31.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Tornado&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=SONOMA%3A97&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA
161 National Climatic Data Center. Storm Events Database. Retrieved 07.31.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Tornado&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=SONOMA%3A97&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA
162 National Climatic Data Center. Storm Events Database. Retrieved 07.31.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Hail&beginDate_mm=01&
indicate that there has been a total of 22 reports of hail since 1996. However, one (1) entry is for a hail event in San Diego County, hundreds of miles away from Sonoma County. The origin of this error is unknown at this time.

**Historical Hail Hazard Losses for Sonoma County since 1996**

According to the NCEI Storm Events Database, since 1996, there have been no deaths, injuries, property damage, or crop damage attributed to hail in Sonoma County.163 (Note: The San Diego County hail event that was included erroneously in the search results for hail hazard events in Sonoma County accounted for all injuries (i.e., 5) and crop damage estimates (i.e., $300,000) presented in the search results.)

**Lightning**

Information from the NCEI Storm Events Database indicates that since 1996, there have been three (3) reported event(s) of lightning in Sonoma County, which translates to approximately 0.12 lightning events per year.164

**Historical Lightning Hazard Losses for Sonoma County since 1996**

According to the NCEI Storm Events Database, the lightning hazard events that Sonoma County has experienced since 1996 have been costly. While there have been no deaths there has been 1 injury, and property damage estimates have totaled approximately $1,000,000; no crop damage has been reported.165

**All Severe Weather Hazard Events Recorded by the NCEI Storm Events Database**

163 National Climatic Data Center. Storm Events Database. Retrieved 07.31.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Hail&beginDate_yyyy=1996&endDate_yyyy=2021&county=SONOMA%3A97&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA

164 National Climatic Data Center. Storm Events Database. Retrieved 07.31.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Lightning&beginDate_yyyy=1996&endDate_yyyy=2021&county=SONOMA%3A97&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA

165 National Climatic Data Center. Storm Events Database. Retrieved 07.31.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Lightning&beginDate_yyyy=1996&endDate_yyyy=2021&county=SONOMA%3A97&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA
Information obtained from the NCEI Storm Events Database indicates that there have been 340 occurrences of the severe weather hazard in Sonoma County. This translates to **13.42** severe weather hazard occurrences per year.\footnote{166}

Please note: Differences between the sums of individual component severe weather hazard event Database searches (i.e., 347 events) and simultaneous Database searches of all severe weather hazard events (i.e., 340 events) may be due to the following factors: (1) multiple event types are in the same record (e.g., "Thunderstorm Wind/Hail" or "Hail/Tornado;", and/or (2) severe weather hazard events such as “Thunderstorm Wind” or “Hail” that are reported for Sonoma County have actually taken place hundreds of miles away, but are erroneously recorded as events that have occurred in the County.\footnote{167}

When such a discrepancy arises, the more conservative aggregate hazard wind event value (i.e., 340 events) is used to determine the historical frequency of occurrence for the severe weather hazard. The origin of this discrepancy is unknown at this time.

**Historical, Aggregated Severe Hazard Losses for Sonoma County since 1996**

According to the NCEI Storm Events Database, the severe weather events that Sonoma County has experienced since 1996 have been costly. There have been 5 deaths and 7 injuries, and property and crop damage estimates have totaled approximately $6,062,000 and $500, respectively.\footnote{168} *It is important to note that for all Sonoma County severe weather hazard events recorded on the Storm Events Database, all deaths, most injuries, and almost two-thirds of all estimated property damages have been attributed to wind hazard events alone; tornadoes and lightning hazard events have comprised 19.9% and 16.5% of the remaining property damage estimates, respectively.*

**Wind Hazards Not Included in the NCEI Storm Events Database**

*Santa Ana Winds*

\footnote{166} National Climatic Data Center. Storm Events Database. Retrieved 07.31.2021 from \url{https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Hail&eventType=%28Z%29+High+Wind&eventType=%28C%29+Lightning&eventType=%28Z%29+Strong+Wind&eventType=%28C%29+Thunderstorm+Wind&eventType=%28C%29+Tornado&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=SONOMA%3A97&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA}


\footnote{168} National Climatic Data Center. Storm Events Database. Retrieved 07.31.2021 from \url{https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Hail&eventType=%28Z%29+High+Wind&eventType=%28C%29+Lightning&eventType=%28Z%29+Strong+Wind&eventType=%28C%29+Thunderstorm+Wind&eventType=%28C%29+Tornado&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=SONOMA%3A97&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA}
Santa Ana wind events occur at least twice per month from October through April.\textsuperscript{169} From 1948 to 2012, total of 2056 events on the 65-year record were recorded in the Southern California region, yielding an average of \textit{32 occurrences per year}. Typical Santa Ana wind events last 1–2 days and represent 27\% of the occurrences, with events lasting up to 6 days accounting for 90\% of all occurrences. The remaining 10\% are made up almost entirely of events lasting between 7 and 12 days.\textsuperscript{170, 171}

Figure below shows the mean monthly frequency per season of Santa Ana Wind events detected from 1948 to 2012. Extreme Santa Ana wind events are shown in dark red, and are defined as those events that are above the 90th percentile of all events on record.

**Diablo Winds**

Diablo wind events occur approximately *2.5 events per year*. These events are most frequent during the fall and early winter seasons, with the highest frequency of events occurring in October. As a result, the highest risk of Diablo-wind-related damage is in the fall and early winter.¹⁷⁴

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Figure below shows the monthly frequency of Diablo winds (along with average live fuel moisture content). The Diablo Wind data are derived from a 17-year climatology of San Francisco Bay Area regional surface weather stations.\(^{175}\)

Figure 25-19: Monthly Frequency of Diablo Winds and Average Live Fuel Moisture Content (Dashed Line)\(^{176}\)

\[\text{Sundowner Winds}\]

Strong sundowner wind events occur approximately \textbf{2-3 times per year}. These events can create sharp temperature rises, local gale force winds, and significant weather-related problems. Rare, “explosive” types of sundowner wind events occur about 6 times per century that present dangerous weather situations, generating extremely strong and hot winds that can reach gale force or higher speeds.\(^{177}\)

\[\text{Historical Frequency of All Severe Weather Hazards}\]

Table below shows the average historical frequency of severe weather hazard events for Sonoma County since 1996.)

\(^{175}\) Retrieved on 07.15.2021 from https://www.fireweather.org/diablo-winds

\(^{176}\) Retrieved on 07.13.2021 from https://www.fireweather.org/diablo-winds

**Table 25-32: Severe Weather Hazard Event**

Frequencies for Sonoma County since 1996.

<table>
<thead>
<tr>
<th>Severe Weather Hazard Category</th>
<th>Average Number of Hazard Events Per Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wind (Includes High, Strong and Thunderstorm Winds ONLY)</td>
<td>12.24</td>
</tr>
<tr>
<td>Tornado</td>
<td>0.24</td>
</tr>
<tr>
<td>Hail</td>
<td>0.83</td>
</tr>
<tr>
<td>Lightning</td>
<td>0.12</td>
</tr>
<tr>
<td>Diablo Wind</td>
<td>2.5</td>
</tr>
<tr>
<td>Santa Ana Wind *</td>
<td>32</td>
</tr>
<tr>
<td>Sundowner Wind*</td>
<td>2 to 3</td>
</tr>
</tbody>
</table>

* Note: The Santa Ana and Sundowner wind hazards are not present in Sonoma County. They are included here for information purposes only.

**Potential Impacts of the Hazard**

The significance (or priority) of a hazard’s potential impacts is based primarily on the frequency and resulting damage caused by the hazard, including deaths/injuries and property, crop, and economic damage. All assets and people within Sonoma State University campus areas are at risk from the effects of severe weather hazards.

**Wind Hazards (Including Tornadoes)**

Wind hazard events have the potential to impact people, property, and operations on campuses across the CSU system. People caught in the open during an extreme wind event are exposed to high winds and debris, and could be injured or killed.

The habitability of buildings can be compromised (by damaging roofs, windows, or other weak points in the building envelope), leading to long-term operational issues for the campus. As with most university campuses, space is always at a premium at the Sonoma State campus, and the loss of any currently utilized space due to building or structural damage would likely disrupt operations and the University’s mission.
Extreme wind events can result in power failure, which would impact the operation of the campus. Fallen tree limbs and other potential transportation hazards may also cause disruption to the surrounding community and limit ingress/egress to the campus.

According to the 2018 City of Rohnert Park Local Hazard Mitigation Plan, wind hazards (including tornadoes) are not considered to be hazards of concern for the city; this means that wind hazards and tornadoes are considered to have low significance and therefore minimal potential impact on the city. However, the Sonoma County Multijurisdictional Hazard Mitigation Plan Update 2021 rates the severe weather hazards of “damaging winds” and tornadoes as having a MEDIUM risk of impacting the Sonoma County planning area (i.e., a moderate potential impact rating). Although the Sonoma State University campus is located within the Rohnert Park planning area, the city is surrounded by the Sonoma County planning area. Therefore, to accommodate both jurisdictional hazard mitigation plans, wind hazards and tornadoes are considered to have a low to moderate potential impact on the Sonoma State campus and surrounding areas.

**Hail**

Hail typically impacts property by damaging structures, cars, and utilities as it falls. Dents in cars, broken glass, and holes in roofs are common impacts of hail. Injuries to people from hail are less common, though they can happen, as hail is a hard object falling in an unpredictable manner at a fairly high rate of speed.

According to the 2018 City of Rohnert Park Local Hazard Mitigation Plan, hail is not considered to be a hazard of concern for the city; this means that the hail hazard is considered to have low significance and therefore minimal potential impact on the city. However, the Sonoma County Multijurisdictional Hazard Mitigation Plan Update 2021 rates the severe weather hazards of “thunderstorms, lightning, and hail” as having a medium risk of impacting the Sonoma County planning area (i.e., a moderate potential impact rating). Although the Sonoma State University campus is located within the Rohnert Park planning area, the city is surrounded by the Sonoma County planning area. Therefore, to accommodate both jurisdictional hazard mitigation plans, hail hazards are

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considered to have a low to moderate potential impact on the Sonoma State campus and surrounding areas.

**Lightning**

Lightning strikes the United States about 20-25 million times a year.\(^{182}\) Although most lightning occurs in the summer months, people can be struck at any time of year. Since 1990, lightning has killed an average of 39 people each year in the United States, and hundreds more have been injured.\(^{183}\) Property losses due to lightning have been very costly across the U.S. For example, from 2005 through 2020, U.S. homeowner’s insurance claim payouts for lightning losses totaled approximately $15,334,600,000, or $958,412,500 worth of payouts per year.\(^{184}\) (Commercial claim payouts for lightning losses for the U.S. were not available.)

According to the 2018 City of Rohnert Park Local Hazard Mitigation Plan, the lightning hazard is not considered to be a hazard of concern for the city; this means that lightning hazards are considered to have LOW significance and therefore LOW potential impact on the city.\(^{185}\) However, the Sonoma County Multijurisdictional Hazard Mitigation Plan Update 2021 rates severe weather hazards of “thunderstorms, lightning, and hail” as having a medium risk of impacting the Sonoma County planning area (i.e., a moderate potential impact rating).\(^{186}\) Although the Sonoma State University campus is located within the Rohnert Park planning area, the city is surrounded by the Sonoma County planning area. Therefore, to accommodate both jurisdictional hazard mitigation plans, lightning hazards are considered to have a low to moderate potential impact on the Sonoma State campus and surrounding areas.

**Probability of Future Occurrence of the Hazard**

Areas throughout California, including all California State University (CSU) campuses, experience severe weather events every year, and future occurrences of such events are projected to increase in both their frequency and intensity. The City of Rohnert Park Local Hazard Mitigation Plan does not consider severe weather hazards significant enough to

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\(^{184}\) Retrieved on 07.21.2021 from https://www.iii.org/table-archive/20504


However, the Sonoma County Multijurisdictional Hazard Mitigation Plan Update 2021 states there have been over three (3) damaging severe weather events per year (on average) since 2000; as a result, the Plan rates the probability of a severe weather event impacting the planning area as “high.” Also, according to the NCEI Storm Events Database, severe weather wind hazard events have occurred in Sonoma County far more than once per year – at an average of 12.24 times per year since 1996. Furthermore, while the severe weather hazard is a non-spatial hazard that affects all areas of the Sonoma State campus equally, the smallest geographic unit of measurement for almost all official severe weather event data is at the county level. Because the severe weather data used in this assessment do not exist at the campus level, it is assumed that the severe weather probabilities for the Sonoma State campus reflect those of the surrounding community and County, identified in the Table below.

Based on the data available from the Rohnert Park and Sonoma County hazard mitigation plans, as well as the data from the NCEI Storm Events Database, the severe weather hazard (in the form of the wind hazard) is expected to occur on (or otherwise impact) the Sonoma State campus at least once on an annual basis. Therefore, the probability of future occurrence of the severe weather hazard for Sonoma State is HIGHLY LIKELY. See Table below for probabilities of future occurrence for component severe weather hazards for the Sonoma County and the campus.

Table 25-33: Severe Weather Hazard Probabilities of Future Occurrence for Sonoma County and Sonoma State University.

<table>
<thead>
<tr>
<th>Severe Weather Hazard Category</th>
<th>Average Number of Hazard Events Per Year</th>
<th>Probability of Future Occurrence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wind (Includes High, Strong and Thunderstorm Winds ONLY)</td>
<td>12.24</td>
<td>Highly Likely</td>
</tr>
<tr>
<td>Tornado</td>
<td>0.24</td>
<td>Possible</td>
</tr>
<tr>
<td>Hail</td>
<td>0.83</td>
<td>Highly Likely</td>
</tr>
<tr>
<td>Lightning</td>
<td>0.12</td>
<td>Possible</td>
</tr>
<tr>
<td>Diablo Wind</td>
<td>2.5</td>
<td>Highly Likely</td>
</tr>
</tbody>
</table>


Vulnerability to the Hazard

People, structures, and assets on the Sonoma State campus are all vulnerable to the impacts associated with severe weather. Infrastructure can be damaged or destroyed by hail, wind, tornadoes, thunderstorms, and lightning, which can result in service interruptions and outages. Structures can be damaged or destroyed by hail, wind, tornadoes, thunderstorms, and lightning. People can be injured or killed by lightning, flying debris, hail, or extreme wind events. The Sonoma State campus also has vehicles, as well as off-campus conference and recreational facilities, that are all vulnerable to a severe weather event.

Estimate of Potential Losses

Severe weather is a non-spatial hazard that affects the entire Sonoma State campus. Each of the hazards associated with severe weather can result in losses throughout the planning area.

All structures within the Sonoma State University campus are at risk from severe weather. There are approximately 45 buildings on the main campus that could be damaged by wind, hail, and/or lightning. If even a fraction of these assets were to be damaged, the resulting estimated losses would still be in the millions of dollars. The total replacement costs due to severe weather hazard are $289,079,090 for 37 of the buildings, and are unknown for the remaining 8 buildings. An analysis of projected dollar losses to campus buildings from severe weather as a percentage of building replacement costs is also not currently available, though CSU leadership may pursue such data in the future.

The population at the Sonoma State campus varies throughout the day. As of Fall, 2019, Sonoma State had 8,649 students and 1,338 faculty and staff. All are at risk from severe weather events, with 9,987 being directly vulnerable in this scenario.

Vulnerability Assessment Conclusions

** Note: The Santa Ana and Sundowner wind hazards are not present in Sonoma County, and therefore are not rated for probability of future occurrence. They are included here for information purposes only.

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| Santa Ana Wind** | 32 | Not Rated |
| Sundowner Wind** | 2 to 3 | Not Rated |
| Severe Weather Hazard | **Highly Likely** |

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Severe weather presents a variety of hazards to the Sonoma State campus. People, assets, infrastructure, and vehicles can all be damaged by this hazard, and losses can quickly begin to rise. In the aggregate, severe weather is a frequently occurring hazard (mostly in the form of wind hazard events) that presents a variety of risks to Sonoma State.

It is evident that the Sonoma State campus has vulnerabilities to and risks from severe weather hazard incidents, and that pre-event planning, communication, and mitigation efforts should be implemented. Public education and outreach regarding areas of shelter that could be used by campus populations during severe weather events is considered by campus leadership to be one viable mitigation option. The campus planning committee will continue to look for feasible and cost-effective options for the mitigation of severe weather risks going forward.

Identified Data Limitations

Numerous federal agencies maintain a variety of records regarding losses associated with hazards. Unfortunately, no single source is considered to offer a definitive accounting of all losses. The Federal Emergency Management Agency (FEMA) maintains records on federal expenditures associated with declared major disasters. The US Army Corps of Engineers (USACE) and the Natural Resources Conservation Service (NRCS) collect data on losses during the course of some of their ongoing projects and studies. Additionally, the National Oceanic and Atmospheric Administration’s (NOAA) National Centers for Environmental Information (NCEI) collects and maintains data about natural hazards in summary format, as well as occurrences, dates, injuries, deaths, and estimated costs for individual storm events. Many of these databases and other data collection services, including the NCEI, have inherent data limitations when searching for information at a scale as small as a single campus.

The best available data and records have been used throughout this section. Where no data or records exist or could be located, that deficiency is noted.
25.4 Social Resilience Assessment

Overview

While every person is vulnerable to risk, individuals from diverse populations such as those with access and functional needs are disproportionately more vulnerable and may be at a higher risk to harm in a disaster event. In addition to physical vulnerabilities, the intersectionality between physical hazard risks and population social vulnerabilities must be considered to holistically address overall campus risk.

As inclusivity is a high priority for CSU, addressing campus risk and resilience must be done through the lens of inclusion and equity. Addressing social vulnerability is an increasingly critical requirement of state and national doctrines and described in Section 4.4 of the HVRA Base Plan. Every individual of the campus’s richly diverse population group needs to have the capacity, skills, and knowledge in order to understand, access, and participate in risk reduction and disaster response in ways that are meaningful to their own unique situation. In a campus community, having strong social support networks and active involvement in community disaster responses may negatively or positively impact these opportunities and reduce the resilience-building process. This section offers a glimpse into the CSU Sonoma campus’s unique social construct, population demographics, strengths and concerns and presents a high-level assessment of the resilience, coping capacities and potential social vulnerabilities of students, staff and faculty. The research variables that were asked are often considered sensitive subjects, and few are traditionally included in emergency management/hazard mitigation planning.

This social resilience assessment of college campuses is the first of its kind in the nation. The research methodology unfolded as the interviews with campuses progressed. The assessment data presented are not definitive or authoritative. The answers, analysis, and suggested trends are strictly indicators for potential social risk. They do not represent an accurate data capture as limitations on the data gathering process influenced an ability to provide accuracy. This assessment provides indications of increased risk, not accuracy of response or a true reflection of the situation of the campus. The information presented is to be considered in the context of the more detailed system-wide CSU social vulnerability assessment that is included in the baseline HVRA.

Campus-Identified Populations of Concern

During the campus interview, the following responses were provided when asked, “In considering the diverse population group(s) amongst student body, faculty and staff, which are of the most concern in your emergency management planning?”
Table 25-34: High level summary of campus populations of concern

<table>
<thead>
<tr>
<th>Question</th>
<th>Campus Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>Which population groups amongst the student body, faculty, and staff, are of the most concern for physical and social vulnerabilities in emergency management planning?</td>
<td>▪ Students in or aging out of foster care</td>
</tr>
<tr>
<td></td>
<td>▪ On-campus populations</td>
</tr>
<tr>
<td></td>
<td>▪ Student and employees in rural areas</td>
</tr>
<tr>
<td>Which population groups are most difficult to reach in an event?</td>
<td>Students and employees in rural areas and/or in unincorporated areas</td>
</tr>
<tr>
<td>Which population groups have little/limited support networks if impacted by an event?</td>
<td>▪ Students relying on student housing</td>
</tr>
<tr>
<td></td>
<td>▪ Students with limited financial support</td>
</tr>
</tbody>
</table>

Resilience Variables Related to Campus Emergency Management

The interviewees were asked to reflect on a set of 12 variables for the campus populations of student, faculty and staff: homelessness (*housing insecurity*), food security, health and wellness, disability/access and functional needs (AFN), racial equity, digital equity, communications, international students, immigrants/immigration status issues (*undocumented, DACA, etc.*), LGBTQI (Lesbian Gay Bisexual Transgender Questioning (or queer) Intersex), and transportation dependency. They were also offered an opportunity to add any other factor they wanted to include. The following two questions were asked:

- Is this factor a particular issue of concern for emergency management on your campus? Responses were summarized as **Very High, High, Medium, Low**
- Is this factor reflected in the emergency plans and processes for your campus? Responses were summarized as **Yes, No, In Progress, NA**
In order to provide a high-level qualitative response for the answers, the approach of averaging response was taken. If conflicting answers were expressed by the interviewees, the answer (code) was averaged out. A detailed explanation of the response averaging approach is included in the base HVRA.

Table 25-35: Campus-specific emergency management issues of concern and inclusion in emergency management plans and processes.

<table>
<thead>
<tr>
<th>Issue of Concern</th>
<th>Plans &amp; Processes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Homelessness (Housing Insecurity)</td>
<td>Low</td>
</tr>
<tr>
<td>Food Security</td>
<td>Low</td>
</tr>
<tr>
<td>Health &amp; Wellness</td>
<td>Low</td>
</tr>
<tr>
<td>AFN</td>
<td>Low</td>
</tr>
<tr>
<td>Racial Equity</td>
<td>Low</td>
</tr>
<tr>
<td>Digital Equity</td>
<td>Low</td>
</tr>
<tr>
<td>Comms.</td>
<td>Medium</td>
</tr>
<tr>
<td>International Students</td>
<td>Low</td>
</tr>
<tr>
<td>Immigrants / Immigration Status</td>
<td>Medium</td>
</tr>
<tr>
<td>LGBTQI</td>
<td>Medium</td>
</tr>
<tr>
<td>Transportation Dependency</td>
<td>High</td>
</tr>
</tbody>
</table>

Qualitative Narrative: Campus Overview of Potential Resilience Vulnerabilities

The following are interview notes of interest:

- Has a good relationship with food banks in the area; limitation is no refrigeration in food pantry.
- Have counseling and psych services involved in the emergency management process; in the EOC; when anticipate events, the director of psych and counseling is part of the process.
- Digital equity will be part of the 2020 EOP update; under audit for accessibility on the webpage.
 Communications are in English, so vast amounts of details are more difficult for non-English-speaking families.
 LGBTQI are not part of the planning documents; cited housing vulnerabilities for former foster youth due to sexual orientation.
 Transportation dependency is a “big one”; don’t have buses but have vans and a relationship with the county.
 There are health vulnerabilities during the PSPS.

Campus High Hazards and Potentially Vulnerable Populations

This section provides a brief introduction to the link between socially vulnerable populations and a particular hazard type. While extensive research has been conducted on the impacts of hazards, not all linkages have been documented or published, and detail for finding them are beyond the scope of this assessment. It’s important to note, the intersectional nature of what makes an individual’s personal experience and resilience to an event is played out by unique factors for that individual or population. The nuanced social vulnerabilities often come from the social and physical environment in which a person is embedded.

In order to aid in further assessing campus resilience, below is a general description of the known impacts. From some hazards, the descriptions are robust, while others are only brief introductions.

Table 25-36: CSU Sonoma *Highly Likely, Likely and Possible* Hazards

<table>
<thead>
<tr>
<th>Hazard</th>
<th>Future Occurrence Probability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Communicable Disease</td>
<td>Highly Likely</td>
</tr>
<tr>
<td>Drought</td>
<td>Highly Likely</td>
</tr>
<tr>
<td>Earthquake</td>
<td>Possible</td>
</tr>
<tr>
<td>Extreme Temperature</td>
<td>Possible (Heat); Possible (Cold)</td>
</tr>
<tr>
<td>Flood</td>
<td>Possible</td>
</tr>
<tr>
<td>Power Outage</td>
<td>Likely</td>
</tr>
<tr>
<td>Wildfire</td>
<td>Likely (Fire); Possible (Smoke)</td>
</tr>
</tbody>
</table>
**Drought**

The 2012-2016 drought had severe effects on two vulnerable sectors of our population: those in low-income brackets, and those, especially Native Americans, who rely on subsistence fishing for their livelihoods. Water bills increased throughout the state. Due to rising water prices, for the working poor, many have paid four to five percent of their income for water. Since many CSU students are commuters, and many living with families, future drought impacts may potentially affect a percentage of non-resident students. NASA’s modeling shows that future droughts are likely to last longer and be more intense, even leading to “megadroughts” in the western states. Fresh water supplies are predicted to be full of extremes, with both droughts and extreme precipitation events being more severe. The interrelationship between drought and other hazard conditions may lead to a set of secondary impacts. Drought conditions lead to water quality issues due to loss of drinking water, increased fire danger that leads to drought-induced fires and elevated AQI levels, as well as extreme heat or prolonged heat events.

**Earthquake**

Impacts on populations from earthquakes are complex, with long-term implications on social stability for all populations. In addition to the physical impact exposure during a no-notice earthquake event and the social and logistical challenges of a recovering community, an earthquake can have lasting impacts long afterwards due to post traumatic stress disorder (PTSD).

Socioeconomic vulnerabilities of populations at risk were analyzed in the hypothetical yet scientifically realistic earthquake sequence that is being used to better understand hazards for the San Francisco Bay region during and after a magnitude-7 earthquake (mainshock) on the Hayward Fault and its aftershocks. In this study, the at-risk populations located in areas of concentrated damage are anticipated to experience longer recovery trajectories, increased long term housing displacement, and transportation impacts due to dependencies on transit dependencies. When neighborhood schools close, families with school age children may move to other areas to keep their children in schools. Persons with access and functions needs are likely to be more dependent on access to functioning medical, social and personal health care services that would be overwhelmed by the event and therefore increasing their vulnerabilities. For the homeless populations, the loss of social community services and damages to shelters could add to protracted relocations. For the young


and mobile populations who rent, the major disruption to housing, jobs and transit will also drive relocation. Widespread housing damage and preexisting housing market constraints will make it “extremely challenging” for the socially and economically vulnerable populations to find alternative housing near their home communities. Those who utilize interim and irregular housing for months and years after a disaster are more vulnerable to physical, social, and mental disorders, including suicide, substance abuse, and physical and verbal abuse. Aftershocks and post disaster conditions delay population return and increase outmigration.193

**Extreme Temps**

People susceptible to respiratory ailments (asthma, lower and upper respiratory disease) disproportionately suffer from the effects of fire, smoke, air pollutions, allergens, heat and PSPS. Those with limited income or without resources are affected disproportionately due to the inability to provide safe shelter, air conditioning, cooling, air purification, medical care, and quality foods, and are also least able to obtain information related to climate risks and adaptation strategies.

**Cold**

Research shows that excess morbidity and mortality occurs during cold weather periods. We critically reviewed evidence relating temperature variability, health outcomes, and adaptation strategies to cold weather. Health outcomes included cardiovascular-, respiratory-, cerebrovascular-, and all-cause morbidity and mortality. Individual and contextual risk factors were assessed to highlight associations between individual- and neighborhood- level characteristics that contribute to a person’s vulnerability to variability in cold weather events.

Skin exposure to cold weather may render one susceptible to adverse health outcomes.194 Respiratory tract infections are more likely to occur during periods of low temperatures and low humidity. Socioeconomic indicators related to morbidity and mortality do not appear to strongly contribute to a person’s susceptibility to cold weather. However, the role of socioeconomic status is not clear as some evidence implies that income disparities and fuel poverty contribute to cold-related mortality.195

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The greatest danger from extreme cold is to people, as prolonged exposure can cause frostbite or hypothermia, and can become life threatening. When someone is suffering from hypothermia, body temperatures can become so low that they affect the brain, making it difficult for the victim to think clearly or move well. In the case of frostbite, the frozen tissue becomes numb and the victim may be unaware that anything is wrong until someone else notices. This makes hazards from extreme cold particularly dangerous, as people may not understand what is happening to them or what to do about it.

The primary hazards from extreme cold are frostbite and hypothermia. Frostbite is caused by freezing of the skin and underlying tissue. It causes a loss of feeling and color in the affected areas of the body, and most often affects the nose, chin, fingers, or toes. It can be permanently damaging if not treated promptly and can lead to infection, nerve damage, or amputation in severe cases. The risk of frostbite is increased in people with preexisting conditions, the elderly, people with reduced blood circulation, and people who are not dressed warmly enough for the conditions.

Hypothermia occurs when the body loses heat faster than it can produce heat, causing a dangerously low body temperature. A normal body temperature is around 98.6°F. Hypothermia occurs when your body temperature falls below 95°F. As this happens, the heart and other essential organs cannot work properly. If hypothermia is not treated, it can lead to heart failure, respiratory failure, and eventually to death.

Heat

Heatstroke, cardiovascular disease, respiratory disease and cerebrovascular disease are related to extreme heat events. Increased number of heat waves creates heat-related physical stress on populations and is exacerbated in the metropolitan areas where greater amounts of heat-absorbing surfaces (e.g., asphalt and concrete) trap heat and emit higher temperatures throughout the night.

The heat also extends the geographic range and the distribution of disease-carrying insects and pests. Health professionals are concerned that California’s warming climate will allow species to acclimate. Such vectors include such pests as ticks that carry Lyme disease, and mosquitoes that transmit Zika, dengue fever, West Nile, plague and tularemia. Some others, such as chikungunya, Chagas disease, and Rift Valley fever virus, are threats as well.

Some communities of color and some low-income, homeless, and immigrant populations are more exposed to heat waves, as these groups often reside in urban areas affected by heat island effects. In addition, these populations are likely to have limited adaptive capacity due to a lack of adequately insulated housing, inability to afford or to use air conditioning, inadequate access to public shelters such as cooling centers, and inadequate access to both routine and emergency health care. These social, economic, and health risk factors give rise to the observed increase in deaths and disease from extreme heat in some immigrant and impoverished communities.
Heat stroke, the most serious heat-related illness, occurs when the body is unable to control its temperature. Body temperature rises rapidly, the sweating mechanism fails, and the body cannot cool down. In extreme causes, heat stroke can cause confusion and unconsciousness, so the victim is unable to seek treatment without assistance.

There are several groups of people who are uniquely vulnerable to the effects of extreme heat, such as infants and children, older adults aged 65 and up, athletes and outdoor workers, low-income households, and individuals with certain chronic medical conditions.

When dealing with an extreme heat event, the most common impacts are those generally felt by the people living in the targeted area. For people in particular, heat can kill when the body is pushed beyond its limits. Most heat disorders occur because the victim has been overexposed to heat. As discussed, the major human risks associated with extreme heat include dehydration, sunburn, fatigue, heat exhaustion, heat stroke, and in severe cases, death.

Some portions of the population are more at risk to the effects of extreme heat. The very young, the elderly, and certain groups with chronic medical conditions (such as asthma or other pulmonary illnesses, heart disease, poor blood circulation, neurological illnesses, and obesity) are generally more vulnerable to the effects of extreme heat, and are more likely to suffer illness or death as a result.

This is especially true if exposure is extended for a period of time and preventative measures are not taken immediately. Distributional implications of impacts, and even less on distributional implications of adaptation actions.” 196

**Flood**

Risk from floods relates to community risk, exposure and infrastructural losses. The degree of vulnerability to these events and their impacts depends on human behavior and the traditional social factors such as situational awareness, prior knowledge of hazards, social capital and decision-making capabilities. The exposure of humans to floods continues to increase, driven by changes in hydrology and land use. The adverse impacts on socially vulnerable populations are amplified because a disproportionately high number live in flood-prone areas. Research has shown that places of social vulnerabilities are places characterized by housing and racial disparities, such as mobile home parks, structural fragility and poverty, and higher

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percentages of populations such as Black and Native Americans, and others with shared histories of discrimination, marginalization and exclusion. 197

Health impacts from flooding are well recognized due to the extensive history of flooding in California and around the nation. The impacts range from waterborne illnesses from contaminated waters, respiratory illnesses that impact the lungs, throat, and airways from airborne particles, mold on flooded buildings that can trigger asthma, allergies and other illnesses—all which are particularly impactful to older, younger and individuals with pre-existing health condition. Foodborne illnesses can increase if there are issues with power outages or sewer overflows. Individuals with increased mental health concerns can be impacted by the stress or anxiety from the impacts of the flood. Poor quality housing can increase vulnerability to many flood risks, including flood inundation, power outages, mold growth, rodent vectors, and serious health impacts. For those with limited finances, flood inundation and impacts to infrastructure or farmlands may lead to extensive income losses.

The poorest residents suffer disproportionately to flood situations, especially those who have been less able to fund homeowner’s insurance to protect against flood losses. Loss of life is not unusual in flooding situations, as is loss of property, livestock, pets, workplaces, and tourist industries. There is a strong interrelationship between water events and other hazards. Flooding, storms and water quality are related to each other. Drought conditions can exacerbate floods as the surface soils are hardened and not as ready to allow surface water absorption. Extreme heat events can cause snowmelt, inundating waterways and causing flood and water quality issues. Flooding and storm events can have impacts on public health, environmental health, agricultural health and economic system health. Mental health issues are reported for all people who have experience flood losses, including anxiety, fear, anger, anger, sadness and grief. 198 Additionally, waterborne disease outbreaks are reported weeks after the flood events. Mold contamination leads to indoor air issues. Damp indoor environments lead to increased prevalence of asthma, and also upper and lower respiratory symptoms.

These issues may influence the diverse CSU populations, both on and off campus, in a number of ways long after a flood event, or the related hazards impacts, has concluded.


**Power Outage/Public Safety Power Shutdowns (PSPS)**

Loss of power creates economic hardship to a region experiencing regular PSPS events, such as those experienced throughout the state over the recent years. Many businesses close, including gas stations, grocery stores, and local retail establishments. These impacts may deeply impact students dependent on support jobs, as well impacting family members of campus staff and faculty. PSPS increases risks to the public due to inability to use medical devices, spoilage of food and medicines, and disruption to infrastructure, such as supply of clean water and electricity used to run home medical equipment, such as lift chairs and ventilators.

**Wildfire**

Increased wildfire threat occurs especially in the end of fall, when conditions are driest, but before the winter rains have come; an east-to-west wind gusts exacerbate fire risk. Wildfire threats have the concomitant threat of Public Safety Power Shutoffs (PSPS). And, in the case of an actual wildfire, danger exists both from fire and from the smoke. Recent wildfires have demonstrated that some demographics are disproportionately affected. Native Americans are six times more likely to be affected than white people. Blacks and Hispanic people are 50 percent more vulnerable. These values take into account the likelihood of a community being affected and the greater difficulty of that community to recover. These statistics reflect the lack of access to resources to pay for insurance, to rebuild and recover, to implement fire safety measures, and to access other resources. Price gouging after a fire (such as documented in Sonoma County after the 2017 Tubbs Fire) further exacerbates the disparity.  

Furthermore, the disabled and the elderly are at particular risk from extreme wildfire conditions, as they are often not as able to effectively evacuate. Of the 85 people who died in the Camp Fire in Butte in 2018, 62 of them were at least 65 years old.

Smoke from wildfires creates a significant public health threat. Especially vulnerable are individuals who have heart or lung issues, such heart disease, lung disease or asthma. Those most vulnerable include the medically fragile, elderly and children. Air Quality Indexes track the level of the following: particulate matter, surface levels of

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ozone, carbon monoxide, sulfur dioxide, and nitrogen dioxide. All of these can cause respiratory distress and harm lungs. 202

The California Department of Public Health reports the increased public health risks, and risk indicators that include: heat-related ED visits, populations living in wildfire areas, adults with multiple chronic conditions, populations living in poverty, race/ethnicity, outdoor workers, public transit access, air conditioner ownership and tree canopy.203

Hazard Mitigation and Emergency Management Planning

The goal of this high-level assessment is to provide a starting point to encourage further exploring campus social risks and vulnerabilities, as well as to inform and to enhance holistic emergency management and hazard mitigation decision making, planning processes and future adaptive risk management strategies. By including the social resilience factors, mitigation investments may move beyond standardized planning and regulations, structure and infrastructure projects, and natural systems protections to embrace a more expanded, customized emergency operations plan and an education and outreach program unique to the campus.

A more robust social resilience inquiry is strongly encouraged to develop an accurate picture, based on methodical and scientific research-based data. Such an effort would be envisioned through both nuanced discussions with a variety of campus stakeholders and the invitation of nontraditional stakeholders to join in a collaborative resilience partnership. Such a forward-leaning effort would be directly in keeping with CSU’s commitment to inclusion and equity in risk reduction.


Section 26
California State University, Stanislaus

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26.1 University Profile

University History

Stanislaus State University was established in 1957. The university offers 45 Bachelor's degrees, 17 Master's degrees, one Doctoral degree (Doctor of Education), and 6 teaching credentials. The California State Legislature established what was then called Stanislaus State College as the 15th campus of the CSU system. Classes began on the Stanislaus County Fairgrounds in September of 1960, and the college moved to its current location five years later. The college was first accredited in 1964.

Stanislaus State University is designated as both a Hispanic-Serving Institution (HSI) and an Asian American and Native American Pacific Islander-Serving Institution (AANAPISI).

University Governance

The campus president is the chief executive officer who oversees the administration of the entire university. The president manages campus operations and fundraising, sets campus priorities, and oversees the hiring and support of staff and faculty. The president also maintains a close working relationship with the CSU’s systemwide office, reporting to the chancellor and participating in the systemwide Executive Council.

The provost is the chief academic officer of the university, overseeing all academic affairs and programs of the university. The provost reports directly to the president.

Governance at Stanislaus State University is guided by the concept of “shared governance.” Shared governance recognizes that the university president ultimately has authority and responsibility for decisions affecting the university. The university benefits from a process of joint decision-making and consultation, wherein mutual responsibility is essential. This collaborative work manifests primarily as shared governance informed by robust consultation. Consultation between the faculty and the administration within this context is defined as a mutual exchange of information, ideas, opinions, and recommendations from initial formulation to final determination of policy and procedures affecting the operations of those areas where primary responsibility rests with the faculty.

University Mission

“The faculty, staff, administrators, and students of California State University, Stanislaus are committed to creating an inclusive learning environment which encourages all members of the campus community to expand their intellectual, creative, and social horizons. We challenge one another to realize our potential, to appreciate and contribute to the enrichment of our diverse community, and to develop a passion for lifelong learning.”

To facilitate this mission, university promotes academic excellence in the teaching and scholarly activities of the university faculty, encourage personalized student learning,
foster interactions and partnerships with our surrounding communities, and provide opportunities for the intellectual, cultural, and artistic enrichment of the region.

University Location

California State University, Stanislaus is located in Turlock within Stanislaus County, California. Aside from the main campus in Turlock there are additional campuses in Lodi/Stockton, Ceres, Merced and a satellite campus in Turlock.

University Population

In the Fall of 2020, Stanislaus State University had 11,163 students enrolled. 54% of the student population were of Latino/Mexican-American/Chicano heritage. The second largest student population are White students making up 22.6%. A majority of undergraduate students are first generation and full-time, and many are Pell Grant eligible.

26.2 Interim Final Rule for Hazard Vulnerability and Risk Assessment

Requirement §201.6(c)(2): The plan shall include a risk assessment that provides the factual basis for activities proposed in the strategy to reduce losses from identified hazards. Local risk assessments must provide sufficient information to enable the jurisdiction to identify and prioritize appropriate mitigation actions to reduce losses from identified hazards.

Requirement §201.6(c)(2)(i): [The risk assessment shall include a] description of the type...location and extent of all natural hazards that can affect the jurisdiction. The plan shall include information on previous occurrences of hazard events and on the probability of future hazard events.

Requirement §201.6(c)(2)(ii): [The risk assessment shall include a] description of the jurisdiction’s vulnerability to the hazards described in paragraph (c)(2)(i) of this section. This description shall include an overall summary of each hazard and its impact on the community.

Requirement §201.6(c)(2)(ii)(A): The plan should describe vulnerability in terms of the types and numbers of existing and future buildings, infrastructure, and critical facilities located in the identified hazard area.

Requirement §201.6(c)(2)(ii)(B): [The plan should describe vulnerability in terms of an] estimate of the potential dollar losses to vulnerable structures identified in paragraph
Requirement §201.6(c)(2)(ii)(C): [The plan should describe vulnerability in terms of] providing a general description of land uses and development trends within the community so that mitigation options can be considered in future land use decisions.

Requirement §201.6(c)(2)(iii): For multi-jurisdictional plans, the risk assessment must assess each jurisdiction's risks where they vary from the risks facing the entire planning area.

26.3 Hazard Identification and Risk Assessment

Overview of California State University, Stanislaus History of Hazards

Numerous federal agencies maintain a variety of records regarding losses associated with hazards. Unfortunately, no single source is considered to offer a definitive accounting of all losses. The Federal Emergency Management Agency (FEMA) maintains records on federal expenditures associated with declared major disasters. The US Army Corps of Engineers (USACE) and the Natural Resources Conservation Service (NRCS) collect data on losses during the course of some of their ongoing projects and studies. Additionally, the National Oceanic and Atmospheric Administration’s (NOAA) National Centers for Environmental Information (NCEI) database collects and maintains data about natural hazards in summary format. The data includes occurrences, dates, injuries, deaths, and estimated costs. Many of these databases and other data collection services, including the NCEI, have inherent data limitations when searching for information at a university scale.

The best available data and records were used throughout this assessment.

Hazard Identification

As part of the initial hazard identification process, the Campus Assessment Team considered potential hazards with the most chance to significantly affect the planning area. The hazards include those that have occurred in the past and may occur in the future. A variety of sources were used to develop the list of hazards considered including national, regional, and local sources such as emergency operations plans, FEMA’s How-To Series, websites, published documents, databases, and maps, as well as discussion among the Campus Assessment Team members.

In the initial phase of the planning process, the Campus Assessment Team considered 14 hazards and the risks they create for the University and its material assets, population, and operations. The hazards initially considered, and the determinations as to the treatment of those hazards, are shown in Table 26-1 (following).
Table 26-1: Hazard Identification Determinations

<table>
<thead>
<tr>
<th>Hazard</th>
<th>Determination (Yes/No)</th>
<th>Reason for Determination</th>
<th>Future Occurrence Probability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Communicable Disease</td>
<td>Yes</td>
<td>Hazard of concern to campus</td>
<td>Highly Likely</td>
</tr>
<tr>
<td>Dam and Levee Failure</td>
<td>Yes</td>
<td>Hazard of concern to campus</td>
<td>Unlikely</td>
</tr>
<tr>
<td>Drought</td>
<td>Yes</td>
<td>Hazard of concern to campus</td>
<td>Highly Likely</td>
</tr>
<tr>
<td>Earthquake</td>
<td>Yes</td>
<td>Hazard of concern to campus</td>
<td>Possible</td>
</tr>
<tr>
<td>Erosion</td>
<td>Yes</td>
<td>Hazard of concern to campus</td>
<td>Likely</td>
</tr>
<tr>
<td>Extreme Temperature</td>
<td>Yes - Heat; No - Cold</td>
<td>Hazard of concern to campus</td>
<td>Possible (Heat only)</td>
</tr>
<tr>
<td>Flood</td>
<td>Yes</td>
<td>Hazard of concern to campus</td>
<td>Possible</td>
</tr>
<tr>
<td>Hazardous Materials</td>
<td>Yes</td>
<td>Hazard of concern to campus</td>
<td>Unlikely</td>
</tr>
<tr>
<td>Landslide</td>
<td>Yes</td>
<td>Hazard of concern to campus</td>
<td>Unlikely</td>
</tr>
<tr>
<td>Power Outage</td>
<td>Yes</td>
<td>Hazard of concern to campus</td>
<td>Likely</td>
</tr>
<tr>
<td>Sea Level Rise</td>
<td>No</td>
<td>Not a hazard of concern to campus</td>
<td>N/A</td>
</tr>
<tr>
<td>Tsunami</td>
<td>No</td>
<td>Not a hazard of concern to campus</td>
<td>N/A</td>
</tr>
<tr>
<td>Volcano</td>
<td>Yes</td>
<td>Hazard of concern to campus</td>
<td>Unlikely</td>
</tr>
<tr>
<td>Wildfire</td>
<td>Yes</td>
<td>Hazard of concern to campus</td>
<td>Unlikely (Fire); Possible (Smoke)</td>
</tr>
</tbody>
</table>

**Future Occurrence Probability**

In order to determine the probability of future occurrences of each hazard profiled, the following scale was developed:

Highly Likely- 76%-100% that the hazard would occur annually.
Likely- 50%-75% that the hazard would occur annually.
Possible- 11%-49% that the hazard would occur each annually.
Unlikely- 0%-10% that the hazard would occur each annually.
**Communicable Disease**

Description of the Hazard

Communicable diseases are illnesses that occur due to infectious agents or their toxic products, and are infectious due to their potential of transmission from one person or species to another by a replicating agent. They may be transmitted from a reservoir to a susceptible host either directly as from an infected person or animal or indirectly through the agency of an intermediate plant or animal host, vector, or the inanimate environment. Communicable diseases are clinically evident illness resulting from the presence of pathogenic microbial agents, including pathogenic viruses, pathogenic bacteria, fungi, protozoa, multi-cellular parasites, and aberrant proteins known as prions. The degree of spread of a communicable disease depends on both the ability of an organism to enter, survive and multiply in the host and the comparative ease with which the disease is transmitted to other hosts.

Some ways in which communicable diseases spread are by:

- Travel through the air, such as tuberculosis, measles, or COVID-19;
- Physical contact with an infected person, such as through touch (staphylococcus), sexual intercourse (gonorrhea, HIV), fecal/oral transmission (hepatitis A), or droplets (influenza, TB, COVID-19);
- Contact with a contaminated surface or object (Norwalk virus), food (salmonella, E. coli), blood (HIV, hepatitis B), or water (cholera); and
- Bites from insects or animals capable of transmitting the disease (mosquito: malaria and yellow fever; flea: plague).

Collectively, the twenty-three (23) campuses and Chancellor’s Office of the California State University (CSU) system have identified nine (9) communicable disease hazards that have had significant impacts on their respective student, faculty, and staff.

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populations. Of these communicable diseases, COVID-19 is considered to be the most prominent and widespread agent across all CSU campuses. (See Table 26-2 below.)

Table 26-2: Communicable Diseases Identified CSU Campuses

<table>
<thead>
<tr>
<th>Collective List of Communicable Diseases Identified by All CSU Campuses</th>
<th>Number of CSU Campuses (Including Chancellor’s Office) Identifying Communicable Disease Having Significant Impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>COVID-19 (SARS-CoV-2)</td>
<td>24</td>
</tr>
<tr>
<td>Meningitis</td>
<td>7</td>
</tr>
<tr>
<td>Measles</td>
<td>6</td>
</tr>
<tr>
<td>Influenza (Including H1N1/Swine Flu)</td>
<td>6</td>
</tr>
<tr>
<td>Tuberculosis</td>
<td>5</td>
</tr>
<tr>
<td>Norovirus</td>
<td>4</td>
</tr>
<tr>
<td>Mumps</td>
<td>2</td>
</tr>
<tr>
<td>E. Coli</td>
<td>2</td>
</tr>
<tr>
<td>Sexually Transmitted Diseases (STDs)</td>
<td>2</td>
</tr>
</tbody>
</table>

(Source: Interviews with CSU campus staff at CSU campuses and at CSU Chancellor’s Office.)

With the exception of COVID-19, there is variability among CSU campuses regarding which communicable diseases have had the greatest impact on individual campus communities. Table 26-3 (following) shows the communicable disease hazards that have had the greatest impact on each CSU campus.

Table 26-3: Communicable Disease Hazards at CSU Campuses with Greatest Impact

<table>
<thead>
<tr>
<th>CSU Campus</th>
<th>Identified Communicable Disease Hazards with the Greatest Impact on CSU Campus</th>
</tr>
</thead>
<tbody>
<tr>
<td>CSU Bakersfield</td>
<td>COVID-19, Meningitis</td>
</tr>
<tr>
<td>CSU Channel Islands</td>
<td>COVID-19, Measles</td>
</tr>
<tr>
<td>Chico State</td>
<td>COVID-19, Tuberculosis</td>
</tr>
<tr>
<td>CSU Dominguez Hills</td>
<td>COVID-19</td>
</tr>
<tr>
<td>Cal State East Bay</td>
<td>COVID-19, Meningitis</td>
</tr>
<tr>
<td>University</td>
<td>Communicable Diseases</td>
</tr>
<tr>
<td>----------------------------------</td>
<td>-----------------------------------------------------------</td>
</tr>
<tr>
<td>Fresno State</td>
<td>COVID-19, Meningitis, Tuberculosis</td>
</tr>
<tr>
<td>Cal State Fullerton</td>
<td>COVID-19, Influenza</td>
</tr>
<tr>
<td>Humboldt State</td>
<td>COVID-19, Measles, Norovirus, Influenza, STDs</td>
</tr>
<tr>
<td>Cal State Long Beach</td>
<td>COVID-19</td>
</tr>
<tr>
<td>Cal State LA</td>
<td>COVID-19, E. coli, Measles</td>
</tr>
<tr>
<td>Cal Maritime</td>
<td>COVID-19</td>
</tr>
<tr>
<td>CSU Monterey Bay</td>
<td>COVID-19</td>
</tr>
<tr>
<td>CSUN (Northridge)</td>
<td>COVID-19, Measles</td>
</tr>
<tr>
<td>Cal Poly Pomona</td>
<td>COVID-19, Influenza (Swine Flu - H1N1)</td>
</tr>
<tr>
<td>Sacramento State</td>
<td>COVID-19</td>
</tr>
<tr>
<td>Cal State San Bernardino</td>
<td>COVID-19, Tuberculosis</td>
</tr>
<tr>
<td>San Diego State</td>
<td>COVID-19, Meningitis, Mumps</td>
</tr>
<tr>
<td>San Francisco State</td>
<td>COVID-19</td>
</tr>
<tr>
<td>San José State</td>
<td>COVID-19, H1N1</td>
</tr>
<tr>
<td>Cal Poly San Luis Obispo</td>
<td>COVID-19, Meningitis, Norovirus</td>
</tr>
<tr>
<td>CSU San Marcos</td>
<td>COVID-19</td>
</tr>
<tr>
<td>Sonoma State</td>
<td>COVID-19, H1N1, Norovirus</td>
</tr>
<tr>
<td><strong>Stanislaus State University</strong></td>
<td><strong>COVID-19,</strong></td>
</tr>
<tr>
<td><em>(Stanislaus State)</em></td>
<td></td>
</tr>
<tr>
<td><strong>Office of the Chancellor</strong></td>
<td><strong>COVID-19,</strong></td>
</tr>
<tr>
<td>CSU System-Wide</td>
<td>COVID-19, Meningitis, Measles, Tuberculosis, Influenza-Swine Flu-H1N1, Mumps, Norovirus, E. coli, STDs</td>
</tr>
</tbody>
</table>

*(Source: Interviews with CSU campus staff at CSU campuses and at CSU Chancellor’s Office.)*

**Descriptions of Identified Communicable Disease Hazards at Stanislaus State University**

Stanislaus State University identified one communicable disease hazard that had the greatest impact on campus – COVID-19. The following is a brief description of the communicable disease hazard at Stanislaus State University.

**COVID-19 (SARS-CoV-2)**

Coronaviruses are a family of viruses that can cause illnesses such as the common cold, severe acute respiratory syndrome (SARS) and Middle East respiratory syndrome (MERS). In 2019, a new coronavirus was identified as the cause of a disease outbreak that...
originated in China. This virus is now known as the **severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2)**. The disease it causes is called Coronavirus Disease 2019 (COVID-19). In March 2020, the World Health Organization (WHO) declared the COVID-19 outbreak a pandemic.

Signs and symptoms of coronavirus disease 2019 (i.e., COVID-19) may appear two to 14 days after exposure. Common signs and symptoms can include fever, cough, and tiredness. Early symptoms of COVID-19 may also include a loss of taste or smell.

The virus that causes COVID-19 spreads easily among people, and more continues to be discovered over time about how it spreads. Data have shown that the COVID-19 virus spreads mainly from person to person among those in close contact (within about 6 feet, or 2 meters). The virus is transmitted by respiratory droplets being released when someone with the virus coughs, sneezes, breathes, sings or talks. These droplets can be inhaled or land in the mouth, nose or eyes of a person nearby. In some situations, the COVID-19 virus can spread by a person being exposed to small droplets or aerosols that stay in the air for several minutes or hours (i.e., airborne transmission). It’s not yet known how common it is for the virus to spread this way. The COVID-19 virus can also spread if a person touches a surface or object with the virus on it and then touches his or her mouth, nose or eyes; however, this is not considered to be a main way it spreads.

The severity of COVID-19 symptoms can range from very mild to severe. Some people may have only a few symptoms, and some people may have no symptoms at all. However, some people may experience worsened symptoms, such as worsened shortness of breath and pneumonia. People who are older have a higher risk of serious illness from COVID-19, and the risk increases with age. People who have existing medical conditions also may have a higher risk of serious illness from COVID-19. In some cases, the disease can cause severe medical complications and may even lead to death. 5

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Location of the Hazard

Communicable diseases have the potential to affect the entire Stanislaus State University (STANISLAUS STATE UNIVERSITY) planning area equally. As a result, this hazard can be found both at main campus of Stanislaus State University located in Turlock, CA (Stanislaus County), and at the Stanislaus State University satellite campus in Stockton, CA (San Joaquin County). Because of the ubiquitous nature of many communicable diseases, students, faculty, staff at (and visitors to) both Stanislaus State University locations are at risk of exposure.6

CSU Student Housing Locations and Populations

Although CSU-campus-owned student housing opportunities have been severely limited due to the COVID-19 pandemic, this situation is temporary. Eventually, students will be allowed back on campus at full capacity, and many of these students will be living in campus-owned housing. When this occurs, over 53,000 students (i.e., just over 11% of the CSU total enrollment) will be at increased risk of exposure to communicable disease hazards, owing to the “close-quarters” living arrangements in student housing. Table 26-4 shows the number of students that were living in CSU-campus-owned housing in Fall, 2019, prior to the CVID-19 pandemic. For Stanislaus State University, approximately 8% of its 10,614 enrolled students (or 849 students) reside in student housing7 8

Extent of the Hazard

Various communicable diseases are categorized by the Center for Disease Control and Prevention (CDC) by levels of containment called Biosafety Levels (or BSLs). The higher the BSL, the greater the level of containment and level of effort necessary to prevent transmission of the disease, and therefore the greater the hazard. Biosafety Levels prescribe procedures and levels of containment for a particular microorganism or material (including research involving recombinant or synthetic nucleic acid molecules) and procedures associated with that containment. BSLs also consider primary barriers (e.g., biosafety cabinets), secondary barriers, facility design, air handling, laboratory security, etc. BSLs are graded from 1 to 4; as the BSL increases so does the relative risk of the agent/procedures as well the stringency of procedures and facility design.


8 California State University. CSU Campus Match. Retrieved 04.30.2021 from: https://www2.calstate.edu/attend/campuses/campus-match/Pages/campus-match.aspx
Figure 26-1 describes the different BSLs, and provides examples of communicable diseases that would typically fall into these classifications, as well as the typical protections that would be necessary to prevent transmission of each of the diseases.

**Figure 26-1: Biosafety Levels (BSLs)**

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**The Extent of Stanislaus State University COVID-19 Communicable Disease Hazard:**

As a microorganism, the SARS-CoV-2 (COVID-19) virus requires a high level of containment. It is therefore classified at BSL-3.10

CSU-campus-specific COVID-19 case data for Stanislaus State University can be found in the *History of the Hazard* section below.

**History of the Hazard**

Over an approximately one-year period, from mid-March, 2020 to March 23, 2021, there were a reported **54** cases of COVID-19 at Stanislaus State University. Most communicable disease data are maintained by at the state and at the county levels, and are not generally available at the municipal or campus levels, unless (a) the CSU campus falls under the jurisdiction of a city-level health department, or (b) a geographically specific outbreak occurs on campus or in the local community. The exception to this is the current COVID-

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19 pandemic, where both campus and County-level case data have been collected. As a result, it is important to provide COVID-19 case statistics for both CSU campuses and the counties where CSU campus assets are located.

Tables 26-5 to 26-7 include confirmed COVID-19 cases since May 2020 involving STANISLAUS STATE UNIVERSITY students, faculty or staff who may have exposed others while working, visiting, attending in-person instruction, or living on campus (student housing) during the illness, as well as cases for Stanislaus and San Juaquin counties. (Note: Case numbers are reported on a weekly basis, and reflect numbers through the previous Saturday. The website is updated by the following Wednesday by close of work.)

Table 26-4: Stanislaus State University Campus-Level COVID-19 Case Data (as of 03.13.2021)

<table>
<thead>
<tr>
<th>Population</th>
<th>Confirmed Cases at Turlock Campus</th>
<th>Confirmed Cases at Stockton Campus</th>
<th>Population Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Students</td>
<td>14</td>
<td>3</td>
<td>17</td>
</tr>
<tr>
<td>Employees</td>
<td>37</td>
<td>0</td>
<td>37</td>
</tr>
<tr>
<td>Total Cases</td>
<td>51</td>
<td>3</td>
<td>54</td>
</tr>
</tbody>
</table>

Table 26-5: Stanislaus State University On- vs. Off-Campus COVID-19 Case Data (as of 03.13.2021)

<table>
<thead>
<tr>
<th>Population</th>
<th>Confirmed On-Campus Cases</th>
<th>Confirmed Off-Campus Cases</th>
<th>Population Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Students</td>
<td>4</td>
<td>13</td>
<td>17</td>
</tr>
<tr>
<td>Employees</td>
<td>16</td>
<td>21</td>
<td>37</td>
</tr>
<tr>
<td>Total Cases</td>
<td>20</td>
<td>34</td>
<td>54</td>
</tr>
</tbody>
</table>

*On campus: Any individual that has been on the campus within the last 14 days of exposure or illness. Example – Essential employee working on campus in an office, workstation, or were in an enclosed area for 15 minutes or more, or a student who attended in a lab setting

*Off campus: Any individual that has not been on campus within the last 14 days of exposure or illness. Example – Employee or student telecommuting or virtual learning.

Table 26-6: Confirmed COVID-19 Statistics for Stanislaus and San Joaquin Counties (as of 03.19.2021)

<table>
<thead>
<tr>
<th>County</th>
<th>Cases</th>
<th>Deaths</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stanislaus</td>
<td>52,137</td>
<td>980</td>
</tr>
<tr>
<td>San Joaquin</td>
<td>68,855</td>
<td>1,231</td>
</tr>
<tr>
<td><strong>Totals</strong></td>
<td><strong>120,992</strong></td>
<td><strong>2,211</strong></td>
</tr>
</tbody>
</table>

Potential Impacts of the Hazard

Communicable disease outbreaks and pandemics potentially have (and will continue to have) direct impact on life, health, and safety across the CSU system, including the Stanislaus State University campuses. The extent of this impact is contingent on the type of infection or contagion, the severity of the outbreak, and the speed at which it is transmitted. Property and infrastructure integrity may be affected if large portions of CSU campus populations contract communicable diseases at the same time and are therefore unable to perform maintenance, operations, and educational tasks. This would be particularly disruptive if those impacted are first responders or other essential personnel. Long-term outbreaks affecting large numbers of Stanislaus State University students could result in cancelled classes, delayed matriculation, or other disruptions to the CSU System’s mission. This has already occurred with the current COVID-19 pandemic, and could occur again with more virulent strains of communicable diseases, including COVID-19.

Communicable disease hazards found across the CSU system (including CSU – Stanislaus) vary both by level of containment (BSL) (described previously) and by level of individual/public health risk, or Risk Group (RG) level. While BSLs describe the procedures and required levels of containment in a laboratory setting, Risk Groups (RGs) reflect the potential effects of disease exposure on humans or animals. Like BSLs, RGs range from Level 1 (RG1) to Level 4 (RG4), with Level 1 (RG1) posing minimal risk to healthy individuals and public health and Level 4 (RG4) posing a very serious or extreme risks to individuals and public. BSLs generally correlate with Risk Group (RG) Levels (e.g.,

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a RG2 agent is worked with at BSL-2), but there are exceptions (e.g., production volumes, high-risk procedures, etc.).14

The World Health Organization’s (WHO) Laboratory Biosafety Manual, 3rd ed., NIH Guidelines, categorizes Risk Groups (RGs) in the following way:

Table 26-7: WHO Risk Group Categorization15

<table>
<thead>
<tr>
<th>Risk Group (RG)</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>RG1</td>
<td>Rarely associated with disease in healthy adult humans or animals and pose no-to-little public health risk (e.g., Saccharomyces cerevisiae, E. coli K-12 strain derivatives often used for recombinant/molecular biology, many environmental organisms)</td>
</tr>
<tr>
<td>RG2</td>
<td>Associated with mild to moderate disease for which preventative measures or post exposure treatments are often available; public health impact is limited (e.g., Streptococcus pyogenes, Salmonella, hepatitis B virus)</td>
</tr>
<tr>
<td>RG3</td>
<td>Associated with serious to lethal human disease for which preventative vaccines or post-exposure therapies may be scarce. Public health impact is limited-to-moderate (e.g., Mycobacterium tuberculosis, hantaviruses, West Nile virus, SARS)</td>
</tr>
<tr>
<td>RG4</td>
<td>Associated with serious to lethal human disease for which preventative vaccines or post exposure therapies are not usually available. Public health impact is high (e.g., Ebola virus, Marburg virus, smallpox virus, etc.)</td>
</tr>
</tbody>
</table>

Table 26.9 describes the four (4) Risk Group Levels (RGs), and provides examples of communicable diseases that would typically fall in to these classifications, and the typical protections that would be necessary to prevent transmission of the disease. It is important to note that all but two (2) communicable disease hazards identified by CSU campuses fall under either the lower-risk RG1 or RG2 categories. COVID-19 and tuberculosis are the two (2) communicable diseases fall under the higher-risk RG3 category. However, with the advent of the recently-developed COVID-19 vaccine, and with the expectation of an increasingly robust vaccine supply, it is possible that the RG level


for COVID-19 could be lowered in the future, thereby reducing both the extent and the potential impact of COVID-19.

Table 26-8: Risk Group Levels (RGs) with Example Diseases and Recommended Precautions

<table>
<thead>
<tr>
<th>Level</th>
<th>Examples</th>
<th>Typical Protection to Prevent Transmission</th>
</tr>
</thead>
<tbody>
<tr>
<td>RG I</td>
<td>E. Coli</td>
<td>Precautions are minimal, most likely involving gloves and some sort of facial protection. Usually, contaminated materials are left in open (but separately indicated) waste receptacles. Decontamination procedures for this level are similar in most respects to modern precautions against everyday viruses (i.e.: washing one's hands with anti-bacterial soap, washing all exposed surfaces of the lab with disinfectants, etc.).</td>
</tr>
<tr>
<td>RG 2</td>
<td>Chicken Pox, Hepatitis A, B, C, Lyme disease, Salmonella, Mumps, Measles, Malaria, Scrapie, Dengue Fever, HIV</td>
<td>These bacteria and viruses cause mild disease in humans or are difficult to contract via aerosol. Routine diagnostic work with clinical specimens can be done safely at BSL-2, using BSL-2 practices and procedures.</td>
</tr>
</tbody>
</table>

---

These bacteria and viruses cause severe to fatal disease in human, but vaccines or other treatments do exist to combat them. Laboratory personnel have specific training in handling pathogenic and potentially lethal agents and are supervised by competent scientists who are experienced in working with these agents. This is considered a neutral or warm zone.

These viruses and bacteria cause severe to fatal disease in humans, for which vaccines or other treatments are not available. When dealing with biological hazards at this level the use of a Hazmat suit and a self-contained oxygen supply is mandatory. The entrance and exit of a BSL-4 lab will contain multiple showers, a vacuum room, an ultraviolet light room, autonomous detection system, and other safety precautions designed to destroy all traces of the biohazard. Multiple airlocks are employed and are electronically secured to prevent both doors opening at the same time. All air and water service going to and coming from a BSL-4 lab will undergo similar decontamination procedures to eliminate the possibility of an accidental release.

### Probability of Future Occurrence of the Hazard

There are significant data limitations regarding non-COVID-19 communicable disease cases, as the information thereof is outdated, anecdotal, and/or inadequate. As a result, it is not feasible to provide quantitative probabilities of future occurrence for non-COVID-19 communicable disease hazards. However, based on the limited data, it is feasible to present qualitative probabilities of future occurrence based on ranges of communicable disease frequency. Table 26-10 shows a probability scale of future occurrence for the nine (9) communicable disease hazards profiled in this assessment. This scale is divided into four (4) levels of probability:
Table 26-9: Likelihood of Future Hazard Occurrence

<table>
<thead>
<tr>
<th>Likelihood</th>
<th>Parameters for Determining Likelihood</th>
</tr>
</thead>
<tbody>
<tr>
<td>Highly Likely</td>
<td>76 – 100% probability that hazard will occur annually (high to very high frequency)</td>
</tr>
<tr>
<td>Likely</td>
<td>50 – 75% probability that hazard will occur annually (moderate to high frequency)</td>
</tr>
<tr>
<td>Possible</td>
<td>11 – 49% probability that hazard will occur annually (low to moderate frequency)</td>
</tr>
<tr>
<td>Unlikely</td>
<td>0 – 10% probability that hazard will occur annually (very low to low frequency)</td>
</tr>
</tbody>
</table>

Due to significant data limitations surrounding non-COVID communicable diseases, the probability of future occurrence of CSU-system-wide communicable disease is measured by the proportion of campuses that have identified a particular communicable disease as having an impact on the campus community. In this measure, the more frequent a communicable disease is seen as impactful CSU-wide, the greater the probability of future occurrence.

Note: Each communicable disease’s probability of future occurrence ranking CSU-system-wide reflects the ranking at the individual CSU campus level unless noted otherwise.

Table 26-10: Probability of Future Occurrence of Communicable Disease Hazard for CSU System.

<table>
<thead>
<tr>
<th>Collective List of Communicable Diseases Identified by All CSU Campuses</th>
<th>Number of CSU Campuses (Including Chancellor’s Office) Identifying Communicable Disease Having Significant Impact</th>
<th>Proportion of CSU Campuses Identifying Communicable Disease as Having Significant Impact System-Wide</th>
<th>CSU System-Wide Probability Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>COVID-19 (SARS-CoV-2)</td>
<td>24</td>
<td>1.00</td>
<td>Highly Likely</td>
</tr>
<tr>
<td>Meningitis</td>
<td>7</td>
<td>0.29</td>
<td>Possible</td>
</tr>
<tr>
<td>Measles</td>
<td>6</td>
<td>0.25</td>
<td>Possible</td>
</tr>
<tr>
<td>Influenza (Including H1N1/Swine Flu)</td>
<td>6</td>
<td>0.25</td>
<td>Possible</td>
</tr>
<tr>
<td>Tuberculosis</td>
<td>5</td>
<td>0.21</td>
<td>Possible</td>
</tr>
<tr>
<td>Norovirus</td>
<td>4</td>
<td>0.17</td>
<td>Possible</td>
</tr>
<tr>
<td>Disease</td>
<td>Vulnerability</td>
<td>IU</td>
<td>Unlikely</td>
</tr>
<tr>
<td>----------------------------------------</td>
<td>---------------</td>
<td>-------</td>
<td>----------</td>
</tr>
<tr>
<td>Mumps</td>
<td>2</td>
<td>0.08</td>
<td>Unlikely</td>
</tr>
<tr>
<td>E. Coli</td>
<td>2</td>
<td>0.08</td>
<td>Unlikely</td>
</tr>
<tr>
<td>Sexually Transmitted Diseases (STDs)</td>
<td>2</td>
<td>0.08</td>
<td>Unlikely</td>
</tr>
</tbody>
</table>

(Source: Interviews with staff at CSU campuses and at the CSU Chancellor’s Office.)

Vulnerability to the Hazard

Vulnerability to a communicable diseases hazard resides in the population of a given area – both human and animal – not in the infrastructure or physical assets. While CSU assets and infrastructure could be impacted indirectly by the communicable disease hazard, these impacts would be secondary to the impact that the communicable disease hazard would have on students, faculty, staff, and visitors at both Stanislaus State University campuses.

CSU campus settings are geographically diverse, with locations ranging from small towns to medium-sized cities to densely populated urban areas. Hundreds of thousands of people work, study, and/or pass through CSU campuses on any given day. (As of Fall 2019, the CSU System had 480,541 students and 53,763 faculty and staff. Stanislaus State University had 10,614 students and 1,276 faculty and staff.17 18 Each of these persons is vulnerable to communicable disease, particularly if it is a pathogen that individual has not been immunized against, or for which no immunization exists. Prolonged outbreaks could result in a loss of services, failure of infrastructure (from lack of operators or maintenance), and closure of facilities. This exact scenario has played out to some degree in the current COVID-19 pandemic on the Stanislaus State University campuses.

Estimate of Potential Losses

The COVID-19 Pandemic Health Impact on CSU Campuses and Surrounding Communities

The most prescient metric for estimating losses from COVID-19 is loss of life. The nationwide campus-related COVID-19 death rate of 0.02% remains well below the average COVID-19 death rate in the U.S. However, due to data limitations, there is no information on CSU-campus-specific deaths by COVID-19 or by any other communicable diseases. In

17 The California State University. Enrollment. Retrieved 05.03.2021 from: https://www2.calstate.edu/csu-system/about-the-csu/facts-about-the-csu/enrollment/Pages/default.aspx

18 The California State University. Employee Head Count by Campus. Retrieved 05.03.2021 from: https://www2.calstate.edu/csu-system/faculty-staff/employee-profile/csu-workforce/Pages/employee-headcount-by-campus.aspx
fact, COVID-19 is the only communicable disease for which case reports have been readily available for CSU campuses.

At some point in the future, CSU campuses will return to full capacity. Without adequate surveillance regarding campus access and student and employee interaction, CSU campuses (including Stanislaus State University) are at risk of developing an extreme incidence of COVID-19, and may become “super-spreaders” for adjacent communities. The emergence of more virulent COVID-19 variants would only add to the potential for high negative impacts on life safety, operations, and service delivery across the CSU system. (Other communicable diseases would also re-emerge, but with low to moderate negative impacts on life safety, operations, and service delivery.)

Economic Impact of COVID-19 Pandemic on CSU Financial Health

During the first few months of the COVID-19 pandemic in 2020, the CSU system suffered tremendous negative fiscal impacts. From March through July of 2020 alone, over $146 million worth of revenue losses were sustained across the CSU system due to refunds to students for parking, housing and dining service fees during Spring Semester, 2020. (See Figure 26.2 below for the economic impact to Stanislaus State University). Several CSU campuses saw refund losses surpass $10 million. (See Figure 26-2)

Figure 26-2: CSU COVID-19 Cost Tracking Showing Revenue Refund Losses and Increased Costs


Mitigative Relief from Federal Assistance

The $1.5 billion in total federal assistance sent to the CSU system will help relieve the losses of revenues from services like dorms, parking and dining services during a year of

Table 26-11: Total Federal Assistance to CSU for COVID-19-Related Losses, 2020-2021

<table>
<thead>
<tr>
<th>Institution</th>
<th>December 2020 Stimulus</th>
<th>CARES Act</th>
<th>APLU Projection of HEERF Total ARP Act Funding Allocation</th>
<th>Total Estimated Federal COVID Relief Funding</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bakersfield</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
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<tr>
<td>Chancellors Office</td>
<td>-</td>
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<tr>
<td>Channel Islands</td>
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<tr>
<td>Chico</td>
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<tr>
<td>Dominguez Hills</td>
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<tr>
<td>East Bay</td>
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<tr>
<td>Fresno</td>
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<td>Fullerton</td>
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<tr>
<td>Humboldt</td>
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<td>Long Beach</td>
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<td>Los Angeles</td>
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<tr>
<td>Monterey Bay</td>
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<tr>
<td>Northridge</td>
<td>-</td>
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<tr>
<td>Pomona</td>
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<tr>
<td>Sacramento</td>
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<tr>
<td>San Bernardino</td>
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<td>San Diego</td>
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<tr>
<td>Sonoma</td>
<td>-</td>
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<tr>
<td>Stanislaus</td>
<td>-</td>
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</table>

<table>
<thead>
<tr>
<th>Institution</th>
<th>December 2020 Stimulus</th>
<th>CARES Act</th>
<th>APLU Projection of HEERF Total ARP Act Funding Allocation</th>
<th>Total Estimated Federal COVID Relief Funding</th>
</tr>
</thead>
<tbody>
<tr>
<td>CSU System Total</td>
<td>5,461</td>
<td>8,597</td>
<td>3,635</td>
<td>30,838</td>
</tr>
<tr>
<td></td>
<td>47,931</td>
<td>134,070</td>
<td>134,070</td>
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26-20
<table>
<thead>
<tr>
<th>University Name</th>
<th>Total Revenue</th>
<th>Grants</th>
<th>Research</th>
<th>3rd-Party</th>
<th>Total</th>
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<tbody>
<tr>
<td>California Polytechnic State University</td>
<td>$20,752,799</td>
<td>$14,725,000</td>
<td>$37,000,928</td>
<td>$72,478,727</td>
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<tr>
<td>California State Polytechnic University, Pomona</td>
<td>$48,614,353</td>
<td>$31,102,000</td>
<td>$86,044,649</td>
<td>$165,761,002</td>
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<tr>
<td>University Channel Islands</td>
<td>$14,288,099</td>
<td>$8,512,000</td>
<td>$24,915,170</td>
<td>$47,715,269</td>
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<tr>
<td>California State University Maritime Academy</td>
<td>$1,381,700</td>
<td>$1,204,000</td>
<td>$2,472,622</td>
<td>$5,058,322</td>
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<tr>
<td>California State University - Sacramento</td>
<td>$59,891,260</td>
<td>$35,643,000</td>
<td>$104,900,133</td>
<td>$200,434,393</td>
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<tr>
<td>California State University, Bakersfield</td>
<td>$22,855,632</td>
<td>$12,483,000</td>
<td>$40,285,565</td>
<td>$75,624,197</td>
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<td>California State University, Chico</td>
<td>$31,603,856</td>
<td>$20,019,000</td>
<td>$55,754,538</td>
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<td>California State University, Dominguez Hills</td>
<td>$31,843,563</td>
<td>$18,312,000</td>
<td>$55,915,410</td>
<td>$106,070,973</td>
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<tr>
<td>California State University, East Bay</td>
<td>$24,243,652</td>
<td>$14,394,000</td>
<td>$42,929,208</td>
<td>$81,566,860</td>
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<tr>
<td>California State University, Fresno</td>
<td>$52,725,317</td>
<td>$32,557,000</td>
<td>$92,926,594</td>
<td>$178,208,911</td>
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<tr>
<td>California State University, Fullerton</td>
<td>$67,736,949</td>
<td>$41,088,000</td>
<td>$120,859,884</td>
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<tr>
<td>California State University, Long Beach</td>
<td>$67,421,424</td>
<td>$41,202,000</td>
<td>$119,508,329</td>
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<td>California State University, Los Angeles</td>
<td>$61,905,561</td>
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<td>$210,516,233</td>
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</table>

26-21
Vulnerability Assessment Conclusions

Before the COVID-19 pandemic, populations at all CSU campuses and CSU-affiliated facilities were substantial. Collectively, as of Fall 2019, CSU campuses had 480,541 students and 53,763 faculty and staff. All were at risk from the communicable disease events, with 534,304 people being directly vulnerable. The COVID-19 pandemic has caused campus population numbers to plummet to a small fraction of full capacity.

At some point in the future, campus population numbers will return to their pre-pandemic levels, and students, faculty, and staff will again be vulnerable to the communicable disease hazard. If just 10% of the total CSU population were to become ill with a highly infective communicable disease like influenza or another strain of SARS, this would mean that approximately 53,430 people would be sick at the same time. This scenario would
likely overwhelm available on-campus medical services and could even overwhelm portions of the larger community’s medical resources – especially if there were large numbers of infected people with immune system compromises or other underlying health problems.

See Table 26-13 below for the “10% outbreak scenario” projections for Stanislaus State University and for the entire CSU System.

Table 26-12: Scenario of Communicable Disease Hazard Affecting 10% of the CSU Population

<table>
<thead>
<tr>
<th>CSU Campus</th>
<th>Approximate Enrollment Population (Fall 2019)</th>
<th>Approximate Total FT/PT Faculty/Staff Population (Fall 2019)</th>
<th>Total Combined Approximate Student and Faculty/Staff Population</th>
<th>10% Outbreak Scenario (Students and Faculty/Staff Combined)</th>
</tr>
</thead>
<tbody>
<tr>
<td>CSU Bakersfield</td>
<td>11,199</td>
<td>1,277</td>
<td>12,476</td>
<td>1,248</td>
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<td>CSU Channel Islands</td>
<td>7,093</td>
<td>994</td>
<td>8,087</td>
<td>809</td>
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<tr>
<td>Chico State</td>
<td>17,019</td>
<td>1,969</td>
<td>18,988</td>
<td>1,899</td>
</tr>
<tr>
<td>CSU Dominguez Hills</td>
<td>17,027</td>
<td>1,761</td>
<td>18,788</td>
<td>1,879</td>
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<tr>
<td>Cal State East Bay</td>
<td>14,705</td>
<td>1,764</td>
<td>16,469</td>
<td>1,647</td>
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<tr>
<td>Fresno State</td>
<td>24,139</td>
<td>2,534</td>
<td>26,673</td>
<td>2,667</td>
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<td>Cal State Fullerton</td>
<td>39,868</td>
<td>3,736</td>
<td>43,604</td>
<td>4,360</td>
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<tr>
<td>Humboldt State</td>
<td>6,983</td>
<td>1,171</td>
<td>8,154</td>
<td>815</td>
</tr>
<tr>
<td>Cal State Long Beach</td>
<td>38,074</td>
<td>4,004</td>
<td>42,078</td>
<td>4,208</td>
</tr>
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</table>


<table>
<thead>
<tr>
<th>Institution</th>
<th>Total Enrollment</th>
<th>Undergraduate</th>
<th>Graduate</th>
<th>Other</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cal State LA</td>
<td>26,361</td>
<td>2,821</td>
<td>29,182</td>
<td>2,918</td>
</tr>
<tr>
<td>Cal Maritime</td>
<td>911</td>
<td>329</td>
<td>1,240</td>
<td>124</td>
</tr>
<tr>
<td>CSU Monterey Bay</td>
<td>7,123</td>
<td>1,059</td>
<td>8,182</td>
<td>818</td>
</tr>
<tr>
<td>CSUN (Northridge)</td>
<td>38,391</td>
<td>3,832</td>
<td>42,223</td>
<td>4,222</td>
</tr>
<tr>
<td>Cal Poly Pomona</td>
<td>27,914</td>
<td>2,650</td>
<td>30,564</td>
<td>3,056</td>
</tr>
<tr>
<td>Sacramento State</td>
<td>31,156</td>
<td>3,228</td>
<td>34,384</td>
<td>3,438</td>
</tr>
<tr>
<td>Cal State San Bernardino</td>
<td>20,311</td>
<td>2,118</td>
<td>22,429</td>
<td>2,243</td>
</tr>
<tr>
<td>San Diego State</td>
<td>35,081</td>
<td>3,702</td>
<td>38,783</td>
<td>3,878</td>
</tr>
<tr>
<td>San Francisco State</td>
<td>28,880</td>
<td>3,401</td>
<td>32,281</td>
<td>3,228</td>
</tr>
<tr>
<td>San José State</td>
<td>33,282</td>
<td>3,568</td>
<td>36,850</td>
<td>3,685</td>
</tr>
<tr>
<td>Cal Poly San Luis Obispo</td>
<td>21,242</td>
<td>2,871</td>
<td>24,113</td>
<td>2,411</td>
</tr>
<tr>
<td>CSU San Marcos</td>
<td>14,519</td>
<td>1,687</td>
<td>16,206</td>
<td>1,621</td>
</tr>
<tr>
<td>Sonoma State</td>
<td>8,649</td>
<td>1,338</td>
<td>9,987</td>
<td>999</td>
</tr>
<tr>
<td>Stanislaus State University (Stanislaus State)</td>
<td>10,614</td>
<td>1,276</td>
<td>11,890</td>
<td>1,189</td>
</tr>
<tr>
<td>Office of the Chancellor</td>
<td>0</td>
<td>673</td>
<td>673</td>
<td>67</td>
</tr>
<tr>
<td>CSU System-Wide</td>
<td>480,541</td>
<td>53,763</td>
<td>534,304</td>
<td>53,430</td>
</tr>
</tbody>
</table>

*Note: Enrollment figures do not include non-specific CSU campus International Programs (455 students) or CALStateTEACH Program (933 students).*
While the case numbers of COVID-19 have been significantly lower (about 1% of the total CSU population) than those in the 10% scenario, the degree of virulence and resultant morbidity and mortality caused by COVID-19 have led to widespread campus shutdowns, educational disruption, and economic harm to the CSU system (including Stanislaus State University). In short, the real-time COVID-19 communicable disease outbreak scenario has proven far more devastating than the 10% simulated scenario.

**Identified Data Limitations**

There is a wealth of technical information available for communicable disease. However, there is also limited non-COVID-19 communicable disease data available regarding risk or vulnerability of specific populations throughout the CSU. Much of the data that does exist is protected by privacy policies, and therefore cannot be obtained for more specific populations. As a result, performing a detailed quantitative assessment for this hazard is difficult.

Data that could be collected prior to the next update in order to improve this methodology includes:

- Data regarding infection rates at the campus level and for specific populations;
- Data regarding communicable disease case numbers and outcomes, by CSU campus;
- Data regarding projected population changes;
- Data regarding absenteeism; and
- Data regarding increased operating costs as a result of absenteeism (i.e., temporary shifting of duties resulting in business interruption).

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**Dam and Levee Failure**

**Description of the Hazard**

A dam failure represents the structural collapse of a dam that stores water in a reservoir behind the dam. These failures are typically the result of structural age, damage to the structure caused by earthquake or flooding, inadequate discharge or spillway capacity, inadequate maintenance, improper construction materials, or extreme inflow of water.
into the reservoir. Prolonged precipitation may result in overtopping of the dam resulting in structural compromise. The tremendous energy generated by a sudden breach of the dam will have significant downstream effects. Flood damage resulting from dam failures potentially will result in economic losses, environmental damage, destruction of agriculture, and human casualties. This type of incident is extremely dangerous as it can occur rapidly, with no warning resulting in an inability to effectively evacuate threatened communities.

A levee failure is similar to dam failures as the result will be a breach causing flooding on the dry side of the levee. Levees are embankments whose primary purpose is to furnish flood protection from seasonal high water or divert the flow of water. Most levees in California are intended to withstand peak water levels generated by heavy precipitation or rapid snowmelt in a watershed. Other levees are designed to withstand fluctuating water levels on a continuous basis such as those in the California Delta exposed to tidal influences. Levees routinely extend for lengthy distances immediately protecting communities. Levees can be found throughout the state but are most prominent in the Sacramento and San Joaquin Valleys.

Levee failures can vary from overtoppings to small uncontrolled discharge to catastrophic failure. Areas downstream of the failure will be subject to inundation dependent on the volume of water released. These levee failures are also typically the result of structural age, damage to the structure caused by earthquake or flooding, slumping, seepage underneath the levee, high velocity flows eroding the levee, inadequate capacity, inadequate maintenance, improper construction materials, or extreme inflow of water into the system. Flood damage resulting from levee failures potentially will result in economic losses, environmental damage, destruction of agriculture, and human casualties.

A dam or levee failure flooding will vary depending on a number of factors including the extent of the collapse or breach, the volume of water behind the structure, and the nature of the exposed downstream features. This unpredictable flooding presents a threat to life and property in addition to critical infrastructure. Lifelines and supply routes will likely be damaged or made impassible by flood erosion or standing water. Water quality and health concerns would likely be cascading effects of dam or levee failures.

Location of the Hazard

Stanislaus County is home to a variety of flood control facilities and levee systems throughout the county. Turlock sits in the heart of the San Joaquin Valley surrounded by agricultural land and between the Sierra Nevada mountains and the Coastal Ranges.

There are dam facilities in Stanislaus County to the east of the city including Modesto Reservoir and Turlock Lake.

The county is additionally downstream of facilities located in other counties. There are dam facilities east of the city in Tuolumne and Mariposa Counties containing significant amounts of water. The Don Pedro Reservoir Dam regulates the Tuolumne River, and the New Exchequer Dam regulates the Merced River. Both eventually feeding into the San Joaquin River. Failures of these facilities are expected to produce inundations that cover sizable areas around Turlock. The Stanislaus State University campus is located within the Don Pedro Dam inundation area but not within the New Exchequer Dam inundation area.

Figure 26-3: Don Pedro Dam Breach Inundation Map

27 California Department of Water Resources, Dam Breach Inundation Map Publisher, https://fmds.water.ca.gov/webgis/?appid=dam_prototype_v2
Extent of the Hazard

Dams are classified according to the hazard that they pose to life and property in the event of failure, rather than the likelihood of that failure.

- High hazard potential dams may result in loss of human life, and will likely result in economic, environmental, or lifeline losses.
- Significant hazard potential dams are not expected to result in loss of life, but are expected to cause economic, environmental, and lifeline losses.
- Low hazard potential dams are not expected to result in loss of life, and there is a low expectation of economic, environmental, or lifeline losses. What losses do occur are generally limited to the dam owner.

Dams classified as high hazard are required to have Emergency Action Plans (EAP). EAPS are formal documents that identify potential emergency conditions at the dam and

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28 California Department of Water Resources, Dam Breach Inundation Map Publisher, https://fmds.water.ca.gov/webgis/?appid=dam_prototype_v2
specify preplanned actions to be followed in case of failure. An EAP is required for all high hazard dams and is recommended for all significant hazard dams.

Table 26-13: Dams in Proximity to Stanislaus State University

<table>
<thead>
<tr>
<th>River</th>
<th>Dam</th>
<th>Storage</th>
<th>Hazard Severity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tuolumne</td>
<td>Don Pedro (Tuolumne County)</td>
<td>2,300,000af</td>
<td>High Hazard</td>
</tr>
<tr>
<td>Tuolumne</td>
<td>Modesto</td>
<td>40,000af</td>
<td>High Hazard</td>
</tr>
<tr>
<td>Merced</td>
<td>New Exchequer</td>
<td>1,100,000af</td>
<td>High Hazard</td>
</tr>
<tr>
<td>Tuolumne</td>
<td>Turlock</td>
<td>63,406af</td>
<td>High Hazard</td>
</tr>
</tbody>
</table>

The Stanislaus State University campus lies within the inundation zone of the Don Pedro Dam listed above. In the event of a catastrophic failure of the identified dams, the Stanislaus State University campus is expected to be in the inundation area covering the entire campus along with the entire community surrounding the campus. The entirety of Turlock would experience the effects of water inundation damage as the water is expected to fan out across much of this portion of the San Joaquin Valley. Additionally, there are multiple transportation corridors, utilities, and other critical infrastructure that lie within the dam inundation zones that could compromise transportation routes, service options, and areas the campus community reside or work. Based on the above factors, the planning committee ranks the extent of the hazard as Moderate.

Extent – Levee Failure

Levees have been constructed to protect portions of Stanislaus County outside of Turlock. A series of levees have been constructed to protect lands alongside the San Joaquin River in eastern Stanislaus County. Additionally, levees line parts of the Tuolumne River north of Turlock. The Stanislaus State University campus is not located in a levee protected area. Based on the above factors, the planning committee ranks the extent of the hazard as Low.

History of the Hazard

There are no records of dam or levee failures in areas that present a threat to the Stanislaus State University campus. Stanislaus County has no record of dam failures:

Table 26-14: Stanislaus County Dam Failures


30 Stanislaus County Local Hazard Mitigation Plan Update, July 2017
Potential Impacts of the Hazard

Dam Failure Impacts - Water that is released due to a dam that has failed generates tremendous energy and force causing a flood that will be catastrophic to life and property. Water levels from the failed dam could be significantly higher than those experienced in worst case scenario flood events. Areas closer to the failed dam will be more likely to experience complete devastation while other areas within the inundation zone will see varying levels of flood waters. The extent of the impacts of a failed dam would vary based on a number of factors such as the volume of water released, the base flow of the river, the time of the failure, the amount of warning provided, and the distance from the dam. Impacts resulting from a dam failure include:

- Loss of life
- Property destruction or damage
- Loss of property contents
- Infrastructure damage
- Flooded or destroyed lifelines/supply routes
- Damaged or destroyed utilities
- Loss of community economic base
- Employment losses
- Agricultural (crops and livestock) damages or destruction
- Environmental damage
- Floods generating threats to public health
- Flood generated debris

Levee Failure Impacts

A levee failure may result in substantial amounts of water to enter into developed areas protected by the levee. The force and volume of water that is generated by a levee failure may cause extensive structural damage in close proximity to the breach and effects of flooding spreading well beyond the point of the failure. The extent of the impacts would vary based on a number of factors such as the volume of water released, the time of the failure, the amount of warning provided, the location of the breach, elevation, and distance from the breach. Potential impacts resulting from a levee failure include:

- Loss of life
- Property destruction or damage
- Loss of property contents
- Infrastructure damage
- Public health hazards resulting from mold, mildew, and disease due to flood water
- Flooded or destroyed lifelines/supply routes
- Damaged or destroyed utilities
- Loss of community economic base
- Employment losses
- Agricultural (crops and livestock) damages or destruction
- Environmental damage
- Prolonged periods of necessary dewatering
- Disruptions to education delivery to community

**Probability of Future Occurrence of the Hazard**

Stanislaus County is determined to be at risk from dam and levee failure in many parts of the county. The location of the Stanislaus State University campus downstream from the Don Pedro and New Malones dams demonstrates that the potential exists for future dam related issues. The City of Turlock including the Stanislaus State University campus resides within the dam inundation zone for the Don Pedro Dam. The entire City of Turlock remains outside of levee protected zones. There are no official recurrence intervals that have been calculated for dam or levee failures. Based on no historical dam or levee failure occurrences, the likelihood of this hazard is low – dams and levees are high priority infrastructure that undergo careful and consistent monitoring and maintenance.

The probability of future occurrence for both dam and levee failures is **Unlikely**.

**Vulnerability to the Hazard**

Given High Priority dam monitoring and maintenance practices in place, a catastrophic dam or levee failure is highly unlikely. In addition, the campus does not lie within an inundation zone. However, in the unlikely event of a catastrophic failure, the effects of flooding from compromised dams and levees on campus would most likely be limited to indirect or secondary effects in terms of disruption to regional transportation networks and services, and the amount of time to respond to the needs of the campus community prior to inundation will be limited.

Any breach along a levee is impossible to predict where a failure may occur. It is likely that response action will not be fully implemented until the incident situational
intelligence provides adequate information as to compromised locations. These variables place all those working and living within dam inundation and flood protection zones in vulnerable locations in the event of a low probability, catastrophic event.

The distributed placement of levees, most near development may expose significant vulnerabilities to other areas of the region even if the Stanislaus State University campus areas are unaffected. There is potential the campus community will be affected as a breach may cause flooding and damages to the homes of students, faculty, and staff or to access/supply routes, utilities, or other critical services. The potential for flood damaged structures being left uninhabitable including campus residence halls will result in the vulnerability of numerous displaced individuals and households. The lack of flood insurance will cause additional and extreme financial burdens on those affected.

Vulnerability to a dam or levee failure on the Stanislaus State University campus will vary depending on the degree of breach or structural failure and when the failure was to occur. The risk to the campus population will be lessened during periods when classes are not in session or during periods of breaks. Conversely, during the days and hours that classes are in session and staff are at their workplaces, the human vulnerability increases. However, in region-wide events this vulnerability may be shared with the homes and workplaces of members of the campus community and their families.

Certain campus populations will experience greater challenges to a post-flood / failure environment. Vulnerable populations will likely need to navigate through flood generated debris, face extreme health safety issues from flood waters, experience extreme stresses of a disaster, an inability to communicate to or gain access to support networks, and find difficulty in accessing equipment or supplies to aid in a specific need.

**Estimate of Potential Losses**

Estimates of potential losses will be influenced by a variety of factors. The volume and force of the water will determine the scale of damages affecting campus infrastructure, equipment, and other impacted features. The proximity to the failure and elevation above flood waters will affect the level of damage and individuals exposed. The time of the academic year, the day of week, and hour in which the failure was to occur will influence the number of people on campus and potential casualties. Losses will be generated by the physical damages, the loss of revenue, loss of academic research, loss of building contents, and community wide economic reductions.

Based on estimate replacement costs of facilities and structures on campus, the total replacement costs due to earthquake are $162,376,793. However, it is unlikely for a dam or levee failure event to cause catastrophic destruction at Stanislaus State University.

**Vulnerability Assessment Conclusions**

While the occurrence of dam and levee failures have not been historically relevant near the Stanislaus State University campus, the potential for hazards related to the region’s levees and dams still exist. Additionally, the presence of earthquake faults in proximity to the existing dam and levee structures presents a valid danger to downstream locations in
the event of an earthquake. In the unlikely event of a high priority dam’s total failure, the consequences would be catastrophic to downstream communities. The potential for dam or levee failure further generates the added potential for a number of cascading effects such as disruptions to the local economy, utility failures, disruptions to providing for the needs of the community, and development of public health hazards. These effects would be exacerbated by effects of seasonal flooding, ongoing heavy precipitation, or excessive run-off from the watershed contributing to the river system. The potential for widespread flooding and damage of structures due to the force of water has exponentially powerful impacts on particular populations among the campus community including those with access or functional needs, international students, the homeless, and students residing in the residence halls.

**Identified Data Limitations**

Data limitations include missing campus structural replacement costs, and an incomplete inventory of both building construction features and mitigation efforts to lessen the impact due to flood inundation. Based on estimate replacement costs of facilities and structures on campus, the maximum total replacement costs (of available data) due to dam and levee failure are $162,376,793.
Drought

Description of the Hazard

Drought is defined as a condition where moisture levels fall significantly below normal for an extended period of time over a large area that adversely affects plants, animal life, and humans. Drought is a gradual phenomenon. Although droughts are sometimes characterized as emergencies, they differ from typical emergency events. Most natural disasters, such as floods or forest fires, occur relatively rapidly and afford little time for preparing for disaster response. Droughts occur slowly, over a multi-year period, and it is often not obvious or easy to quantify when a drought begins and ends.

Throughout California, one dry year does not normally constitute a drought. California’s extensive system of water supply infrastructure (reservoirs, groundwater basins, and conveyance assets) mitigates the effect of short-term dry periods for most water users. Defining when a drought begins is a function of drought impacts to water users. Drought in one location may not constitute a drought for all water users, as some users in relative proximity may have a different water supply. For example, individual water suppliers may use a combination of sources such as rainfall/runoff, water in storage, or expected supply from a water wholesaler to define their water supply conditions.

Drought can be characterized as one or more of the four following types:

- **Meteorological drought** is defined on the basis of the degree of dryness (in comparison to some “normal” or average amount) and the duration of the dry period. A meteorological drought must be considered as region-specific since the atmospheric conditions that result in deficiencies of precipitation are highly variable from region to region.

- **Hydrological drought** is associated with the effects of periods of precipitation (including snowfall) shortfalls on surface or subsurface water supply (e.g., streamflow, reservoir and lake levels, ground water). The frequency and severity of hydrological drought is often defined on a watershed or river basin scale. Although all droughts originate with a deficiency of precipitation, hydrologists are more concerned with how this deficiency plays out through the hydrologic system. Hydrological droughts are usually out of phase with or lag the occurrence of meteorological and agricultural droughts. It takes longer for precipitation deficiencies to show up in components of the hydrological system such as soil moisture, streamflow, and ground water and reservoir levels. As a result, these impacts are out of phase with impacts in other economic sectors.

- **Agricultural drought** focus is on soil moisture deficiencies, differences between actual and potential evaporation, reduced ground water or reservoir levels, and so forth. Plant water demand depends on prevailing weather conditions, biological characteristics of the specific plant, its stage of growth, and the physical and biological properties of the soil.
- **Socioeconomic drought** refers to when physical water shortage begins to affect health, well-being, and quality of life of people, or when the drought starts to affect the supply and demand of an economic product that relies on water. The drought issue in California is further compounded by water rights. The central challenge is how to prioritize water usage among a broad variety of contexts. It is for this reason that water is a commodity possessed and utilized under a variety of legal doctrines. As such, many competing sets of interests create a dynamic prioritization process between, for example, farming and federally protected fish habitats and water supply for municipal/public use (including usage for CSU - Stanislaus) versus water usage for wildfire abatement or natural resource protection.

**Location of the Hazard**

Drought conditions have been identified throughout Stanislaus County and the City of Turlock where CSU - Stanislaus is located. Drought is not a location-specific hazard and affects the entire planning area equally. Drought location is not isolated to the campus footprint but occurs as a geographic sub-set of drought conditions occurring at larger scales. From 2000-2020, drought conditions existed continuously in the state, with 80-100% of the state impacted for 12 of the last 20 years.  

**Extent of the Hazard**

Although the extent of drought on campus is identified as minimal, given the historical occurrence of drought impacts throughout the city and county surrounding the planning area, and the potential future impact exacerbated by climate change, the CSU Planning Committee recognizes that drought will continue to pose a high degree of risk statewide, potentially impacting crops, livestock, water resources, the natural environment at large, buildings and infrastructure (from land subsidence), and local economies. Although drought affects the entire CSU system-wide planning area equally, the extent of the hazard is variable and specific to each campus/jurisdiction, depending on contextual factors such as the degree of assets and activities, historically impacted by drought within each jurisdiction. That said, the extent of the hazard on campus is reported to be Low due to the use of award-winning water retention/conservation ponds and recycled water for mitigating prolonged drought impacts to campus grounds and the campus research garden.

In addition, drought related land subsidence has occurred statewide and will continue in areas where the groundwater basin has been subject to overdraft and long-term recharge is inadequate to maintain the water table elevation, leaving underground voids. Subsidence levels have been measured up to 30-feet in California with subsidence bowls covering hundreds of square miles. As such, drought-related subsidence may result in

serious structural damage to buildings, roads, irrigation ditches, underground utilities, and pipelines. Though these effects have not been reported on campus, they remain issues of concern for the campus over the long term.

Although the campus planning team identifies the extent of the hazard as Low (qualitatively) which corresponds to D0 – D1 on the Extent scale (below), Sonoma County has experienced more severe drought conditions, including D4 levels during the statewide event from 2012-2017. As such, the campus planning team recognizes that while historic impacts shaping the extent of drought on campus have been minimal, the potential impacts are tied to trends across larger geographic areas, and, therefore, the committee recognizes that the extent of drought on campus has the potential to increase in the future.

The U.S. Drought Monitor developed tables of impacts reported during past droughts in California in order to depict the extent of drought risk for each level of drought on the U.S. These possible extent conditions for California complement the general impacts column of the U.S. Drought Monitor Classification Scheme.

Table 26-15: Impacts of Drought Levels as Determined by US Drought Monitor32

<table>
<thead>
<tr>
<th>Category</th>
<th>Impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>D0</td>
<td>Soil is dry; irrigation delivery begins early</td>
</tr>
<tr>
<td></td>
<td>Dryland crop germination is stunted</td>
</tr>
<tr>
<td></td>
<td>Active fire season begins</td>
</tr>
<tr>
<td></td>
<td>Winter resort visitation is low; snowpack is minimal</td>
</tr>
<tr>
<td>D1</td>
<td>Dryland pasture growth is stunted; producers give supplemental feed to cattle</td>
</tr>
<tr>
<td></td>
<td>Landscaping and gardens need irrigation earlier; wildlife patterns begin to change</td>
</tr>
<tr>
<td></td>
<td>Stock ponds and creeks are lower than usual</td>
</tr>
<tr>
<td>D2</td>
<td>Grazing land is inadequate</td>
</tr>
<tr>
<td></td>
<td>Producers increase water efficiency methods and drought-resistant crops</td>
</tr>
<tr>
<td></td>
<td>Fire season is longer, with high burn intensity, dry fuels, and large fire spatial extent; more fire crews are on staff</td>
</tr>
<tr>
<td></td>
<td>Wine country tourism increases; lake- and river-based tourism declines; boat ramps close</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>D3</th>
<th>Trees are stressed; plants increase reproductive mechanisms; wildlife diseases increase</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Water temperature increases; programs to divert water to protect fish begin</td>
</tr>
<tr>
<td></td>
<td>River flows decrease; reservoir levels are low and banks are exposed</td>
</tr>
<tr>
<td></td>
<td>Livestock need expensive supplemental feed, cattle and horses are sold; little pasture remains, producers find it difficult to maintain organic meat requirements</td>
</tr>
<tr>
<td></td>
<td>Fruit trees bud early; producers begin irrigating in the winter</td>
</tr>
<tr>
<td></td>
<td>Federal water is not adequate to meet irrigation contracts; extracting supplemental groundwater is expensive</td>
</tr>
<tr>
<td></td>
<td>Dairy operations close</td>
</tr>
<tr>
<td></td>
<td>Marijuana growers illegally tap water out of rivers</td>
</tr>
<tr>
<td></td>
<td>Fire season lasts year-round; fires occur in typically wet parts of state; burn bans are implemented</td>
</tr>
<tr>
<td></td>
<td>Ski and rafting business is low, mountain communities suffer</td>
</tr>
<tr>
<td></td>
<td>Orchard removal and well drilling company business increase; panning for gold increases</td>
</tr>
<tr>
<td></td>
<td>Low river levels impede fish migration and cause lower survival rates</td>
</tr>
<tr>
<td></td>
<td>Wildlife encroach on developed areas; little native food and water is available for bears, which hibernate less</td>
</tr>
<tr>
<td></td>
<td>Water sanitation is a concern, reservoir levels drop significantly, surface water is nearly dry, flows are very low; water theft occurs</td>
</tr>
<tr>
<td></td>
<td>Wells and aquifer levels decrease; homeowners drill new wells</td>
</tr>
<tr>
<td></td>
<td>Water conservation rebate programs increase; water use restrictions are implemented; water transfers increase</td>
</tr>
<tr>
<td></td>
<td>Water is inadequate for agriculture, wildlife, and urban needs; reservoirs are extremely low; hydropower is restricted</td>
</tr>
<tr>
<td></td>
<td>Fields are left fallow; orchards are removed; vegetable yields are low; honey harvest is small</td>
</tr>
<tr>
<td></td>
<td>Fire season is very costly; number of fires and area burned are extensive</td>
</tr>
<tr>
<td></td>
<td>Many recreational activities are affected</td>
</tr>
<tr>
<td></td>
<td>Fish rescue and relocation begins; pine beetle infestation occurs; forest mortality is high; wetlands dry up; survival of native plants and animals is low; fewer wildflowers bloom; wildlife death is widespread; algae blooms appear</td>
</tr>
<tr>
<td></td>
<td>Policy change; agriculture unemployment is high, food aid is needed</td>
</tr>
</tbody>
</table>

26-38
Poor air quality affects health; greenhouse gas emissions increase as hydropower production decreases; West Nile Virus outbreaks rise

Water shortages are widespread; surface water is depleted; federal irrigation water deliveries are extremely low; junior water rights are curtailed; water prices are extremely high; wells are dry, more and deeper wells are drilled; water quality is poor;

History of the Hazard

Although no occurrences of drought are reported specifically for the campus, historically, drought has been so prevalent in California that its presence is almost continuous. According to the US Drought Monitor, Time Series data, Stanislaus County (which encompasses the City of Turlock and the campus) has experienced 8 periods of drought covering 12 of the last 20 years, including the severe statewide event from 2012-2017.

Figure 26-5: Periods of Drought in Stanislaus County, CA, 2001 – 2021

According to the National Drought Mitigation Center, over 3,500 reports and publications covering 370 drought-related events took place across the state (many of which were statewide events) between 2000-2020. In addition, the National Center for Environmental Information (NCEI) reports more than 500 events statewide during this same time period. These events produced a comprehensive range of impacts to water supply, regulations and allocations to businesses and municipalities, budgets and resources for firefighting, water law and policy, and physical impacts to built and natural environments. As such, data records of previous occurrences can be viewed as separate time and event demarcations for a hazard almost continuously in effect across the state with cascading impact potential.

According to the Department of Water Resources, droughts exceeding three years are relatively common in Southern California, but relatively rare in Northern California - the region is the geographic source of much of the state’s developed water supply. The 1929-34 drought established the criteria commonly used in designing storage capacity and yield of large Northern California reservoirs.34

According to the US Drought Monitor’s time series data, from 2000-2021 (with the exception of a 2–3-month period in 2000 and 2011), some degree of drought conditions have been continuously in effect somewhere in California. In fact, 80% - 100% of the state has been subjected to drought conditions for 12 of the last 20 years, with the most severe drought being the 100% state-wide event from 2012-2017.

Figure 26-6: Periods of Drought in State of California, 2001 – 202135

![California Percent Area](image)

Given the extent of the drought risk in California, the following drought event was selected as an exemplar due to its broad and significant impacts on the state and on the county and city surrounding the CSU - Stanislaus campus planning area:

2012 – 2017 – Drought produced severe impacts to water wells throughout the state of California, with a high number of wells running dry. Land subsidence due to increased groundwater pumping also occurred in numerous areas of the state such as the San Joaquin and Central Valleys. Crop damage was widespread as well. Water allotments were drastically reduced in many towns and water agencies, with extremely high costs for procuring water. In addition, job loss occurred with many families requiring food supply assistance, and water supply assistance provided to home-owners with dry wells. According to a report released by UC Davis Center for Watershed Sciences, the 2012 - 2017 period of the California drought cost the state’s agriculture industry about $1 billion in lost revenue, with a total statewide economic cost of the drought calculated to be $2.2


billion. The report says, ‘it is responsible for the greatest water loss ever seen in California agriculture - about one third less than normal”. The report calls the groundwater situation in California "a slow-moving train wreck." Spring snowpack at Donner Summit reached record low levels in 2014, exceeded in 2015 by a remarkable April 1 snow-water-equivalent value of only 5% of average. Decreased precipitation since contributed to near-record low levels in the Shasta Reservoir. The ongoing drought has contributed to declines in crop values across the state. For example, crops including cotton, corn silage and barley (the field crop category) fell by 42 percent.36

**Potential Impacts of the Hazard**

Drought impacts are wide-reaching and may be economic, environmental, and/or societal. This assessment of its impact recognizes that historic occurrences of drought throughout the city, county and region surrounding the planning area are a sub-set of larger and inter-connected regional droughts, and that the (related) historic impacts provide a sound basis for understanding potential (future) impacts.

The most significant potential impact associated with drought across the CSU - Stanislaus campus planning area is a potential reduction in water availability for the municipal area tied to the campus. Other impacts include crop loss and damage to trees and other natural resources (See Tree Mortality below). The footprint of CSU - Stanislaus to some extent includes these vulnerable resources based on the campus landscape (trees) and the presence (and footprint size) of the campus’ agricultural and drought research garden. That said, the campus utilizes recycled water and developed a set of water retention/conservation ponds designed to reduce the potential impacts tied to water scarcity.

As a secondary impact of drought, wildfire is directly attributable to dry atmospheric conditions. Wildfires almost always coincide with drought in California, though not limited to such.37 However, the wildfire hazard is analyzed separately in this plan.

In reviewing the occurrences of drought for Stanislaus County and the city of Turlock (which surround CSU - Stanislaus), the US Drought Monitor and the National Drought Mitigation Center report that tens of millions of trees died during the (2012-2017) state-wide drought disaster. Though data sources do not provide data for tree mortality specific to CSU - Stanislaus, the broad geographic extent of the impact makes it likely that tree mortality occurred to some degree on the campus. Due to the lasting and ongoing effects of drought on the landscape, trees will continue to be impacted within the municipalities, counties and regions wherein lies the CSU campus system as long as drought conditions continue to occur in the future.


Given the absence of data, in order for the CSU Committee to assess the impact of tree mortality, it is useful to view it as a risk sub-set to the probability, location, extent, severity and duration of the drought hazard within each campus-located municipality, county and region. Regarding potential impacts, standing dead trees could fall, posing a risk to people, buildings, power lines, roads and other infrastructure. In addition, drought-impacted trees become susceptible to diseases and insect infestations (bark beetle) further adding to the risk of tree mortality and related potential impacts. No data is currently available for tree mortality on campus, however, the CSU Planning Team will pursue data on this issue in the future.

As a potential tertiary impact, prolonged and repeated drought conditions over time can produce land subsidence and the risk of damage to building foundations and infrastructure on campus resulting from ground instability and collapse. Land subsidence is defined as the vertical sinking of the land over manmade or natural underground voids. Subsidence is often the direct result of groundwater over-extraction in response to drought conditions, as well as oil and gas extraction. Weight can accelerate the process of subsidence resulting from surface development and infrastructure such as roads and buildings, vibrations from construction blasting and heavy truck or train traffic. For example, the State Water Project’s 444-mile-long California Aqueduct has required repairs such as the raising of canal linings, bridges, and water control structures on the Aqueduct – in the Central Valley a five-mile reach of the Eastside Bypass was impacted by subsidence, and the Department of Water Resources estimated that it may cost in the range of $250 million to acquire flowage easements and levee improvements to restore the design capacity of the subsided area.

At present, drought related damage to campus buildings and infrastructure at CSU - Stanislaus has not been reported, but the potential for such impacts is possible. With regard to overall potential impact, water supply/availability for CSU - Stanislaus is ultimately tied to broader inter-dependent, and more intensive modes of water use at local and regional scales such as agriculture and ranching, wildfire protection, larger metropolitan/municipal usage, manufacturing and commerce, tourism, recreation, and wildlife preservation. During drought periods, the State of California’s regulated water allocations are modified and often reduced, which can result in reduced water availability for all usage contexts, including CSU - Stanislaus. A reduction of electric power generation and water quality deterioration are also potential impact factors.

Table 26-16: Summary of Drought Impacts on Water Resources

<table>
<thead>
<tr>
<th>Resource</th>
<th>Type of Impact</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sea Level</td>
<td>Direct</td>
<td>Sea level is rising and will likely impact coastal areas</td>
</tr>
<tr>
<td>Soil Moisture</td>
<td>Direct</td>
<td>Prolonged dry seasons can lead to decreases in soil moisture; drier vegetation</td>
</tr>
<tr>
<td>Vegetation</td>
<td>Indirect</td>
<td>Longer and more intense fire season with increased extent of area burned</td>
</tr>
<tr>
<td>Stream Conditions</td>
<td>Direct</td>
<td>Increases in water temperature; potential effects on fish</td>
</tr>
<tr>
<td>Snowpack</td>
<td>Indirect</td>
<td>Increases in temperature will lead to decreases in snowpack</td>
</tr>
<tr>
<td>Runoff</td>
<td>Direct</td>
<td>Warmer temperatures are likely to lead to a shift in peak runoff from spring to winter and a likely decrease in summer base flow</td>
</tr>
<tr>
<td>Hydropower</td>
<td>Indirect</td>
<td>Decreased summer flows resulting from earlier snowmelt and a shift in peak runoff could affect hydropower generation during summer months</td>
</tr>
<tr>
<td>Precipitation</td>
<td>Direct</td>
<td>Warmer winter temperatures will result in a greater percentage of precipitation falling as rain rather than as snow</td>
</tr>
<tr>
<td>Groundwater</td>
<td>Indirect</td>
<td>Reduction in snowpack and extended periods of drought are likely to increase dependency on groundwater</td>
</tr>
</tbody>
</table>

Probability of Future Occurrence

**Highly Likely** — The US Drought Monitor’s time series data (2000-2020) indicates that some degree of drought has nearly a 100% probability of occurrence in the state in any given year. Given that CSU – Stanislaus lies within a drought impacted region, with drought having occurred during 12 of the last 20 years, is prudent to extend the Highly

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Likely probability of occurrence to the campus planning area, even though drought risk is ranked as Low by the campus planning committee.

Vulnerability to the Hazard

In California, rising temperatures are projected to increase the average lowest elevation at which snow falls, reducing water storage in the snowpack, particularly at those lower mountain elevations which are now on the margins of reliable snowpack accumulation. Higher spring temperatures will also result in earlier melting of the snowpack. The shift in snow melt to earlier in the season is critical for California’s water supply because flood control rules require that water be allowed to flow downstream and that water cannot be stored in reservoirs for use in the dry season. As such, state-level drought risk factors that have led to drought’s state-wide severity and extent, and potential impacts also create drought vulnerabilities at the level of the CSU - Stanislaus campus.

Moreover, climate change will likely adversely impact the vulnerability of watersheds and ecosystems in their ability to deliver important ecosystem services. These changes may limit the natural capacity of healthy forests to capture water and regulate stream flows. Sierra Nevada mountain winters and springs are warming, and on average, precipitation as snowfall relative to rain is decreasing. A warming climate with reduced snowpack will result in earlier snowmelt and will subsequently reduce downstream water availability during summer and early fall.

As such, the state and the CSU - Stanislaus planning area stakeholders potentially have less capacity to address future drought risks due to projected temperature increases and shortages in water; ground-water withdrawals have been occurring at a deficit rate of 1 – 2-million-acre feet per year, where the impacts of drought include decreased availability of water for agriculture and environmental uses. In forested and other vegetated areas, prolonged drought decreases the moisture content of forest fuels and increases the risk of high severity wildfires.

It should be pointed out that California is the single most productive agricultural state and its agricultural industry relies heavily on reservoir water supplied by snowmelt and rainfall runoff. Yearly variations in snowpack depths have implications for water availability as snowmelt from the winter snowpack feeds a network of reservoirs. Spring snowpack at Donner Summit reached record low levels in 2014, exceeded in 2015 by a remarkable April 1 snow-water-equivalent value of only 5% of average. Decreased precipitation since 2011 has contributed to near-record low levels in the Shasta Reservoir.

Vulnerability of Populations


Drought vulnerabilities on California’s population include agricultural sector job loss, secondary economic losses to local businesses and public recreational resources, increased cost to local and state government for large-scale water acquisition and delivery, and water rationing and water wells running dry for individuals and families. As drought is often accompanied by prolonged periods of extreme heat, negative health impacts such as dehydration can also occur, where children and elderly are most susceptible. Air quality often declines in times of drought which can affect those with respiratory ailments. These same vulnerabilities may apply to the students, faculty and staff of the CSU - Stanislaus campus over the long term.

**Property Vulnerability**

Drought vulnerabilities for property include crop loss, injury and death of livestock and pets, and damage to infrastructure, homes and other buildings resulting from the secondary drought impact of land subsidence. The related drought impacts of tree mortality and land subsidence pose risks to vulnerable critical infrastructure and property. These same vulnerabilities may apply to the properties of the CSU - Stanislaus campus over the long term.

**Natural Environment Vulnerability**

Drought vulnerabilities for the campus’ natural environment are primarily the flora/landscaping on campus grounds, and the agriculture and flora tied to the campus’ research garden. In response, the campus has tried to reduce the vulnerability by installing a series of water conservation ponds and by utilizing recycled water. On a broader scale, drought vulnerability is widespread throughout public and private lands within the state, including tree mortality, potential impacts to all flora and fauna, and potential destabilization (subsidence) of land along streams and rivers, and within watersheds.

The core issue shaping natural resource vulnerability on campus, in Turlock and Stanislaus County and throughout California is water supply and demand. Several factors play into the issue including groundwater basins, surface water run-off, public and agricultural demand, and surface water storage water sheds. A USGS led analysis was first conducted in 2010 through the Forest and Rangeland Assessment and ongoing through the USGS Forest and Rangeland Ecosystem Science Center to identify threats and assets where water supply would benefit from environmental management designed to protect or enhance water resources, the key effort which, in part, both defines and mitigates the severity of drought risk and vulnerabilities.

With regard to overall threat and asset findings shaping the potential severity of drought, the watersheds in the Sierra region contribute most greatly to the state’s water supply, but are under threat from climate change, wildfire and development. In addition, groundwater basins in the San Joaquin Valley and Sacramento Valley bioregions are an abundant resource that is heavily threatened by over pumping.

**Critical Facilities Vulnerabilities**
Drought vulnerabilities for CSU - Stanislaus’s critical facilities include water shortfalls for facility operations and critical functions, and potential structural destabilization and damage resulting from land subsidence over the long term.

**Estimate of Potential Losses**

An estimate of potential losses from drought has not been calculated for the campus or the CSU system as a whole. However, drought-related losses to the City of Turlock and county of Stanislaus, and the surrounding region such as crop loss and cost increases for water resources have re-occurred over time. Please consult city and county level government, and/or state agricultural agencies for data on the financial impacts from drought.

**Vulnerability Assessment Conclusions**

The CSU Planning Committee understands that the high degree of vulnerability posed by drought will be exacerbated by greater climate variation in the future and therefore greater variation and uncertainty regarding the availability of water supplies which are already under tremendous stress. In response to such vulnerability, state legislation passed in 2014 requires local governments to regulate pumping and recharge to better manage groundwater supplies, and groundwater-dependent regions are required to halt overdraft and bring basins into sustainable levels of pumping and recharge by the early 2040s. That said, the Committee will continue to work with local, regional and state partners and stakeholders to explore solutions for mitigating the drought hazard on its campuses by accessing the best available data and resources on climate change and its relationship to drought.

**Identified Data Limitations**

Data is limited concerning campus-related agricultural assets as well as data on campus tree mortality.
**Earthquake**

Description of the Hazard

An earthquake is a sudden motion or shaking caused by the release of pressure accumulated along the edge of tectonic plates covering the earth. These huge plates are constantly moving and move ever so slowly under, over, or by passing one another. This movement is gradual however the plates may lock together accumulating enormous amounts of energy. When this energy builds, stress develops, and the adjoining plates will eventually break free and result in ground shaking – an earthquake.

Large earthquakes may result in fissuring, ground settlement, and/or vertical or horizontal displacement. Earthquakes occur without warning and can result in extensive damages and human casualties. Damages associated to earthquake generated ground shaking is normally confined to a narrow area along fault trend from the earthquake epicenter. However, seismic waves may generate ground shaking resulting in damages in areas outside of the fault trend.

**Fault Rupture**  – The rupture of faults is the differential movement of the two sides of the earth’s plates at the point of the fault. Horizontal or vertical displacement may be significant and occur over great distances. The movement and energy that occurs along a fault is released in waves resulting in ground shaking. The intensity of ground shaking varies based on the magnitude of the earthquake, the proximity to the earthquake epicenter, the composition of the ground sediment or rock the waves travel through, and the depth of the earthquake.

**Liquefaction**  – In addition to the primary fault rupture that occurs right along a fault during an earthquake, the ground many miles away can also fail during intense shaking. As seismic waves travel through saturated granular soil; the soil begins to liquefy and act as a fluid. Soil strength and stability is lost causing the effects of ground shaking to intensify and for ground deformation to occur. These water saturated soils when shaken quickly lose the ability to support buildings, bridges, utilities, and other structures. Areas susceptible to liquefaction include places where sandy sediments have been deposited by rivers along their course or by wave action along beaches. The greater the magnitude of an earthquake and longer duration of strong ground shaking will result in an enhanced potential for liquefaction to occur. Settlement can cause damage when the amount settlement varies significantly across the length of a structure. Lateral spreading occurs when liquefaction occurs on gently sloping ground and the liquefied material at depth allows the area to slide, often toward a vertical discontinuity or “free face” such as a creek or stream channel. Liquefaction can occur in susceptible soils below bodies of water, and settlement and lateral spreading can damage structures built on or adjacent to these areas. Transportation bridges across water bodies, wharves, piers and other structures at ports and harbors, and underwater utility lines can be severely damaged by this hidden hazard.
**Subsidence** - Changes in the local environment that cause subsidence or sinkholes are called triggering mechanisms. Water is the primary factor that affects the local environment and causes subsidence. Water level decline, changes in groundwater flow, increased loading, and deterioration (such as abandoned mines) are all triggering mechanisms. Water level decline may occur naturally, or it may be the result of human action. Factors that lead to water decline are pumping (from wells), localized drainage (for construction activities), dewatering, or drought. Changes in groundwater flow can result from an increase in the velocity of groundwater movement, and increase in the frequency of water table fluctuations, and changes in discharge (either increase or decrease). Increased loading can cause pressure in the soil, leading to the failure of underground cavities and space, such as caves. Vibrations from earthquakes, heavy machinery, and blasting may result in structural collapse, followed by surface resettlement.

**Location of the Hazard**

The State of California is particularly vulnerable to earthquake activity due to California’s location residing between two large tectonic plates. Stanislaus State University is located in the northern San Joaquin Valley. In general, fault systems extend along the mountain ranges on the eastern and western edges of the valley a distance from Stanislaus State University. There are no known fault systems in the immediate area surrounding the campus.
The Stanislaus State University campus does not reside in areas designated to be liquefaction zones.

Extent of the Hazard

The extent or severity of earthquake damage is expressed in terms of magnitude, intensity and duration. The amount of energy released during an earthquake is normally conveyed as a magnitude measured from a seismogram. Magnitude is expressed in numbers and decimals representing the physical size of the earthquake. The strength and effect of the shaking on the surface of the earth is classified as the intensity. Intensity is further defined from the effects the earthquake has on people, structures, and the natural environment. The intensity of an earthquake in terms of measuring magnitude and evaluating its effects is generally expressed using the Modified Mercalli (MM) Intensity Scale. Duration is the length of time the earthquake’s energy is released.

The Richter magnitude scale was developed in 1935 by Charles F. Richter of the California Institute of Technology as a mathematical device to compare the size of earthquakes. The Richter Scale is the best-known scale for measuring the magnitude of earthquakes. The
The magnitude value is proportional to the logarithm of the amplitude of the strongest wave during an earthquake. A recording of 7, for example, indicates a disturbance with ground motion 10 times as large as a recording of 6. The energy released by an earthquake increases by a factor of 31 for every unit increase in the Richter scale.

Table 26-17: Earthquake Intensity/Frequency Comparisons

<table>
<thead>
<tr>
<th>Magnitude</th>
<th>Mercalli Intensity</th>
<th>Potential Damage</th>
<th>Global Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 2.0</td>
<td>I</td>
<td>None</td>
<td>Continually</td>
</tr>
<tr>
<td>2.0 - 2.9</td>
<td>I to II</td>
<td>None</td>
<td>&gt; IM per year</td>
</tr>
<tr>
<td>3.0 - 3.9</td>
<td>II to IV</td>
<td></td>
<td>&gt; 100,000 per year</td>
</tr>
<tr>
<td>4.0 - 4.9</td>
<td>IV to VII</td>
<td>Light</td>
<td>10K to 15 K per year</td>
</tr>
<tr>
<td>5.0 - 5.9</td>
<td>VI to VII</td>
<td>Moderate</td>
<td>1K to 1,500 per year</td>
</tr>
<tr>
<td>6.0 - 6.9</td>
<td>VII to X</td>
<td>Heavy</td>
<td>100 to 150 per year</td>
</tr>
<tr>
<td>7.0 - 7.9</td>
<td>VII &lt;</td>
<td></td>
<td>10 - 20 per year</td>
</tr>
<tr>
<td>8.0 - 8.9</td>
<td>VII &lt;</td>
<td>Very Heavy</td>
<td>1 per year</td>
</tr>
<tr>
<td>&gt; 9.0</td>
<td>VII &lt;</td>
<td></td>
<td>1 per 10-50 years</td>
</tr>
</tbody>
</table>

The Modified Mercalli Intensity Scale provides descriptive values of earthquake intensity that may provide greater meaning to the broader population as the description of intensity refers to the effects actually experienced. This scale uses an arbitrary ranking based on observed earthquake effects. The scale is composed of increasing levels of intensity ranging from shaking that is not recognizable to intense shaking resulting in catastrophic damages and casualties. The Modified Mercalli Intensity Scale is demonstrated below:
Table 18: Modified Mercalli Intensity Scale

<table>
<thead>
<tr>
<th>Intensity</th>
<th>Shaking</th>
<th>Description / Damage</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Not felt</td>
<td>Not felt except by a very few under especially favorable conditions.</td>
</tr>
<tr>
<td>II</td>
<td>Weak</td>
<td>Felt only by a few persons at rest, especially on upper floors of buildings.</td>
</tr>
<tr>
<td>III</td>
<td>Weak</td>
<td>Felt quite noticeably by persons indoors, especially on upper floors of buildings. Many people do not recognize it as an earthquake. Standing motor cars may rock slightly. Vibrations similar to the passing of a truck. Duration estimated.</td>
</tr>
<tr>
<td>IV</td>
<td>Light</td>
<td>Felt indoors by many, outdoors by few during the day. At night, some awakened. Dishes, windows, doors disturbed; walls make cracking sound. Sensation like heavy truck striking building. Standing motor cars rocked noticeably.</td>
</tr>
<tr>
<td>V</td>
<td>Moderate</td>
<td>Felt by nearly everyone; many awakened. Some dishes, windows broken. Unstable objects overturned. Pendulum clocks may stop.</td>
</tr>
<tr>
<td>VI</td>
<td>Strong</td>
<td>Felt by all, many frightened. Some heavy furniture moved; a few instances of fallen plaster. Damage slight.</td>
</tr>
<tr>
<td>VII</td>
<td>Very strong</td>
<td>Damage negligible in buildings of good design and construction; slight to moderate in well-built ordinary structures; considerable damage in poorly built or badly designed structures; some chimneys broken.</td>
</tr>
<tr>
<td>VIII</td>
<td>Severe</td>
<td>Damage slight in specially designed structures; considerable damage in ordinary substantial buildings with partial collapse. Damage great in poorly built structures. Fall of chimneys, factory stacks, columns, monuments, walls. Heavy furniture overturned.</td>
</tr>
</tbody>
</table>

The graph below illustrates the increasing intensity of energy that is released and as the measured magnitude increases. While each whole number increases in magnitude represents a tenfold increase in the measured amplitude, it represents an increasing rate of 32 times more energy released in the same increase in magnitude. As the magnitude of an earthquake is measured higher, the intensity of the earthquake worsens progressively from one category to the next.

Figure 26-8: Earthquake Magnitude and Equivalent Energy Release

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Based on the earthquake shaking potential in the Stanislaus County area, the campus’ proximity to five fault systems and history of occurrence, the extent of the earthquake risk is considered **Moderate**.

**History of the Hazard**

The State of California has a long history of chronic and destructive earthquakes throughout the state. On average, earthquakes strong enough to result in structural damages occur three to four times a year in California, while earthquakes Magnitude 6.0 to 6.9 occur once every two to three years. Stanislaus County also has history of earthquake activity especially on the western side. Stanislaus County has a limited history of significant earthquakes occurring in the central part of the County including where Stanislaus State University is located.

<table>
<thead>
<tr>
<th>Date</th>
<th>Location</th>
<th>Magnitude</th>
<th>Damages</th>
</tr>
</thead>
<tbody>
<tr>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
</tr>
</tbody>
</table>

**Potential Impacts of the Hazard**

The shaking of the ground from earthquakes can result in building collapse, bridge failure, utility disruptions and other structural collapse. Large earthquakes can additionally cause natural gas lines to break resulting in structure fires. Earthquakes are unlikely to be centered in Stanislaus County. However, a major earthquake in Stanislaus County would likely result in region-wide social disruptions in addition to structural damages. The region-wide structural damages may disrupt lifelines and supply chain routes limiting the campus from effective evacuation routes and receiving necessary supplies or equipment.

Most injuries resulting from earthquakes are from collapsing walls, flying glass, or other objects moved by ground shaking. The lack of warning allows individuals minimal time to react and find areas of safety. A moderate earthquake occurring near Turlock could cause injuries or fatalities to members of the campus community or support networks the campus relies on. These earthquake effects might be aggravated by collateral incidents such as fire, flooding, hazardous material spills, dam/levee compromises, and other cascading events. A catastrophic earthquake near Turlock could result in extensive casualties, expansive structural damages, panic, widespread utility outages, communication failures, and secondary emergencies such as fire.

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44 Stanislaus County Local Hazard Mitigation Plan, July 2017
Local impacts to Stanislaus State University campus caused by an earthquake could include:

- Potential hazardous material releases on and off campus
- Infrastructure damage to State Route 99
- Damages to rail lines and rail cars 1 mile from campus
- Structural damage to bridges over waterways and flood control channels
- Potential isolation of campus from community
- Potential isolation among on-campus residents
- Structural damage to flood control levees
- Structural damage to campus academic and support buildings
- Structural damage to residence halls resulting in displaced student populations
- Structural damage to nearby residences and businesses
- Community members arriving on campus for refuge from damaged homes
- Damaged university communications, computer systems, and networks
- Considerable stress and fear among community
- Closure or reduction of service to campus operations
- Reduction of campus revenue

Probability of Future Occurrence of the Hazard

The Working Group on California Earthquake Probabilities (WGCEP), a collaboration between the United States Geological Survey (USGS), the Southern California Earthquake Center (SCEC), and the California Geological Survey (CGS) develops Uniform California Earthquake Forecasts (UCERFs) using the best currently available science and technology. The UCERF version 3 provides a three-dimensional view of the likelihood a region in California will experience a Magnitude 6.7 or greater earthquake in the next 30 years. The likelihood for the fault systems surrounding Stanislaus County and Turlock is included in the following table.

Table 26-20: Major Potentially Active Faults in Proximity to Stanislaus State University 45

45 Stanislaus Multi-Jurisdictional Hazard Mitigation Plan, 2017
While seismic activity is not common in Stanislaus County, counties to the west and east are at high risk for earthquakes. The fault systems described above each reside outside of the county but have the potential to effect Stanislaus County. The USGS indicates the likelihood of an earthquake of magnitude 5.0 occurring within 50km of the county in the next 50 years is 80.62%. Based on the earthquake shaking potential in the areas east and west of the Stanislaus County area, the proximity to the San Andreas, Calaveras, Greenville, Ortigalita, and the Sargent Fault Systems, the probability of seismic ground shaking generating damage is considered Possible.

**Vulnerability to the Hazard**

A considerable challenge regarding earthquakes is they generally occur without warning. The fault systems surrounding the region tend to remain to the west along the Coastal Ranges and to the east in the Sierra Nevada Mountains. Many of these cross major transportation routes potentially reducing the availability of access and the supply chain. However, Turlock is likely less vulnerable to the direct effects of earthquake as known fault systems are removed from the area. The geographic location of Turlock sits at the base of river systems that have deposited sediment from the surrounding mountains. In many cases, these sediment-based soils are loose and expose the potential for liquefaction. The soils of the area surrounding the campus are described by the Local Hazard Mitigation Plan as generally being not conducive to significant liquefaction due to a high clay content.

The known fault systems generating the threat to Turlock generally exist to the east and west of the city but do not cross into the city including the Stanislaus State University campus. The distance to these surrounding systems help mitigate significant vulnerabilities in the event a seismic event were to occur on those systems. In the event of an earthquake occurring in the region on an unknown system, the potential for earthquake damaged structures being left uninhabitable including campus residence halls


47 Stanislaus Multi-Jurisdictional Hazard Mitigation Plan, 2017, p.45
will result in numerous displaced individuals and households. The lack of earthquake insurance will cause extreme financial burdens on those affected. Campus buildings and equipment would be vulnerable to damages from building, seismic shaking, secondary fires, and secondary building floods from broken pipes.

Elements of the vulnerability to a major earthquake on the Stanislaus State University campus will vary depending on when the earthquake were to strike. The primary basis of vulnerability is based on the population affected and the built environment exposed. In general, newer construction will be more earthquake resistant than older buildings as building codes and construction technology have improved. A locally centered earthquake, even from moderate events, would have the potential for more damaging results when associated with the moderate liquefaction zones of the city. This would particularly be seen with greater damages to unreinforced masonry buildings.

The risk to the campus population will be lessened during periods when classes are not in session or during periods of breaks. Conversely, during the days and hours that classes are in session and staff are at their workplaces, the human vulnerability increases. Generally, people are safer when at home in wood frame structures as earthquakes tend to generate less structural damage to wood construction than in commercial or industrial facilities. The greater number of people on campus at the time of an earthquake will result in more people being exposed to effects from damaged campus facilities or equipment and require greater evacuation assistance. However, in region-wide events this vulnerability may simply shift to the homes and workplaces of members of the campus community and their families.

The aftermath of a major earthquake will likely result in widespread search and rescue operations for trapped and injured individuals. The demand on emergency services will be great, potentially requiring the campus community to be prepared for these scenarios and initiate response actions as needed. There will be needs for emergency medical care, shelter, water, and food for individuals who have been displaced by the earthquake. In earthquakes causing significant damages, there may be a necessity to provide assistance with sheltering and care of those unable or unwilling to return to their homes. Damages to the homes of the members of the campus community may place greater demands on campus resources and capabilities in the short-term period following a seismic event.

There may be a need to evacuate members of the campus community from the campus and to other locations that are deemed to be safer locations. Certain campus populations will experience greater challenges to a post-earthquake environment. Vulnerable populations including those that rely on specific services, require electrical power, homeless students, experience disabilities, non-English speakers, those whose age make evacuating difficult, and others will be most affected. These individuals will likely need to navigate through earthquake generated debris, extreme stresses of a disaster, an inability to communicate to or gain access to support networks, and find difficulty in accessing equipment or supplies to aid in a specific need.

**Estimate of Potential Losses**
Estimates of potential losses will be influenced by a variety of factors. The intensity of the earthquake will determine what scale of damages affecting campus infrastructure, equipment, and other impacted features. Losses will be generated by the physical damages, the loss of revenue, loss of academic research, loss of building contents, and community wide economic reductions. Based on estimate replacement costs of facilities and structures on campus, the maximum total replacement costs due to earthquake are $162,376,793.

*Buildings with no value defined are also included in the respective Zones they are found in.
Vulnerability Assessment Conclusions

It is difficult to predict the severity of casualties, property, and cascading impacts generated by future seismic events affecting the Turlock area and the Stanislaus State University campus. Each of the earthquake generated effects will vary widely based on the intensity of the earthquake, location of the epicenter, proximity to people and development, time of day and year, the soil composition under the impacted structures, building construction, among others. In any case, the potential for a major earthquake exists affecting the campus and causing extensive challenges to the Stanislaus State University campus and community.

In the event that a major earthquake was to strike along the fault systems surrounding Turlock, the effects could be significant to the campus community and campus operations. The widespread impacts generated by a major earthquake would extend the effects of casualties, damages, and other impacts to the broader Stanislaus County region creating large-scale regionwide needs for critical assistance and a heavy demand on limited emergency resources. The threat and impacts presented to the campus will be shared with the campus community from their homes and places of work. The campus will likely be required to address critical needs independently during early phases of the disaster.

The campus population are additionally vulnerable to the effects of major ground shaking that are far reaching. The psychological and social impacts a major earthquake will give rise to will potentially harm individuals and cause tremendous fear. The willingness to return indoors may be hampered especially as after-shocks continue. These effects are magnified for populations having specific vulnerabilities or access limitations.

Identified Data Limitations

Data limitations include missing campus structural replacement costs, and lack of a complete inventory of building construction types to include status of earthquake retrofitting. HAZUS generated analysis is focused on the broader community level versus fine-tuning the analysis to the micro-level for facilities such as a university campus.
Erosion

Description of the Hazard
The US Geological Survey (USGS) defines erosion as “the process whereby materials of the earth’s crust are loosened, dissolved, or worn away and simultaneously moved from one place to another.” Erosion may occur in areas of streams and rivers, along bluffs, around immovable objects (such as buildings or bridge abutments), or as a cascading result of other natural hazards, such as earthquakes or wildfires. When erosion occurs along bodies of water, the removal of material causes the shore to move further landward.

Forces such as sea level rise and changes in sediment supply impact erosion gradually and can be difficult to recognize. In contrast, the impacts of short-term events, such as storms and flooding, can be severe and are immediately recognizable. Along the Pacific coast, rain, wind, and waves can induce significant short-term erosion.

Location of the Hazard
Erosion is a relatively non-spatial hazard that can occur in any location with conducive soil structure and a source of movement such as water or wind. As such, for the purpose of this campus-level analysis, the erosion hazard poses a consistent risk across the terrain of the Stanislaus State University campus with erosion-prone characteristics. An area’s potential for erosion is determined by several factors, including rainfall, topography, soil characteristics, and vegetative cover. Streambank and bluff erosion can occur near any riverine area.

Extent of the Hazard
There is no published scale of severity or extent for this geologic hazard. If conditions are favorable, erosion is likely to occur. Given no historical occurrence of erosion on campus, and no known areas of erosion, the planning committee ranks the extent of this hazard as Low.

History of the Hazard
There have been no recorded incidents of erosion on the Stanislaus State University campus.

Potential Impacts of the Hazard
Erosion causes instability in soil. During high-intensity rain events, for example, eroded areas will continue to erode, resulting in additional loss of soil and ground stability in the area. This removal of sediment can result in damage to infrastructure, public health, and safety. On campus, areas of erosion can create pedestrian and transportation hazards, and structures may become unsafe if erosion is not controlled.

In agricultural areas, the erosion of soil degrades the quality of the soil, which can lead to reduced crop yields. At the Sustainable Garden, soil erosion can create significant concerns for agriculture and research. Eroded test plots can negatively impact experiments and tests, resulting in a loss of knowledge and data.

**Probability of Future Occurrence of the Hazard**

Erosion is an on-going and dynamic process that occurs regularly. As climate change induces more frequent and intense weather events, such as wildfires and flooding, erosion may generally become more widespread or severe. These events can cause erosion or exacerbate areas already experiencing erosion. As a result, and in consideration of the potential extent of erosion, the probability of at least a limited degree of future occurrence is high over the long term.

**Vulnerability to the Hazard**

Topography, soil structure, land use, and precipitation are all factors of erosion. Stanislaus State University infrastructure, buildings, and agriculture located on steep slopes, in areas with little vegetation, or in areas with conducive soil types are more vulnerable to erosion. CSU leadership may consider performing an analysis to identify such at-risk buildings, infrastructure, slopes and soil types in the future.

In the wider Stanislaus community, erosion vulnerabilities include agricultural sector job loss, degradation of riverine ecosystems, and loss of water quality.

**Estimate of Potential Losses**

The historic and potential impacts of erosion on property statewide include reduced agricultural productivity, lower surface water quality, and damaged drainage networks.

Current modeling is not precise enough to allow for an assessment of potential losses to buildings and infrastructure on campus.

**Vulnerability Assessment Conclusions**

While the ability to predict future erosion on the Stanislaus State University campus is limited, the core issues shaping erosion vulnerability on campus are flora and landscaping. If left unchecked, erosion can cause significant damage to campus infrastructure and the surrounding environment.

**Identified Data Limitations**

The complex interactions between soil erosion factors make predictive modeling, determination of hazard areas, and quantification of loss difficult. Localized data on this hazard is also limited, resulting in more generalized findings.

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**Extreme Temperatures (Includes Extreme Cold and Extreme Heat)**

**Description of the Hazard**

What is considered an excessively hot temperature varies according to the normal climate for that region. However, when temperatures are extremely high, people are at higher risk for heat-related illnesses, such as dehydration, heat exhaustion, heat stroke, and in severe cases, death.50

Hazards from extreme heat are made worse when high temperatures are accompanied by high levels of humidity, which is defined as the amount of moisture in the air.51 As the temperature climbs, the air is able to hold more moisture. High humidity prevents the human body from cooling down naturally, which leads people to perceive that the temperature “feels” hotter. The combination of temperature and humidity is known as the heat index.52

Heat stroke, the most serious heat-related illness, occurs when the body is unable to control its temperature. Body temperature rises rapidly, the sweating mechanism fails, and the body cannot cool down.53 In extreme causes, heat stroke can cause confusion and unconsciousness, so the victim is unable to seek treatment without assistance.

There are several groups of people who are uniquely vulnerable to the effects of extreme heat, such as infants and children, older adults aged 65 and up, athletes and outdoor workers, low-income households, and individuals with certain chronic medical conditions.54

**Location of the Hazard**

Extreme heat events are a non-spatial hazard, and may occur at the Stanislaus State campus.

**Extent of the Hazard**

Extreme heat has a wide range of extent and severity markers and characteristics. Monthly average maximum temperatures in June through October range approximately from the high 80s to mid-90s in the City of Turlock, where the campus is located. According to data from the National Climatic Data Center (NCDC), the highest daily


52 Ibid.


temperature recorded in the City of Turlock was 111° F on two sequential days, July 23, 2006 and July 24, 2006. These high temperatures were part of an extended period of excessive heat that affected much of the state of California. Heat index values reached as high as 119° F. Given the historical occurrence of numerous extreme heat events, the planning committee ranks the extent of the hazard as Moderate.

The National Weather Service issues a Heat Advisory when the heat index value is expected to reach 100° – 104° F within the next 12 to 24 hours. Excessive Heat Warnings are issued when there is an anticipated heat index of 105° F or greater that will last for two (2) or more hours. Excessive Heat Warnings are issued by the county when any location in the county is expected to reach that criteria.55 In anticipation of an Excessive Heat Warning, an Excessive Heat Watch may be issued 1 to 2 days in advance, when the Heat Warning criteria is 50 – 79% likely to occur.

Figure 26-9 (following) depicts the National Weather Service’s methodology for determining the heat index, using the % humidity and the actual temperature.

As the heat index rises, so does the potential danger to people and animals. Table 26-22 (following) shows the health hazards associated with extreme heat.

Table 26-21: Health Risks Associated with Heat Index

<table>
<thead>
<tr>
<th>Category</th>
<th>Heat Index</th>
<th>Health Hazards</th>
</tr>
</thead>
<tbody>
<tr>
<td>Extreme Danger</td>
<td>130° F or higher</td>
<td>Heat stroke / sunstroke is likely with continued exposure.</td>
</tr>
<tr>
<td>Danger</td>
<td>105° – 129° F</td>
<td>Sunstroke, heat cramps, and/or heat exhaustion is likely with prolonged exposure and/or physical activity.</td>
</tr>
<tr>
<td>Extreme Caution</td>
<td>90° – 104° F</td>
<td>Sunstroke, heat cramps, and/or heat exhaustion is possible with prolonged exposure and/or physical activity.</td>
</tr>
<tr>
<td>Caution</td>
<td>80° – 89° F</td>
<td>Fatigue is possible with prolonged exposure and/or physical activity.</td>
</tr>
</tbody>
</table>

History of the Hazard

Data gathered from the National Centers for Environmental Information (NCEI) Storm Events Database shows two excessive heat events that have impacted Stanislaus County since 2007:

**May 8, 2007; July 5, 2007:** 2007 was one of the driest years on record for most California counties, which fueled at least 9,000 separate wildfires.

In addition to these declared heat events, the NCEI has recorded nearly 400 separate dates between 1986 and 2019 when the air temperature in the City of Turlock was at or above 100° F.

Potential Impacts of the Hazard

Stanislaus State University may experience impacts from extreme heat due to cancelled classes or postponed outdoor events in order to protect students, faculty, and staff from the weather.

In addition to the threat extreme heat poses to humans, high temperatures also pose a threat to utility production, which in turn threaten facilities and operations that rely on utilities. As temperatures rise, more people stay indoors, increasing the demand for air conditioning, fans, and other electronics. This puts a strain on the electrical grid, which can cause temporary outages. These outages can impact operations throughout campus, resulting in interruptions and delays in service. Outages may also negatively impact

research efforts on campus, as the inability to maintain a steady, constant temperature may impact research specimens and experimental results.

Probability of Future Occurrence of the Hazard

Given over 400 days with temperatures at or above 100 degrees from 1989 – 2019 (30 years), more than 10 such events will occur per year on average. As such, extreme heat is Highly Likely to occur annually.

Vulnerability to the Hazard

When dealing with an extreme heat event, the most common impacts are those generally felt by the people living in the targeted area. For people in particular, heat can kill when the body is pushed beyond its limits. Most heat disorders occur because the victim has been overexposed to heat. As discussed, the major human risks associated with extreme heat include dehydration, sunburn, fatigue, heat exhaustion, heat stroke, and in severe cases, death.

Some portions of the population are more at risk to the effects of extreme heat. The very young, the elderly, and certain groups with chronic medical conditions (such as asthma or other pulmonary illnesses, heart disease, poor blood circulation, neurological illnesses, and obesity) are generally more vulnerable to the effects of extreme heat and are more likely to suffer illness or death as a result.57 This is especially true if exposure is extended for a period of time and preventative measures are not taken immediately.

Stanislaus State University is aware of the potential for extreme heat events. In addition to any warnings issued by the county, the campus will notify students and staff via the Stanislaus State University emergency notification system, StanAlert. The university advises students to find an air-conditioned space, stay hydrated, avoid high-energy activities, and check yourself and others for signs of heat-related illness. In the case of a power outage during an extreme heat event, the decision to close campus is made by the President or other Executive Designee.

While this is a hazard that the campus may experience regularly, the campus has ample familiarity with appropriate steps to take in order to handle the risks and vulnerabilities.

Estimate of Potential Losses

Based on the previous historical occurrences, annualized losses are considered to be negligible. In an extreme heat event, loss of human life or health impacts are a greater concern than is property damage.

Vulnerability Assessment Conclusions

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While the ability to predict future heat events at the Stanislaus State campus is limited, the effects of climate change may provide some information. According to the Environmental Protection Agency (EPA), North-Central California has warmed about 1.5 – 2 degrees on average over the last century, with less rainfall. This may lead to stronger and more frequent heat events, drought, and an increased risk of wildfires.58

**Identified Data Limitations**

Numerous public and private actors conduct research, acquire data and disseminate meteorological information and forecasting to the general public, including the CSU university system. Currently, it is assumed that, apart from regular access to climate change models on changes to temperature extremes over time, the CSU community maintains sufficient access to the data needed to plan for, respond to, and mitigate the effects of extreme heat and cold.

### Flood

**Description of the Hazard**

The incredible geographic diversity in California presents tremendous challenges for flood planning and response. The state is home to extensive mountain ranges such as the Sierra Nevada, Cascades, Klamath, Coastal Ranges, and the Southern California Transverse Range all creating tremendous watersheds. Large river systems drain the mountains traveling through populated communities including the Sacramento and San Joaquin Rivers draining into the California Delta. The state has a complex system of reservoirs, dams, and levees providing water storage and flood protection. Finally, California’s 840-mile coastline exposes the coastal regions to tidal influences.

Floods are characterized by the rising and overflowing of excess water from a water source such as a stream, river, lake, canal, or coastal body onto an area of normally dry floodplain. A floodplain is a lowland area downstream and adjacent to water bodies that are subject to flood events. Flooding is a naturally occurring event that become hazardous when populations and property are affected.

Flooding can result from excessive precipitation from weather systems generating prolonged rainfall, excessive snowmelt from watersheds upstream from the floodplain, infrastructure failure, exceeding the capacity of dams or levees, tidal influences, or a combination from any of the previous factors.

Floods represent one of the costliest and most frequent natural disasters that influences human suffering and economic impact in the United States. Flooding will likely result in

significant damage to structures, infrastructure, utilities, landscapes, and the environment. Erosion of stream banks, roadways, other feature may result from the movement of flood waters. The saturated ground resulting from standing flood waters may cause ground instability, collapse, erosion, or other damages. Further, floods will often generate substantial debris that will accumulate and be deposited throughout the flooded areas.

Floods can be either slow-rise or rapid onset floods. With slow rise floods, there is often warning preceding water rise by hours or days before dangerous conditions present themselves. Slow rise floods that are expected to enter into populated areas generally allow for some time to initiate evacuation and sand bagging efforts. Flooding that occurs rapidly conversely are water events that present with extremely limited warning times and a limited ability to take response actions until flooding has already begun to occur.

Flooding may take on different forms:

- **Flash Flooding** – Flash flooding is typically characterized by a rapid rise, short duration, and large volume of water in a localized area. Heavy rainfall in areas that have limited drainage capacities often contribute to flash flooding conditions. These flooding events frequently occur with limited notice requiring immediate evacuation or rapid response efforts such as sand bagging. Flash flooding may arrive with fast moving water creating added hazardous conditions.

- **Riverine Flooding** – Riverine flooding is usually caused by prolonged rainfall or rainfall combined with heavy snowmelt. When soils are already saturated, the ability for the ground to absorb water is minimized. In a riverine flood, the water way exceeds channel capacity and extends into areas outside of the channel, often in developed communities. In California, riverine flooding is most likely to occur from November through April. The duration of riverine floods may vary from a period of hours to weeks.

- **Localized Flooding** – Localized flooding is commonly the result of stormwater drainage systems being overwhelmed by unusually heavy rainfall. These flooding events frequently occur in areas that are urbanized or developed with greater amounts of impervious surfaces not allowing ground absorption. This generates added runoff into the drainage systems and onto roadways creating backups.

- **Infrastructure Failure** – Failures of dams or levees presents a serious flooding concern for areas downstream from the compromised structure. This situation may result in a catastrophic flood with limited warning time and widespread areas affected. **Coastal Flooding** – Coastal flooding can occur in multiple areas along the California coastline. Flooding may result from intense storms coming from the Pacific Ocean that generate elevated water levels or storm surge. The size, duration, winds generated, and intensity of the storm will influence the effect the waves will have on the shoreline. Periods of high tide can aggravate the conditions allowing greater wave impingement into coastal areas.
Atmospheric Rivers

California, including the location of this campus, is subject to the effects of a phenomenon referred to as atmospheric rivers. These weather events consist of long, narrow regions in the atmosphere transporting tremendous amounts of water vapor from the tropics. These weather regions behave like rivers in the sky. They can carry heavy volumes of water vapor compared to the amount of water flow at the mouth of the Mississippi River. As these atmospheric rivers arrive into California they tend to generate significant rain and snow.

Atmospheric rivers can arrive in many different shapes and sizes. The larger events are able to generate extreme rainfall amounts resulting in flooding. They can stall over watersheds vulnerable to flooding, often saturated with heavy snow amounts. The atmospheric rivers known as a “Pineapple Express” coming from the tropics and arriving with warmer air may produce heavy rains that will melt ground snow adding to the water volume that will be added in the flood runoff.

These events can produce heavy amounts of precipitation creating extensive damages. However, these events may present as weaker systems that produce precipitation that is enough to be beneficial for the local water supply. At the higher elevations in the California mountains, these events have the potential to generate a tremendous snowpack providing a source of water during the dry summer months.

Figure 26-10: Introduction to Atmospheric Rivers
Location of the Hazard

Turlock lies in the northern portions of the San Joaquin Valley at the base of the Sierra Nevada Mountains. The San Joaquin River, Merced River, Tuolumne River, and creeks between the rivers have been identified as the primary flood sources for Stanislaus County. The eastern portions of Stanislaus County are primarily mountainous terrain of the Sierra Nevada Mountains. The Merced River watershed encompasses 1,726 square miles of drainage above New Exchequer Dam. The watershed receives the majority of its water from snowfall generating 479,000 acre-feet of surface water run-off into the Merced River. The Tuolumne River watershed drains an area of 1,958 square miles into the Tuolumne River generating 1,850,000 acre-feet of water through northern Stanislaus County.

The Stanislaus State University campus is located 7 miles south of the Tuolumne River. The Merced River lies 10 miles to the south of the campus. The entire Stanislaus State University campus sits within a Zone X: Area of Minimal Flood Risk. There are no flood hazard zones located in Turlock or in proximity to the campus.
Extent of the Hazard

The Stanislaus State University campus is located entirely in a designated Zone X: Minimal Flood Hazard. The entire City of Turlock also is located within the Zone X: Minimal Flood Hazard. The access routes into and out of the campus servicing Stanislaus County locations are found in areas designated as Zone X: Minimal Flood Hazard.

The Stanislaus State University campus also lies outside of a levee flood protected area. Levees protect areas at the base of the foothills and lining flood control channels. This specific hazard does not substantially alter the ability of the campus to maintain operations as the distance to levee protected channels exceeds the protection zones. However, members of the campus community residing in these areas could be heavily affected with damages to their homes, and access to campus could be limited, as well as student financial capacity to support ongoing education being diminished. Based on the campus’ location within an area of minimal flooding and no history of flooding in or near the campus, the planning committee ranks the extent of the flood hazard on campus as Low.

In support of the NFIP, FEMA identifies those areas that are more vulnerable to flooding by producing Flood Hazard Boundary Maps (FHBMs), Flood Insurance Rate Maps (FIRMs), and Flood Boundary and Floodway Maps (FBFMs). Several areas of flood hazards are commonly identified on these maps, including the 1% annual chance flood zone. Flood zones are further delineated by risk and are assigned a letter signifier. The flood zone designations are defined and described in the following table.

Table 26-22: Flood Zone Designations and Descriptions

<table>
<thead>
<tr>
<th>Zone Designation</th>
<th>Percent Annual Chance of Flood</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Zone V</td>
<td>1%</td>
<td>Areas along coasts subject to inundation by the 1% annual chance of flooding with additional hazards associated with storm-induced waves. Because hydraulic analyses have not been performed, no BFEs or flood depths are shown.</td>
</tr>
<tr>
<td>Zones VE and V1-30</td>
<td>1%</td>
<td>Areas along coasts subject to inundation by the 1% annual chance of flooding with additional hazards associated with storm-induced waves. BFEs derived from detailed hydraulic analyses are shown within these zones. (Zone VE is used on new and revised map in place of Zones V1-30.)</td>
</tr>
<tr>
<td>Zone</td>
<td>Annual Chance</td>
<td>Description</td>
</tr>
<tr>
<td>--------</td>
<td>---------------</td>
<td>---------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Zone A</td>
<td>1%</td>
<td>Areas with a 1% annual chance of flooding and a 26% chance of flooding over the life of a 30-year mortgage. Because detailed analyses are not performed for such areas, no depths or base flood elevations are shown within these areas.</td>
</tr>
<tr>
<td>Zone AE</td>
<td>1%</td>
<td>Areas with a 1% annual chance of flooding and a 26% chance of flooding over the life of a 30-year mortgage. In most instances, BFEs derived from detailed analyses are shown at selected intervals within these zones.</td>
</tr>
<tr>
<td>Zone AH</td>
<td>1%</td>
<td>Areas with a 1% annual chance of flooding where shallow flooding (usually areas of ponding) can occur with average depths between 1 – 3 feet.</td>
</tr>
<tr>
<td>Zone AO</td>
<td>1%</td>
<td>Areas with a 1% annual chance of flooding, where shallow flooding average depths are between 1 – 3 feet.</td>
</tr>
<tr>
<td>Zone X (shaded)</td>
<td>0.2%</td>
<td>Represents areas between the limits of the 1% annual chance flooding and 0.2% chance flooding.</td>
</tr>
<tr>
<td>Zone X (unshaded)</td>
<td>Undetermined</td>
<td>Areas outside of the 1% annual chance floodplain and 0.2% annual chance floodplain, areas of 1% annual chance sheet flow flooding where average depths are less than one (1) foot, areas of 1% annual chance stream flooding where the contributing drainage area is less than one (1) square mile, or areas protected from the 1% annual chance flood by levees. No BFEs or depths are shown within this zone.</td>
</tr>
</tbody>
</table>

**History of the Hazard**

Flooding in Stanislaus County has typically occurred during the winter months when Pacific storms are more common. The occurrences of significant flooding typically have been the result of successive intense storms with heavy precipitation. The region has experienced flood events that have caused tens of millions of dollars in damages and casualties. However, the documented flooding incidents in Stanislaus County have...
occurred along the San Joaquin, Tuolumne, and Merced Rivers and not specifically in Turlock or near the campus. Table 26-24: Historic Flooding Events in Turlock60

<table>
<thead>
<tr>
<th>Date</th>
<th>Event</th>
<th>Declaration</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
</tr>
</tbody>
</table>

Potential Impacts of the Hazard

A flood will potentially result in extensive amounts of water entering onto developed areas. The force and volume of water that is generated by a flood may cause extensive structural damage in areas subject to standing or moving water. The effects of flooding may spread over significant distances covering large areas of land. The extent of the impacts would vary based on a number of factors such as the volume of water flooding, the time of the flood event, the amount of warning provided, the location and extent of the flood boundary, facility elevation, and distance from the flood source. Potential impacts resulting from flooding include:

- Injuries or loss of life
- Property destruction or damage
- Loss of property contents
- Infrastructure damage including roadways, bridges, other transportation means
- Public health hazards resulting from mold, mildew, and disease due to flood water
- Flooded or destroyed lifelines/supply routes
- Damaged or destroyed utilities
- Loss of community economic base
- Employment losses
- Agricultural (crops and livestock) damages or destruction
- Environmental damage
- Prolonged periods of necessary dewatering
- Flooding erosion may alter natural drainage channels
- Societal and community impacts
- Psychological impacts of impacted populations

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60 Stanislaus County Local Hazard Mitigation Plan, July 2017
- Disruptions to education delivery to community
- Contamination and potential exposure from standing water with chemical, bacterial and other toxic substances

Additionally, individuals who were unable to evacuate in time or refused to leave will likely need assistance or rescue from the flooded area. Remaining in or being trapped by flood waters places individuals in significant risk of injury or death. The impacts extend beyond the danger placed upon the affected individual and places greater resource demands on agencies and organizations making efforts to rescue trapped individuals.

**Probability of Future Occurrence of the Hazard**

Stanislaus County is determined to be at high risk from flooding. The location of the Stanislaus State University campus and the entire City of Turlock resides outside of any Special Flood Hazard Area. The potential exists for urban flooding due to heavy precipitation and the remote chance for effects from dam, levee, or river flooding.

Based on the campus location outside the SFHA, and on no occurrences of flooding near the Stanislaus State University campus, the probability of future occurrence for flooding is **Unlikely** on an annual basis, but **Possible** over the long term.

**Vulnerability to the Hazard**

The Stanislaus State University campus is subject to the effects of flooding resulting primarily from excessive precipitation and isolated strong storms. Strong storms producing localized heavy accumulations of water on campus present the most likely scenario for flooding events to face the campus. There is a more remote potential for flooding and damage on campus and surrounding residential and commercial areas of Turlock due to overflow or damage to distant flood control systems. However, when these systems are inundated with flood water, the potential for displacement of people exists presenting possible impacts to individuals from the campus community.

Vulnerability to flooding on the Stanislaus State University campus will vary depending on when the flood were to occur. The risk to the campus population will be lessened during periods when classes are not in session or during periods of breaks.

It is unlikely, but should an urban flood occur, impacts may pertain to campus equipment, communication systems, protected documents, artwork, academic materials, computer systems, research, and other critical activities on lower levels of buildings.

**Estimate of Potential Losses**

Estimates of potential losses will be influenced by a variety of factors. The volume and force of the water will determine the scale of damages affecting campus infrastructure, equipment, and other impacted features. The location and elevation above flood waters will affect the level of damage and individuals exposed. The time of the academic year, the day of week, and hour in which the flooding was to occur will influence the number of people on campus and potential casualties. The severity of the storms producing
precipitation, the speed of the storms moving across the area, the level of snowpack in
the higher elevations, and amount of resulting snowmelt will produce varying effects on
damages produced and costs incurred. Losses will be generated by the physical
damages, the loss of revenue, loss of academic research, loss of building contents, and
community wide economic reductions.

Based on estimate replacement costs of facilities and structures on campus, the
maximum total replacement costs due to flood are $162,376,793. However, it is unlikely
for flood to cause destructive losses to the entire campus.

Table 26-23: Special Flood Hazard Area (SFHA) Estimated Losses

<table>
<thead>
<tr>
<th>Zone Designation</th>
<th>No. of Buildings</th>
<th>Maximum Replacement Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Zone V</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Zone VE &amp; V 1-30</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Zone A</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Zone AE</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Zone AH</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Zone AO</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Zone X .2%</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Zone X Minimal Risk</td>
<td>86</td>
<td>$162,376,793</td>
</tr>
<tr>
<td>Not in a SFHA</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>No Building Value Data Provided*</td>
<td>47</td>
<td>Unknown</td>
</tr>
</tbody>
</table>

*Buildings with no value defined are also included in the respective Zones they are found in.

Vulnerability Assessment Conclusions

The potential for highly unlikely, severe flooding on the campus and surrounding area
generates the potential for a number of cascading effects such as disruptions to the local
economy, utility failures, disruptions to providing for the needs of the campus and the
community, and development of public health hazards. These effects would be
exacerbated by effects of seasonal flooding, ongoing heavy precipitation, or excessive
run-off from the watershed contributing to the river system. The potential for widespread
flooding and damage of structures due to the force of water, while unlikely, has
exponentially powerful impacts on particular segments of the campus community
including those with access or functional needs, international students, the homeless, and
students residing in the residence halls.

Identified Data Limitations

Data limitations include missing campus structural replacement costs, and an incomplete
inventory of both building construction features and mitigation efforts to lessen the impact
due to flood inundation. HAZUS generated analysis is focused on the broader community
level versus fine-tuning the analysis to the micro-level for facilities such as a university campus.

**Hazardous Materials**

**Description of the Hazard**

A hazardous material is defined in California’s State Hazardous Materials Incident Contingency Plan (1991) as “a substance or combination of substances which, because of quantity, concentration, physical, chemical, or infectious characteristics may: cause, or significantly contribute to an increase in deaths or serious illnesses; and/or pose a substantial present or potential hazard to humans or the environment.”61 Hazardous materials are one or more of the following: flammable, corrosive or an irritant, oxidizing, explosive, toxic (poisonous or infectious), thermally unstable or reactive, or radioactive. Hazardous materials are ubiquitous in modern society and may be found at all stages of production, consumption, and disposal.

Federal and state laws permit the intentional release of some hazardous materials into the environment such that the risk to human health and the environment is thought to be acceptable. However, sometimes releases are unintentional, resulting from leaks, accidents, or natural hazards. This section focuses on such accidental releases and fall into the following key categories:

**Fixed Hazardous Materials Incident:** A fixed hazardous materials incident is the accidental release of chemical substances or mixtures during production or handling at a fixed facility.

**Transportation Hazardous Materials Incident:** A transportation hazardous materials incident is the accidental release of chemical substances or mixtures during highway, waterway or air transport. Populations, built and natural environments are potentially impacted.

**Pipeline Incident:** A pipeline transportation incident occurs when a break in a pipeline creates the potential for an explosion or leak of a dangerous substance (oil, gas, etc.) possibly requiring evacuation. An underground pipeline incident can be caused by environmental disruption, accidental damage, or sabotage. Incidents can range from a small, slow leak to a large rupture where an explosion is possible. Inspection and maintenance of the pipeline system along with marked gas line locations and an early warning and response procedure can lessen the risk to those near the pipelines.

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Hazardous materials can also be classified according to worker safety and health. Information provided by California Division of Safety and Health includes guidelines related to:

- **Safety hazards**: fire and fire byproducts, electricity, flammable gases, unstable structures, demolition, sharp or flying objects, excavations)
- **Health hazards**: carbon monoxide ash, soot and dust; asbestos; hazardous liquids; other hazardous substances; heat illness)

**Natural-Technological Incidents (Natechs):** During the past two decades, increasing attention has been given to hazardous materials releases resulting from Natechs or a natural disaster event that triggers a technological hazard event. Natechs are of particular concern for the following reasons:

- They can produce a simultaneous effect on many industrial facilities
- Can overwhelm response capacity
- Containment systems may fail
- May produce cascading disasters
- Response may be hindered by a disaster’s impact on the physical environment

**Location of the Hazard**

Hazardous materials and infrastructure such as fuel tanks, rail lines, chemicals, hazardous waste sites and gas pipelines to varying degrees are located within the CSU system and/or within its surrounding communities. The planning committee indicates that chemicals are located in the science lab. Mapping indicates two hazardous waste sites are about ½ mile from the campus, and a chemical site and gas pipeline that runs adjacent to the east side of campus. Also, Pacific Rail carrying toxic chemicals such as ethanol is about 1 mile away. At larger scales (beyond the campus planning area) hazardous materials and infrastructure are located throughout the city and county of Stanislaus, and reflect different types, configurations and scales dispersed across these geographic areas.

Figure 26-12: National Pipeline Map Near Stanislaus

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Extent of the Hazard

There is no comprehensive statewide vulnerability assessment available at this time. As such, the true extent of the hazardous materials risk in California and its communities is not known, meaning no overarching conclusions have been reached which have been able to integrate all qualitative and quantitative risk factors to produce a comprehensive measure of the extent of the hazard.

For the CSU – Stanislaus planning committee, chemicals are well managed in the campus science lab and only small quantities are stored. Chemical spills have not taken place. But the rail line adds to the extent of the risk – it carries toxic chemicals that if released during a derailment, could produce toxic gas impacting the campus directly downwind of the rail line. Based on these factors, along with the somewhat close proximity of hazardous waste sites within 1/2 mile, the extent of the hazard for the CSU – Stanislaus campus is **Low to Moderate**. That said, it is prudent to consider worst case scenarios as the main driver of policy in order to fully mitigate all possible hazardous materials event outcomes.

For example, according to the 2018 CA State Hazard Mitigation Plan, 400 hazardous materials problems are tied to 32 past earthquakes, including over 150 problems from the Loma Prieta Earthquake alone. 66 That said, the plan indicates that it is likely that many such hazardous materials releases have received little attention in the past because public authorities, the media, and the public have overlooked them in the rush to address and

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recover from immediate disaster threats, and that responsible parties may have an
incentive to understate the extent of releases or not to report them at all.

History of the Hazard

According to the California Governor’s Office of Emergency Services’ Hazardous
Materials Spill Report, the state experiences from 10 to 30 spill events daily. As of April
2021, a total of 2,096 spill events had occurred so far this year. Such events have occurred
in all the cities and/or counties where CSU campuses are located.67

According to the 2018 CA State Hazard Mitigation Plan, with regard to natural-
technological hazard events (Natechs), 400 hazardous materials events are tied to 32 past
earthquakes, including over 150 Natech events from the Loma Prieta Earthquake alone.

For more details on specific hazmat events, please refer to the local, county and/or multi-
jurisdictional hazard mitigation plans where CSU campuses are located at:
https://www.caloes.ca.gov/cal-oes-divisions/hazard-mitigation/hazard-mitigation-
planning/local-hazard-mitigation-program

According to the campus planning committee, no hazmat events have occurred on

Potential Impacts of the Hazard

A large hazardous materials release could affect an entire community or city under
certain conditions related to direction of air flow (air-based chemical release) and
population density or the contamination of a community’s main water supply. Either type
of release could necessitate large scale evacuation. By contrast, in the rural
unincorporated areas where population densities are low, even in the event of a large
release, the number of homes that may need to be evacuated would be significantly
lower than in an urban environment. The occurrence of a hazmat incident can also result
in the shut-down of transportation corridors which can last for hours at a time while the
impacted area is stabilized.

The release of some toxic gases may cause immediate death, disablement, or sickness if
absorbed through the skin, injected, ingested, or inhaled. Contaminated water resources
become unsafe and unusable, depending on the amount of contaminant. Some
chemicals cause painful and damaging burns if they come in direct contact with skin.
Prolonged and concentrated exposure to such chemicals can produce severe long-term
impacts to respiratory, endocrine and nervous systems, heart and brain health.

The potential impacts of chemicals and toxic gases discussed here also to some degree
apply to the students, staff and environment on the CSU – Stanislaus campus.

https://w3.calema.ca.gov/operational/malhaz.nsf/$defaultView?OpenView&Start=121&ExpandView
With regard to the natural environment overall, contamination of air, ground, or water may result in harm to fish, wildlife, livestock, and crops. The release of hazardous materials into the environment may cause debilitation, disease, or birth defects over a long period of time. Loss of livestock and crops may lead to economic hardships within the community.

Recent California examples include the 2016 Aliso Canyon methane gas leak, which caused evacuation of nearby residents, many of whom experienced temporary health problems such as difficulty breathing and eye irritation; and the 2016 Fruitland metal recycle plant fire in Maywood, which released heavy metals such as lead, magnesium, copper, aluminum, antimony, calcium, iron, sulfur, tin, potassium, and zinc which pose severe risks to public health.68 Health effects from exposure to these metals included short-term symptoms such as irritation to the eyes, nose, throat, and lungs.

**Potential Impact of the Hazard (Natechs)**

Natural disasters, including earthquake, flood, and fire also pose risks to public health and the environment. For example, following the Northridge Earthquake, California State University (CSU) Northridge laboratories and chemical storage rooms experienced multiple chemical spills. Such incidents, triggered by a natural disaster, pose a significant risk to students, faculty, staff, and first responders. At a minimum, all CSU campuses with a science lab (including CSU – Stanislaus) is at risk of potential impact from a natural-technological (combined impact) event.

In a severe flood event, floodwaters are often contaminated with hazardous materials posing a threat to public and animal health, groundwater, and other parts of the environment. These hazardous materials may be released from damaged or flooded underground tank sites (e.g., gas stations or chemical storage facilities), propane tanks, manure or human waste handling facilities, fertilizer and pesticide storage, agricultural sites, and household hazardous waste.

In a fire event, (such as the October 2017 Northern California firestorms which destroyed approximately 6,000 residences) entire neighborhoods can be burned to the ground. Hazardous material release creates public health concerns which can delay the initial steps of fire recovery, including reopening burned areas to residents and initiating debris removal activities. The post-fire “toxic sweep” poses a risk of coming into contact with toxic substances due to the presence of synthetic and hazardous materials. 69

**Probability of Future Occurrence**


69 Source: 2018 California State Hazard Mitigation Plan, section 9.2.
The probability of occurrence for a hazmat event on the CSU – Stanislaus campus can be
viewed in two different ways: the history of occurrence serves as a sound predictor of
future probability assuming current risk and vulnerability factors remain somewhat
constant. For the purposes of the current estimate, no current data clearly indicates
otherwise. As such, the probability of occurrence is **Low** - the campus has not
experienced a hazmat event and chemicals in the science lab are well managed. That
said, hazardous waste sites are in fairly close proximity and the rail line carrying
chemicals may increase vulnerability and the probability of a campus-related event.
Hazmat occurrences are largely based on human error, and any changes in risk and
vulnerability factors such as a decreased vigilance in materials oversight and handling
practices or changes in the amount of material or exposure will likely increase the
probability on campus.

Assessment of Vulnerability

Hazardous materials pose a risk to the CSU – Stanislaus campus. As identified by the
campus planning committee and on the hazmat map, the following vulnerabilities are
present on campus: chemicals are well managed in the campus science lab and only
small quantities are stored. The campus actively addresses this vulnerability and held a
full exercise in the lab in 2018. But the Pacific rail line adds to the extent of the risk –
though 1 mile away, it carries toxic chemicals that if released during a derailment, could
produce a toxic gas cloud impacting the campus directly downwind of the rail line. As
such, gases and chemicals or hazardous waste, if spilled or released, could impact human
health and campus operations.

Although it is quite difficult to produce a quantitative measure of vulnerability because
(Unlike natural hazards) the probability of occurrence is dependent on human error, which
itself is variable based upon a fluctuating set of interrelated factors, some of which lack
prediction or control, given the complexity of how all natural and built environments and
hazmat risks factors interrelate at the local or campus level, it is prudent to assume for
planning purposes that the campus’ vulnerability is a sub-set of the larger community’s
vulnerability. As such, the CSU – Stanislaus leadership maintains vigilance to mitigate the
campus’ vulnerabilities identified above at a minimum.

Estimate of Potential Losses

As discussed previously, it is difficult if not impossible to produce an accurate
quantitative measure of vulnerability because of the variable nature of a hazardous
materials spill. For example, the release of a toxic airborne chemical in a populated area
has severe impact potential, whereas the impact potential of a small chemical spill in a
remote or rural area is most likely limited to remediation of soil. And, in both cases, the
probability of occurrence is dependent on human error, which itself is variable based
upon a fluctuating set of interrelated factors, some of which lack prediction or control. In
all cases, different types and amounts of hazardous materials interact with fluctuating
combinations of human error to produce different event outcomes with variable impact
costs.
Vulnerability Assessment Conclusions

It is well understood that with regards to hazmat vulnerability, each campus and its surrounding community (including CSU – Stanislaus) operates through a complex and dynamic interaction between industrial and commercial inputs and outputs and the natural and built environment. Such activity produces hazardous materials that move through the environment along both convergent and divergent routes and across all levels of land-use from site to campus to city and county and beyond. It is also clear from a review of the Stanislaus County hazard mitigation plan and Cal OES’ records of hazardous material spills, that such events occur with great frequency and varying degrees of severity across jurisdictions statewide. As such, in assessing the vulnerability of the CSU – Stanislaus campus, campus-level risks and vulnerabilities are not discreet or isolated but can become exacerbated or augmented through connections to broader community-level hazmat risks and vulnerabilities.

Finally, in order to draw conclusions on vulnerability, it should be noted that any identified vulnerabilities at the campus level and/or community level are circumscribed and potentially reduced by targeted policy and program interventions. Numerous policies and programs have been established in recent years in response to California’s widespread and complex and integrated hazardous materials risks - California established the Unified Program which consolidates and integrates the administrative requirements, permits, inspections, and enforcement activities of the following environmental and emergency response programs: the Aboveground Petroleum Storage Act (APSA) Program, Area Plans for Hazardous Materials Emergencies, the California Accidental Release Prevention (CalARP) Program, the Hazardous Materials Release Response Plans and Inventories (Business Plans), Hazardous Material Management Plan (HMMP) and Hazardous Material Inventory Statement (HMIS) requirements (California Fire Code), the Hazardous Waste Generator and Onsite Hazardous Waste Treatment (tiered permitting) Programs, and the Underground Storage Tank Program.

Identified Data Limitations

The CSU – Stanislaus planning committee has provided information on campus-level hazmat materials and risks. Data limitations pertain to a comprehensive understanding of human activity and error related to materials control over the long term.

Landslide

Description of the Hazard
A landslide is a down-slope movement of soil, rock, or other debris, and can also be referred to as a mass movement or slope failure. These geological hazards can range in size from a few feet to over a mile in length and width and, when heavy and rapidly moving, can cause serious damage and loss of life.

Landslides are classified based on the type of material and type of movement involved. They can range from slow-moving earth flows to fast-moving debris flows, though many large slope failures involve more than one type of movement. The primary natural triggers of slope failures are water, seismic activity, and volcanic activity. Slope saturation by water can occur from intense rainfall, snowmelt, changes in ground-water levels, and surface-water level changes along coastlines. In winter months, El Nino storms or other high rainfall events may saturate soils and trigger slope failure.

**Deep-Seated Landslides**

Deep-seated landslides, ranging in depth from ten to several hundred feet, occur as a result of geologic and hydraulic changes, such as earthquakes or increased levels of groundwater. These landslides can move slowly or quickly and can cause extensive property damage, but rarely result in loss of life.

**Debris Flows Related to Shallow Landslides**

Shallow landslides may mobilize into rapidly moving debris flows and typically occur after sudden saturation of the ground. These types of debris flows are typically more dangerous because they move rapidly, causing both property damage and loss of life.

Debris flows may also occur as a result of post-fire conditions, where wildfires have left barren ground exposed to heavy rainfall. Intense rainfall, generally greater than .5 inch per hour, has the potential to trigger a post-fire debris flow. These landslides may impact lives and properties within the deposition zone and can result in downstream flooding. Post-fire debris flows often occur during the fall and winter following major summer fires.

**Location of the Hazard**

The susceptibility of an area to landslides depends on several variables, including magnitude of slope gradients, water content, ground cover, presence of erosion, and slope material and structure. However, landslides are most prevalent in terrain with weak material and steep slopes, and the highest risk is found in areas with high rainfall or high earthquake potential. Slope failures are also most likely to occur in areas where they have


occurred in the past. In California, the most landslide-prone areas are found along the coast and in the northern Franciscan Formation.

General landslide vulnerability can be estimated from the distribution of weak rocks and steep slopes as seen in Figure 26-12. Based on the Figure below, the Stanislaus State University campus is not connected to areas susceptible to landslide.

Figure 26-13: Deep-Seated Landslide Susceptibility Surrounding Stanislaus State University

Extent of the Hazard

Landslide hazards are limited to the foothills of Stanislaus County. However, the indirect impacts of landslides such as disruption of transportation routes in the region may cover a larger geographical extent. Based on the campus’ distance from the landslide hazard zone, the planning committee ranks the extent of the landslide hazard for the campus as Low.

History of the Hazard
FEMA has declared 4 disasters in Stanislaus County since 1983 that involve mud flows, mudslides, or landslides. No landslides have occurred on or immediately adjacent to the campus.

Potential Impacts of the Hazard
Stanislaus State University may be impacted by the disruption of services as a result of landslides in the region. Students, faculty, and staff who live in nearby communities may also be impacted. Landslides can result in physical damage to buildings and property and have the potential to significantly affect infrastructure. As a landslide moves, it distresses structural foundations by settlement, cracking, and tilting. Fast-moving flows can remove entire structures in one instance, while other types of flows can cause damage gradually.

Transportation and utility infrastructure are particularly vulnerable to landslides, since the failure of any component can disrupt service over a large area. The loss of power and communication and disruption of transportation can have cascading effects throughout an area, including impaired disposal of sewage, contamination of water supplies, and the release of flammable fuels. Transportation routes are also often expensive to clean up, and prolonged obstruction can disrupt the movement of people and goods for long periods of time.

Probability of Future Occurrence of the Hazard
Slope failures are often triggered by other natural hazards such as heavy rainfall and earthquakes, so landslide frequency is often related to the frequency of these other hazards. As climate change impacts the frequency and intensity of triggers such as rain events, fires, and coastal erosion, landslides may generally occur more often. Historically, landslides have occurred rarely in Stanislaus and therefore are not likely to occur in the future. Based on these factors, and the fact that the campus is not located anywhere near a landslide zone, the probability of future occurrence is Unlikely.

Vulnerability to the Hazard
The vulnerability of the built environment to landslides depends on exposure and is more likely to incur damage as a result of proximity, rather than inferior structural design. The structures most vulnerable to landslides are buildings and utility/transportation lifelines, which can be impacted by either impact or ground deformation. Utilities and
transportation infrastructure are particularly vulnerable, due to their geographic extent and susceptibility to physical distress. Any population proximal to a landslide when it occurs is vulnerable to its impacts. The campus does not exhibit any such vulnerabilities.

Estimate of Potential Losses
There are no current models for estimating potential losses from a landslide directly impacting the campus.

Although the economic impact of landslide damage can exceed that of the direct repair costs, there are currently no applicable methods for estimating indirect costs related to Stanislaus State University.

Vulnerability Assessment Conclusions
Community exposure to landslides varies depending on their physical locations—whether in flat plains or on steep hillsides—and on their dependence on critical infrastructure located in landslide hazard zones.

Landslides could impact the campus primarily related to indirect impacts to transportation and utilities. Utility outages can impact health, particularly for vulnerable populations, and can cause interruptions in operations. Interruptions may impact student and employee’s ability to travel to campus and the delivery of classes and events.

Identified Data Limitations
The ability to predict future landslides at the Stanislaus State University campus is limited. However, the USGS estimates that climate change-induced shifts in weather will increase the frequency of post-wildfire landslides, which are expected to occur almost every year in California.
**Power Outage**

**Description of the Hazard**

Most aspects of modern life, and almost all aspects of urban life, rely on the availability of reliable utilities, such as electricity, water, and natural gas. An interruption in the supply or distribution of these commodities can leave populated areas like Stanislaus County without basic services, such as electricity or sanitation. These interruptions can be cascading effects from other hazard events, such as windstorms, floods, wildfires and earthquakes, or they can be caused by intentional disruptions of transmission lines.

A power outage event can interrupt day-to-day operations of the Stanislaus State University campus, like in-person classes, impede or limit digital, telephonic or radio communications, create traffic jams around the busy avenues and boulevards surrounding the campus, close the student health center, and close restaurants around campus and outside the campus. Additionally, hundreds of Stanislaus State University student residents in on-campus housing would also be affected by a power outage on campus and in the area.

Additionally, a severe outage in Stanislaus County would also directly affect the campus and the community. Even though the power provider may be different, the disruption to the surrounding community impacts transportation for commuter staff, faculty, and students.

Electric power disruptions and outages fall into two categories: intentional and unintentional.

The four types of **intentional** disruptions are:

- **Planned:** Some disruptions are intentional and can be scheduled based on maintenance or upgrading needs.
- **Unscheduled:** Some intentional disruptions must be done "on the spot" in response to an emergency.
- **Demand-Side Management:** Some customers (i.e., on the demand side) have entered into an agreement with their utility provider to curtail their demand for electricity during periods of peak system loads.
- **Load Shedding:** When the power system is under extreme stress due to heavy demand and/or failure of critical components, it is sometimes necessary to intentionally interrupt the service to selected customers to prevent the entire system from collapsing. These intentional interruptions result in rolling blackouts.

**Unintentional** or unplanned disruptions are outages that come with essentially no advance notice or warning. This type of disruption is the most problematic. The following are categories of unplanned disruptions:

- **Accident by the utility, utility contractor, or others.**
- **Malfunction or equipment failure.**
- Equipment overload (utility company or customer).
- Reduced capability (equipment that cannot operate within its design criteria).
- Tree contact other than from storms.
- Vandalism or intentional damage.
- Weather, including lightning, wind, earthquake, flood, and broken tree limbs taking down power lines.
- Wildfire that damages transmission lines.

**Location of the Hazard**

Although power outages can take place within a certain area, it has the potential to affect the entire planning area equally.

**Extent of the Hazard**

In order to anticipate outage conditions and reduce impacts, campus facility managers and others keep track of conditions and data provided by the media, municipal utilities and the California Independent System Operator (CAISO). CAISO is tasked with managing the power distribution grid that supplies most of California, except in areas served by municipal utilities, and is thus the entity that coordinates statewide flow of electrical supply. CAISO uses a series of “stage alerts” to the media based on system conditions. The alerts are as follows:

- Stage 1 - reserve margin falls below 7 percent.
- Stage 2 - reserve margin falls below 5 percent.
- Stage 3 - reserve margin falls below 1.5 percent.

Rotating blackouts become a possibility when Stage 3 is reached. Utility agencies aim to advise affected areas approximately 48 hours in advance of a potential PSPS event and will attempt notification again approximately 24 hours before power is shut off. Campus staff respond accordingly.

Given the prevalence of rolling blackouts and other power outages in California, the campus maintains safety precautions, situational awareness, access to emergency power generators and other protocols for managing campus power outages. Given also that recorded outages have taken place on campus, the planning committee ranks the extent of the power outage hazard as **Moderate**.

**History of the Hazard**

Stanislaus State University reported experiencing power outages in recent years due to transformer explosions. Their electric utility provider, the Turlock Irrigation District has
experienced outages, which have affected the residents of Stanislaus over the years. Major power outages impacting the City of Turlock in recent years have affected a large number of residents, including the university community. Stanislaus State University did not report any power outages in the recent years at Stanislaus State University but did advise that the university is expanding their mitigation efforts through actions while enacting the business continuity plan and agility recovery strategies. Some of the recent power outage events on campus:

- January 2016: Elevator repairs necessary due to power outage.
- February 2017: Campus wide power outage.
- July 2017: Basement fire led to a power outage.
- March 2018: Appliance overload created a power outage in dining facilities.
- April 2018: Power outage at Warrior Grill. No determination was made for the cause of power loss.

Potential Impacts of the Hazard

Instructors, campus residents, staff and administration rely on electricity to maintain ongoing operations. During a widespread power failure, it may take days to restore operations. Electrical power may be the only cooling source for many individuals around the campus and its community, enabling students with disabilities to enter, navigate and leave University buildings and long-term outages can potentially put students, faculty and staff safety at risk. Additionally, many medical devices, communications devices, and security rely on power to maintain their functions and losing power can potentially lead to tragic results.

Climate Change and Energy Shortage

Climate change is expected to bring more frequent and intense natural disasters. These changes have created a variability at a rate that makes historical data a poor predictor of future climate. For example, the warmest years on record in California occurred in 2014, 2015, and 2016. The 2016-2017 year broke the record as the wettest ever recorded in the northern Sierra Nevada Mountains.

Changes in temperatures, precipitation patterns, extreme events, and sea-level rise have the potential to decrease the efficiency of thermal power plants and substations, decrease the capacity of transmission lines, render hydropower less reliable, spur an increase in electricity demand, and put energy infrastructure at risk of flooding.

With climate warming, higher costs from increased demand for cooling in the summer are expected to outweigh the decreases in heating costs in the cooler seasons. Hotter temperatures in California will mean more energy (typically measured in “cooling-degree days”) needed to cool homes and businesses both during heat waves and on a daily basis, during the daytime peak of the diurnal temperature cycle. During future heat
waves, historically cooler coastal cities (e.g., San Francisco and Los Angeles) are projected to experience greater relative increases in temperature, such that areas that never before relied on air conditioning will experience new cooling demands.

Secondary impacts of energy shortages are most often felt by vulnerable populations. For example, those who rely on electric power for life-saving medical equipment, such as respirators, are extremely vulnerable to power outages. Also, during periods of extreme heat emergencies, the elderly and the very young are more vulnerable to the loss of cooling systems requiring power sources.

Probability of Future Occurrence of the Hazard

The probability of California experiencing a power outage can be difficult to quantify but is a hazard that occurs annually during the same seasonal periods of temperature variance throughout the calendar year. Stanislaus County experiences such outages. As such, the probability ranking for Stanislaus County is Likely. Although the Stanislaus State University campus has recorded fewer events than the surrounding area, it is prudent to assign this same ranking for the campus.

Climate models suggest summer global temperatures are likely to increase while changes between temperature extremes would be more pronounced. As such, it is expected that power outages will occur more frequently in the future.

Vulnerability to the Hazard

Based on the data available, and in consideration of the increasing effects of climate change, the campus remains vulnerable to power outages in terms of impacts to people, power infrastructure and campus operations. Nonetheless, as discussed, campus leadership works to reduce vulnerabilities through consistent use of safety and operational protocols and emergency power sources to ensure it is able to mitigate and cope with an interruption to electrical power.

Estimate of Potential Losses

Although the economic impact of power outage damage can exceed that of the direct repair costs, there are currently no applicable methods for estimating indirect costs related to Stanislaus State University.

Vulnerability Assessment Conclusions

Elevators, entry ways, air filtration systems and lighting provide the campus community with the necessary infrastructure and systems to function and navigate through the campus and to maintain a safe campus environment and visibility during nighttime hours. The primary concern for campus leadership is that a loss of power can lead to potential hazards to students, faculty, and staff at Stanislaus State University. Vulnerable populations (especially students with physical disabilities) may be the most heavily affected by loss of power, as they rely on elevators, entry ways with automatic doors, and locks and lights; a power outage would impede a disabled student’s ability to travel and
utilize the campus and its structures safely. The use of communication devices, billing, records, and electrical tools may also become unusable due to a loss of electricity. Many records and billing items may have to revert to “by-hand” procedures and paper copies may have to be kept continuing operations. Additionally, classrooms may not be usable if lighting equipment is not functioning impacting a semester or quarter’s progress for the academic year.

Identified Data Limitations
Stanislaus State University did not report any monetary or life losses due to a power outage. Also, the campus did not report any incidents involving a power outage directly affecting the campus community and operations.

Volcano (Associated Air Quality)

Description of the Hazard
The US Geological Service defines volcanoes as “openings or vents where lava, tephra (small rocks), and steam erupt on to the Earth’s surface. Through a series of cracks within and beneath the volcano, the vent connects to one or more linked storage areas of molten or partially molten rock (magma). This connection to fresh magma allows the volcano to erupt over and over again in the same location.”

A volcanic eruption occurs when magma, lighter than surrounding rock, is driven upwards by its buoyancy and by pressure from the dissolved gases contained within it. Gases are released from magma as it reaches the surface and pressure decreases. Magma can be erupted in several ways and violent eruptions typically cause tiny pieces of tephra (ash) to be carried away by the wind. This ash is hard, does not dissolve in water, is extremely abrasive and mildly corrosive, and conducts electricity when wet.

The gases released in an eruption include carbon dioxide, sulfur dioxide, hydrogen sulfide, and hydrogen halides. Depending on their concentration, these are potentially hazardous to people, animals, agriculture, and property.

Location of the Hazard
There are eight volcanic areas located throughout California. Seven of these - Medicine Lake Volcano, Mount Shasta, Lassen Volcanic Center, Clear Lake Volcanic Field, Long Valley Volcanic Region, Coso Volcanic Field, and Salton Buttes – are considered active.


volcanoes. No portion of Stanislaus State University or Stanislaus County is located within a volcano hazard zone.

**Extent of the Hazard**

Volcanic hazards are most severe within a few miles of the volcano vent and the severity generally decreases with distance. Ash impact zones can range from tens to hundreds of miles from the vent source. The US Geological Survey has estimated zones surrounding active volcanoes wherein 2 inches or more of ashfall following an eruption is possible. While Stanislaus State University does not fall within an estimated ashfall zone, lighter dustings of ash outside of those areas may directly or indirectly impact the campus. As such, the planning committee ranks the extent of the hazard off the campus as **Low**.

**History of the Hazard**

Over the last 1,000 years, there have been at least 12 eruptions in California. The most recent volcanic eruption in California occurred at Lassen Peak about 100 years ago, when a major explosion delivered windborne ash over 275 miles away. No historical eruption events have affected the campus.

**Potential Impacts of the Hazard**

The specific impacts vary widely and depend on which type of volcano erupts, the style of explosion, the volume of lava, the eruption duration, and the local water conditions. As Stanislaus State University is not proximal to an active volcano, only the potential impacts of ashfall and gases have been detailed. While both these hazards can be widespread, their most severe impacts are generally seen closer to the volcanic source.

Although ashfall is typically a nonlethal volcanic hazard, it is the most widespread and disruptive. Falling ash can damage crops, electronics, and machinery. It can also impact human health by irritating the respiratory tract, eyes, and skin. The particles may enter drinking water and structures and may cause structure failure if it is thick and heavy enough. Even a fine layer of ash can disrupt utilities. A portion of California’s major electric transmission lines, aerial telecommunication lifelines, transportation corridors, and water storage and conveyance lie within the state’s volcano hazard zones. Impacts to any of these can impact operations at Stanislaus State University.

The potential impacts of gases released during volcanic eruptions are as follows:

- Carbon dioxide typically becomes diluted very quickly and is not life threatening. However, it can become trapped in higher concentrations in low-lying areas and has the potential to be fatal.
- Sulfur dioxide can cause acid rain and air pollution downwind of a volcano.
- Hydrogen sulfide can cause irritation of the upper respiratory tract. At high concentrations it can cause unconsciousness and death.
- Hydrogen halides can coat ash particles and, once deposited, poison drinking water, agricultural crops, and grazing land.
Probability of Future Occurrence of the Hazard

The US Geological Survey, based on the record of volcanic activity in California, estimates that the probability of another small- to moderate-sized eruption in the next thirty years is about 16 percent. As such, the annual probability of future occurrence for the campus is ranked by the committee as **Unlikely**.

Vulnerability to the Hazard

Populations living near volcanoes are the most vulnerable to eruptions and lava flows. However, volcanic ash can travel and affect populations miles away. The location and thickness of ash in any given area is a function of the severity of the eruption and wind speed and direction. For Stanislaus State University, there is low vulnerability to the immediate impacts of volcanic eruptions due to the limited area affected and remote potential of an eruption. In the event of a widespread ashfall event, the elderly, infants, and populations with existing respiratory disease will be at higher risk.

Estimate of Potential Losses

Impacts to critical infrastructure, agriculture, and property from ashfall have the potential to cause widespread disruption, damage, and economic loss throughout the state. In the event of a widespread ashfall event, impacts will be immediate.

Current modeling is not precise enough to allow for an assessment of potential losses from ashfall to structures or infrastructure on or surrounding the campus.

Vulnerability Assessment Conclusions

Stanislaus State University is unlikely to experience the direct impacts of a volcanic event. While the campus may be indirectly impacted by ashfall elsewhere in the state, direct ashfall impacts are generally unlikely but possible in a widespread event. However, the likelihood of any volcanic eruption in the state impacting the campus is very low.

Identified Data Limitations

Not all active volcanoes in California have been zoned for hazards by the US Geological Survey. This, together with the infrequent occurrence of volcanic explosions and number of factors determining type and extent of impacts, make the quantification of potential loss difficult.
Wildfire

Description of the Hazard

While wildfires are a natural part of California’s ecosystem, wildfires in California represent a hazard that presents one of the greatest probabilities of destruction along with a demonstrated history of catastrophic fire events in recent years. The destructive fire seasons of 2017 to 2020 illustrated the destructive forces fire presents to communities across the state. Wildfires may result in the structural loss, infrastructure loss, dangerous air quality, environmental damages, economic impacts, injuries, and loss of life. In many communities throughout California, wildfire presents greatest risk to human life and property. Wildfires have been defined as any free burning vegetation fire that initiates from an unplanned ignition, whether natural or human caused demanding fire suppression actions to contain. These fires are prone to become uncontrolled, spreading through vegetative fuels rapidly exposing people and structures to harm. Wildfires present a significant risk to communities across the state, as evidenced by increasing trends of structural losses from wildland fires. This risk is elevated in areas where development and community growth has intersected, also known as the wildland-urban interface (WUI). In the interface setting, development itself can provide additional fuel for large fires. Recent fires have also demonstrated the ability of fire to consume populated areas in extreme conditions.

California’s Mediterranean climate in combination with its geography and vast population create a combination of factors that promotes an optimal environment for large fire growth and consequences. As there is great diversity of geographic characteristics across the state, the risks and potential consequences of wildfire must be assessed locally. The physical location, weather patterns, local fuel types and volume, extent of the WUI, topography, and additional factors will factor differently from part of the state to another. The behavior of wildfires in California is significantly influenced by three distinct geographic factors. These factors will help shape the size, direction of spread, rate of combustion, fire intensity, and ability to pre-heat fuels. The physical factors contributing to wildfire behavior include:

- **Topography** – The rate in which wildfires spread increases with greater slopes in topography. The greater the slope will result in more pre-heating of fuel above the advancing fire. The direction that a slope faces will also influence fire behavior as south facing slopes receive greater solar radiation and thus drier vegetation that is more susceptible to combustion. Ridgetops often denote the end of fire spread as fire has greater difficulty spreading downhill.

- **Weather** – Weather factors substantially in influencing the behavior of wildfires. Wind, temperature, humidity, lightning, and lack of precipitation all contribute to a fire’s ability or inability to spread and intensify. California routinely experiences conditions in which these factors are in alignment to contribute to extreme fire

75 State of California Hazard Mitigation Plan, September 2018
behavior during the summer and fall seasons. High winds, low humidity, and high temperatures provide an environment promoting extreme fire activity.

- Fuels – Certain types of vegetation are increasingly prone to igniting and promote more intense burning. Areas with greater “fuel loading” (amount of fuel present in terms of weight of fuel per unit of area) increases the amount of fuel to fuel a fire. Greater volumes of dead or dry vegetation compared to live plants is a critical factor. Vegetation during drought conditions will experience decrease in moisture content increasing the conditions for combustion. Fuels close proximity to one another allows for rapid spread through contact or radiant exposures.

A risk assessment for wildfires should be implemented within a geospatial context focusing on the specific location features and incorporates the three components of the wildfire risk triangle – likelihood, intensity, and susceptibility.

Location of the Hazard

Substantial portions of the State of California are exceptionally vulnerable to wildfire activity or reside in a wildland-urban interface (WUI) area due to the vast open spaces, rangelands, forests and other lands with high susceptibility to fire occurring throughout the state. Turlock is located in the center of the northern San Joaquin Valley between the southern Sierra Nevada Mountains and Coastal Ranges. In general, areas considered to be within Fire Hazard Severity Zones defined by the Fire and Resource Assessment Program (FRAP) within the California Department of Forestry and Fire Protection (CalFire) occur 16 miles to the east and 18 miles to the west of Turlock. These areas surrounding the valley are topographically diverse, contain heavier vegetative fuels, and often have residential development interspersed. The land in the San Joaquin Valley where the Stanislaus State University campus is located, is largely agricultural, urban, or otherwise developed.

The Stanislaus State University campus is located in the northern portion of the City of Turlock. The area immediately surrounding the campus is predominately developed with residential and commercial land uses. Extensive agricultural fields exist surrounding the city. The campus is established in 2 miles from downtown Turlock. High Fire Hazard Severity Zones are found along the length of the foothills to the Sierra Nevada Mountains and Coastal Ranges. Agricultural areas with extensive crop and orchard production are located on all sides of the city separating areas with wildfire threat by significant distance. There are no areas in proximity to the campus that present direct threats to wildfire.

However, the Stanislaus State University campus is located in the Central Valley surrounded by the mountains and extensive areas of fire hazards. These mountain ranges host three national forests with extensive history of large fire development. The fires that burn in these areas have the potential to develop vast quantities of smoke that can fill the valley in the right weather conditions. The geography of the Central Valley creates a topography that captures air pollutants including smoke within the surrounding mountains and the development of inversion layers. The Stanislaus State University
campus is located in a region in which is vulnerable to wildfire smoke that can saturate the air around the campus.

Figure 26-14: Fire Hazard Severity Zones near Stanislaus State University

Extent of the Hazard

The area immediately surrounding the Stanislaus State University campus is not in proximity to fire hazard zones designated as a High Fire Hazard Severity Zones, and the campus does not have a history of wildfire activity occurring within proximity to the campus. Although the campus is not surrounded by High Fire Severity Zones, it is surrounded by areas that are considered to be of high fire threat and that would produce

76 California Department of Forestry and Fire Protection, Fire and Resource Assessment Program, Fire Hazard Severity Zone Viewer, https://egis.fire.ca.gov/FHSZ/
vast quantities of smoke and particulates into the air. As a result, the planning committee ranks the extent of the wildfire hazard for the Stanislaus State University campus as **Moderate**.

The National Fire Danger Rating System (NFDRS) is the current system in use for rating and classifying the potential danger of fire. The NFDRS tracks the effects of previous weather events on both dead and live fuel loads and adjusts accordingly based on future or predicted weather conditions. These complex relationships and equations are computed, and the outputs are expressed in terms that users can quickly and easily understand. The current NFDRS is used by all federal and most state agencies to assess fire danger conditions.

The following table depicts the NFDRS, from the US Forest Service’s Wildland Fire Assessment System.

<table>
<thead>
<tr>
<th>Rating</th>
<th>Basic Description</th>
<th>Detailed Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>CLASS 1: Low</td>
<td>Fires not easily started</td>
<td>Fuels do not ignite readily from small firebrands. Fires in open or cured grassland</td>
</tr>
<tr>
<td>Danger (L)</td>
<td></td>
<td>may burn freely a few hours after rain, but wood fires spread slowly by creeping or</td>
</tr>
<tr>
<td>COLOR CODE:</td>
<td></td>
<td>smoldering and burn in irregular fingers. There is little danger of spotting.</td>
</tr>
<tr>
<td>Green</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CLASS 2:</td>
<td>Fires start easily and spread at a</td>
<td>Fires can start from most accidental causes. Fires in open cured grassland will burn</td>
</tr>
<tr>
<td>Moderate</td>
<td>a moderate rate</td>
<td>briskly and spread rapidly on windy days. Woods fires spread slowly to moderately fast.</td>
</tr>
<tr>
<td>Danger (M)</td>
<td></td>
<td>The average fire is of moderate intensity, although heavy concentrations of fuel --</td>
</tr>
<tr>
<td>COLOR CODE:</td>
<td></td>
<td>especially draped fuel -- may burn hot. Short-distance spotting may occur but is not</td>
</tr>
<tr>
<td>Blue</td>
<td></td>
<td>persistent. Fires are not likely to become serious and control is relatively easy.</td>
</tr>
<tr>
<td>CLASS 3: High</td>
<td>Fires start easily and spread at a</td>
<td>All fine dead fuels ignite readily, and fires start easily from most causes.</td>
</tr>
<tr>
<td>Danger (H)</td>
<td>a rapid rate</td>
<td>Unattended brush and campfires are likely to escape. Fires spread rapidly and short-</td>
</tr>
<tr>
<td>COLOR CODE:</td>
<td></td>
<td>distance spotting is common. High intensity burning may develop on slopes or in</td>
</tr>
<tr>
<td>Yellow</td>
<td></td>
<td>concentrations of fine fuel. Fires may</td>
</tr>
</tbody>
</table>

become serious and their control difficult, unless they are hit hard and fast while small.

<table>
<thead>
<tr>
<th>CLASS 4: Very High Danger (VH)</th>
<th>Fires start very easily and spread at a very fast rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>COLOR CODE: Orange</td>
<td>Fires start easily from all causes and immediately after ignition, spread rapidly and increase quickly in intensity. Spot fires are a constant danger. Fires burning in light fuels may quickly develop high-intensity characteristics - such as long-distance spotting - and fire whirlwinds when they burn into heavier fuels. Direct attack at the head of such fires is rarely possible after they have been burning more than a few minutes.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>CLASS 5: Extreme (E)</th>
<th>Fire situation is explosive and can result in extensive property damage</th>
</tr>
</thead>
<tbody>
<tr>
<td>COLOR CODE: Red</td>
<td>Fires under extreme conditions start quickly, spread furiously, and burn intensely. All fires are potentially serious. Development into high intensity burning will usually be faster and occur from smaller fires than in the Very High Danger class (4). Direct attack is rarely possible and may be dangerous, except immediately after ignition. Fires that develop headway in heavy slash or in conifer stands may be unmanageable while the extreme burning condition lasts. Under these conditions, the only effective and safe control action is on the flanks, until the weather changes or the fuel supply lessens.</td>
</tr>
</tbody>
</table>

Due to the impacts of wildfires on public health, agencies across the nation have adopted the use of the Air Quality Index (AQI) to communicate and provide a consistent approach to air quality measurements and categorization. The AQI primarily focuses on the health effects caused by pollutants in the air such as smoke. The goal of the AQI is to provide advisories to assist the public in determining when to reduce exposures to inhalation of air pollution as pollution levels rise. Figure 26-15: Air Quality Index for Ozone and Particulate Pollution
The State of California has a long history of chronic and destructive wildfires throughout the state. On average, 8,300 wildfires have caused burnt 928,245 acres across the state over the 20-year period between 2000 and 2020. Stanislaus County also has a long history of wildfire activity primarily in the foothills and mountains of the Sierra Nevada and Coastal Range Mountains. Wildfires occurring in Stanislaus County have resulted in hundreds of thousands of acres burned and millions of dollars in damages. The area immediately surrounding the Stanislaus State University campus is not in proximity to fire hazard zones designated as a High Fire Hazard Severity Zones. The campus does not have a history of wildfire activity occurring within proximity to the campus. However, the County is surrounded by areas that are considered to be of high fire threat that would produce vast quantities of smoke and particulates into the air. The Turlock campus has experienced multiple days of poor air quality due to fires burning in the Sierra Nevada and Coastal Range Mountains. The 2017, 2018, and 2020 fire seasons in particular illustrated the increase in wildfire generated smoke saturating the air of communities throughout the state including Stanislaus County. Stanislaus State University personnel reported the ongoing development of policies and procedures to address the response to poor air quality days.

Table 26-27: Historic Large-Scale Fires Near Stanislaus State University 79

<table>
<thead>
<tr>
<th>Daily AQI Color</th>
<th>Levels of Concern</th>
<th>Values of Index</th>
<th>Description of Air Quality</th>
</tr>
</thead>
<tbody>
<tr>
<td>Green</td>
<td>Good</td>
<td>0 to 50</td>
<td>Air quality is satisfactory, and air pollution poses little or no risk.</td>
</tr>
<tr>
<td>Yellow</td>
<td>Moderate</td>
<td>51 to 100</td>
<td>Air quality is acceptable. However, there may be a risk for some people, particularly those who are unusually sensitive to air pollution.</td>
</tr>
<tr>
<td>Orange</td>
<td>Unhealthy for Sensitive Groups</td>
<td>101 to 150</td>
<td>Members of sensitive groups may experience health effects. The general public is less likely to be affected.</td>
</tr>
<tr>
<td>Red</td>
<td>Unhealthy</td>
<td>151 to 200</td>
<td>Some members of the general public may experience health effects; members of sensitive groups may experience more serious health effects.</td>
</tr>
<tr>
<td>Purple</td>
<td>Very Unhealthy</td>
<td>201 to 300</td>
<td>Health alert: The risk of health effects is increased for everyone.</td>
</tr>
<tr>
<td>Maroon</td>
<td>Hazardous</td>
<td>301 and higher</td>
<td>Health warning of emergency conditions: everyone is more likely to be affected.</td>
</tr>
</tbody>
</table>

History of the Hazard

The State of California has a long history of chronic and destructive wildfires throughout the state. On average, 8,300 wildfires have caused burnt 928,245 acres across the state over the 20-year period between 2000 and 2020. Stanislaus County also has a long history of wildfire activity primarily in the foothills and mountains of the Sierra Nevada and Coastal Range Mountains. Wildfires occurring in Stanislaus County have resulted in hundreds of thousands of acres burned and millions of dollars in damages.

The area immediately surrounding the Stanislaus State University campus is not in proximity to fire hazard zones designated as a High Fire Hazard Severity Zones. The campus does not have a history of wildfire activity occurring within proximity to the campus. However, the County is surrounded by areas that are considered to be of high fire threat that would produce vast quantities of smoke and particulates into the air. The Turlock campus has experienced multiple days of poor air quality due to fires burning in the Sierra Nevada and Coastal Range Mountains. The 2017, 2018, and 2020 fire seasons in particular illustrated the increase in wildfire generated smoke saturating the air of communities throughout the state including Stanislaus County. Stanislaus State University personnel reported the ongoing development of policies and procedures to address the response to poor air quality days.

Table 26-27: Historic Large-Scale Fires Near Stanislaus State University 79

78 California Department of Forestry and Fire Protection, Stats and Events, https://www.fire.ca.gov/stats-events/

79 Stanislaus County Local Hazard Mitigation Plan Update, July 2017
Potential Impacts of the Hazard

The location of the Stanislaus State University campus surrounded by areas of urban development removed from areas with a fire hazard places a minimal direct threat from wildfire to the campus. The potential impacts to wildfire exist with members of the campus community who reside or work in these fire hazard zones.

Potential impacts to the campus community resulting from wildfires include:

- Injuries or loss of life
- Campus property destruction or damage
- Residential property destruction or damage
- Commercial property destruction or damage
- Loss of property contents
- Infrastructure damage
- Damaged or destroyed lifelines/supply routes
- Damaged or destroyed utilities
- Damaged or destroyed critical facilities supporting campus emergency support needs
- Loss of community economic base
- Employment losses
- Loss to ground supporting vegetation on hillsides resulting in erosion or landslides in future precipitation events
- Agricultural (crops and livestock) damages or destruction
- Environmental damage
- Societal and community impacts
- Damage to organizations and facilities providing support services to vulnerable populations
- Greater evacuation challenges for those most vulnerable
- Psychological impacts of impacted populations
- Disruptions to education delivery to community
Potential impacts resulting from wildfire generated smoke include:

- Dangerous levels of air pollution
- Human Health Effects
  - Similar health impacts on pets
- Air conditioning systems overwhelmed
- Greater demands on air filtration systems
- Greater demands on healthcare systems
- Reduced outdoor work productivity
- Closures of academic sessions

Additionally, there remains a number of secondary impacts from wildfires that could affect the campus community. Utilities feeding areas of Stanislaus County including the campus may be damaged resulting in power outages. Fire related damage in the watersheds will likely cause future landslides, degradation to plants supporting hillsides, and impact the hydroelectric power capabilities. Fires may present threats to areas of recreation, scenic value, and wildlife that are a part of the culture of the campus community. Finally, the campus may experience effects of evacuated individuals arriving on campus from other areas as a location of refuge.

Probability of Future Occurrence of the Hazard

Based on the wildfire threat potential in the areas surrounding the Stanislaus State University campus, including the distance to Fire Hazard Severity Zones and density of residential and commercial development, the probability of wildfire related damage is considered Unlikely.

Based on the wildfire threat potential in the area surrounding the Turlock region, including the volume of areas in elevated Fire Hazard Severity Zones surrounding the San Joaquin Valley, the probability of wildfire generated smoke impacts to air quality is considered Possible.

Vulnerability to the Hazard

The Stanislaus State University campus is not likely to be subject to direct impact from wildfire due to the campus location in an urban/suburban area of Turlock. The vulnerabilities to the effects of wildfire would largely lie within the campus community who may reside or work in locations that are exposed to the Fire Hazard Severity Zones outside of Turlock. Wildfires occurring in other areas of the region may result in the displacement of large numbers of people. These effects may spill onto the campus in the form of evacuees or facility support to emergency resources.
Fire directly threatening the campus would likely take the form of localized fires involving single structures or small areas. Smaller vegetation fires are possible surrounding the campus in the urban forest or fields surrounding the city. These incidents would likely have little impact to the campus.

The primary basis of vulnerability is based on the population affected and the built environment exposed. In general, newer construction will be more fire resistant than older buildings as building and fire codes and construction technology have improved. Density of buildings and proximity of fuels to buildings or equipment at risk of combustion would additionally influence the fire’s ability to spread to structures.

Some areas of particular vulnerability on the campus includes:

- Students and staff engaging in outdoor activities when the air is determined to be unhealthy are vulnerable to adverse health effects.
- Buildings with ineffective HVAC will cause limitations in filtering of air during smoke filled days
- Air pollution effects to students housed on the campus
- Power outages or brownouts during days with high levels of smoke will limit shelter in place options during heat events in summer.

The greater concerns regarding vulnerabilities to wildfire on Stanislaus State University are related to the smoke that fires in the area would produce. The recent summer seasons have clearly demonstrated the reality of large wildfires producing enough smoke to fill the San Joaquin Valley even from substantial distances away. These recent fires have displayed how the effects of this smoke impact the general population and especially vulnerable populations. Stanislaus State University students, faculty, and staff both on campus and off campus face these same vulnerabilities related to smoke filled air.

Individuals with existing health problems such as respiratory or cardiac illnesses are increasingly vulnerable to wildfire generated smoke. Staff who work in roles requiring outdoor activity will be increasingly exposed during days where the air quality index is considered unhealthy or worse. Student athletes participating in outdoor sports and engaging in aerobic activities are increasingly vulnerable to the effects of wildfire depending on when the air quality was to reach unhealthy levels. The risk to the campus population will be lessened during periods when classes are not in session or during periods of breaks. Conversely, during the days and hours that classes are in session and staff are at their workplaces, the human vulnerability increases. However, in region-wide events this vulnerability may be shared with the homes and workplaces of members of the campus community and their families.

Vulnerable populations will likely face disproportionate health safety issues from smoke filled air, experience increased stresses, may require the need to remain away from the campus enclosed at home, and may find difficulty in accessing equipment or supplies to aid in a specific need.
Estimate of Potential Losses

Estimates of potential losses will be influenced by a variety of factors. Costs would also be likely to include mitigation or repairs of HVAC systems, sealing of doors and windows, and other methods of keeping smoke from entering buildings. Secondary costs would include lost academic days during campus closures, lost staff on campus productivity, and health and medical interventions for affected members of the campus community.

Based on estimate replacement costs of facilities and structures on campus, the maximum total replacement costs due to wildfire are $162,376,793. Due to the lack of a complete inventory of building and facility costs, the total replacement estimate is likely much higher. However, the location of the campus in an suburban setting removed from hazard prone areas makes wildfire related damages unlikely.

Table 26-25: Wildfire Hazard Potential (WHP) Zone Estimated Losses

<table>
<thead>
<tr>
<th>WHP Zone</th>
<th>No of Buildings</th>
<th>Maximum Replacement Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Extreme</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Very High</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>High</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Moderate</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Low</td>
<td>3</td>
<td>$58,000</td>
</tr>
<tr>
<td>Very Low</td>
<td>4</td>
<td>$33,907,000</td>
</tr>
<tr>
<td>Non-Burnable</td>
<td>79</td>
<td>$128,411,793</td>
</tr>
<tr>
<td>No Building Value Data Provided*</td>
<td>47</td>
<td>Unknown</td>
</tr>
</tbody>
</table>

*Buildings with no value defined are also included in the respective Zones they are found in.

Vulnerability Assessment Conclusions

The occurrence of wildfires has been a frequent event in the mountains surrounding Stanislaus County; however, wildfire incidents do not pose a direct risk to the Stanislaus State University campus. The suburban location of the Stanislaus State University campus surrounded by densely developed residential and commercial land uses mitigates any vulnerabilities of wildfire hazards to the campus community or facilities.

Communities located within or near the Wildland Urban Interface may be subject to damaging fires. These same communities may be home to members of the campus community. The students, faculty, and staff of Stanislaus State University who live or work in these hazard areas may experience vulnerabilities to the direct exposure to wildfire not likely at the campus. These effects may create tremendous challenges that could impact their ability to maintain engagement with university academic or professional activities. The potential for large-scale wildfires in the region further generates the added potential for a number of cascading effects such as disruptions to
the local economy, utility failures, disruptions to providing for the needs of the community, and development of public health hazards.

Additionally, the topography and weather patterns of Central California often creates conditions that allows for smoke filled air to linger in the Central Valley with the potential for unhealthy air quality depending on wind conditions. Fires in surrounding mountains and forests some distance away that generate tremendous quantities of smoke present tremendous health related vulnerabilities to members of the campus community. The campus community exposed to these unhealthy air conditions are vulnerable to a variety of potential health related effects.

Identified Data Limitations

Data limitations include missing campus structural replacement costs, and lack of both a complete inventory of building construction types and mitigation efforts to lessen the impact due to fire activity. HAZUS generated analysis is focused on the broader community level versus fine-tuning the analysis to the micro-level for facilities such as a university campus.

**Severe Weather (Wind, Tornado, Hail, and Lightning)**

Description of the Hazard

Severe weather can be described as a variety of weather or climate events that are beyond or near the ends of the range of observed weather patterns and behavior. These events can include high or extreme winds, storms, lightning, hail, tornadoes, heat waves, unusually cold temperatures, extreme rainfall, and flooding.80 According to the Intergovernmental Panel on Climate Change (IPCC), to be classified as severe (or extreme), the occurrence of each value of a climate or weather variable (e.g., wind, hail, lightning, tornado, etc.) must be “above (or below) a threshold value near the upper (or lower) ends of the range of observed values of the variable.”81

Severe weather in California can be generated by local, regional, and/or global weather and climate influences. From the individual thunderstorm to the Santa Ana wind event to the strong El Niño, damaging weather elements that are produced by and accompany


severe weather and climate phenomena (e.g., damaging winds, hail, lightning, and tornadoes) occur throughout California and the California State University (CSU) system.

Global Scale Influences on Severe Weather in California: El Niño, La Niña, and ENSO

The El Niño-Southern Oscillation (ENSO) is a recurring climate pattern involving changes in the temperature of waters in the central and eastern tropical Pacific Ocean. On periods ranging from about three (3) to seven (7) years, the surface waters across a large swath of the tropical Pacific Ocean warm or cool by anywhere from 1°C to 3°C, compared to normal. This oscillating warming and cooling pattern, referred to as the ENSO cycle, directly affects rainfall distribution in the tropics and can have a strong influence on weather across the United States and other parts of the world.

El Niño and La Niña are extreme phases of the ENSO cycle, with a third phase occurring between them called the Neutral phase. The El Niño phase is characterized by unusually warm ocean temperatures and weaker-than-normal east winds in the Equatorial Pacific, while the La Niña phase is characterized by unusually cold ocean temperatures and stronger-than-normal east winds in the Equatorial Pacific. Both extreme ENSO phases lead to significant differences from the average ocean temperatures, winds, surface pressure, and rainfall across parts of the tropical Pacific. The Neutral phase indicates that conditions are near their long-term average.

The extreme ENSO phases affect the frequency and intensity of weather events across the world, including in California. On average, areas across California experience exceptionally stormy winters with increased precipitation under El Niño conditions, but experience less stormy and drier winters under La Niña conditions. This variability in storminess and precipitation brought on by El Niño and La Niña events affects the both the frequency and intensity of severe weather conditions experienced by all CSU campuses, including Stanislaus State University.

Regional Climate Influences on Severe Weather across California

Most of the weather in California is influenced by the wet-winter/ dry-summer Mediterranean climate pattern. In the summer months, Pacific storm tracks are deflected north due to the position of the Pacific High (i.e., a large-scale atmospheric circulation

82 Retrieved on 07.18.2021 from https://www.weather.gov/mhx/ensowhat
84 Retrieved on 07.17.2021 from https://www.climate.gov/news-features/understanding-climate/el-ni%C3%B1o-and-la-ni%C3%B1a-frequently-asked-questions
85 Retrieved on 07.16.2021 from https://www.pmel.noaa.gov/elnino/what-is-el-nino
over the Northeast Pacific Ocean), preventing Pacific storms from reaching California. As a result, most summer storms are generated due to the incursion of moist air from the Gulf of Mexico or the Gulf of California, and occur as scattered, locally heavy showers in the desert and mountain regions of the state. In the winter months, the Pacific High decreases in intensity and moves south, permitting powerful Pacific storms to move into and across the state; these storms can produce extreme winds, heavy rains (including “atmospheric river” events), and widespread coastal and inland flooding. (Please see the Flood Hazard profile in this document for information on Floods.) As a result, storm events accompanied by precipitation in California are far more frequent in the winter months than they are in the summer months.\(^{87}\)

While the Mediterranean climate pattern influences the seasonal frequency, intensity, geographic spread, and type of some severe weather events CSU campuses experience (including Stanislaus State University), other severe weather phenomena may occur in California at any time of the year. For example, near the coast and over the Central Valley, there appears to be no defined seasonality to thunderstorms, and these storms are usually light and infrequent. Thunderstorms are more intense and more frequent in the intermediate and higher elevations of the Sierra Nevada, and occur with greater frequency during the summer months.\(^{88}\)

Types of Storms in California

The 2018 California State Hazard Mitigation Plan (SHMP) defines a storm as a violent atmospheric disturbance occurring over land and/or water that is distinguished by its strength, characteristics, and the scale of the resulting damage.\(^{89}\) The SHMP also lists the following types of storms that produce hazardous conditions and potential damage throughout the state of California.\(^{90}\) These storms affect (in varying degrees) all CSU campuses, including Stanislaus State University.

- **Thunderstorm**: A rain-bearing cloud that also produces lightning. Thunderstorms can produce some of nature’s most destructive and deadly weather including tornadoes, hail, strong winds, lightning and flooding.\(^{91}\) Thunderstorms are caused by an atmospheric imbalance from warm unstable air rising rapidly into the atmosphere. Lightning, which occurs during all thunderstorms, can strike

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87 Retrieved on 07.17.2021 from https://wrcc.dri.edu/Climate/narrative_ca.php

88 Retrieved on 07.17.2021 from https://wrcc.dri.edu/Climate/narrative_ca.php


Thunderstorms can produce some of nature’s most destructive and deadly weather including tornadoes, hail, strong winds, lightning and flooding. **Severe thunderstorms** are more intense, violent, and dangerous thunderstorms. The National Oceanic and Atmospheric Administration (NOAA) defines a severe thunderstorm as any storm that produces one or more of the following elements: Damaging winds or speeds of 58 mph (50 knots) or greater, hail 1 inch in diameter or larger, and/or a tornado.93 94

- **Hailstorm**: a type of storm that precipitates round chunks of ice. Hailstorms usually occur during regular thunderstorms.95

- **Wind storm**: marked by high wind with little or no precipitation.96

- **Winter storm**: A storm that can produce a combination of freezing rain, sleet, heavy snow, and/or strong winds.97

- **Coastal storm**: large wind-driven waves and/or storm surge that strike the coastal zone.98

- **Ice storm**: Ice storms are one of the most dangerous forms of winter storms. When surface temperatures are below freezing, but a thick layer of above-freezing air remains aloft, rain can fall into the freezing layer and freeze upon impact into a glaze of ice. In general, 8 millimeters (0.31 inch) of accumulation is all that is required, especially in combination with breezy conditions, to start downing power lines as well as tree limbs. Ice storms also make unheated road surfaces too slick

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93 Retrieved on 07.15.2021 from https://www.noaa.gov/explainers/severe-storms

94 Retrieved on 07.15.2021 from https://www.weather.gov/safety/thunderstorm


to drive on. Ice storms can vary in time range from hours to days and can cripple small towns and large urban centers alike.99

- **Snowstorm:** A heavy fall of snow accumulating at a rate of more than 5 centimeters (2 inches) per hour that lasts several hours. Snowstorms, especially ones with a high liquid equivalent and breezy conditions, can down tree limbs, cut off power, and paralyze travel over a large region.100

**Severe Weather Hazard Elements: Wind Hazards, Hail, and Lightning**

This hazard profile concentrates on the following types of severe weather hazards: wind hazards (including tornadoes), hail, and lightning. These hazards are produced by a variety of weather phenomena, including thunderstorms, coastal storms, winter storms, and topographically-enhanced downslope winds. While storm and downslope wind hazards are responsible for severe weather events across the CSU system, only the wind, tornado, hail, and lightning elements generated by these hazards are covered in this profile. (Storm-related hazards such as flooding and extreme temperatures are covered in other sections of this document.)

**Wind Hazards**

Wind is the horizontal movement of air past any given point. Wind begins with differences in air pressures; pressure that is higher at one point than another sets up a force, pushing the high towards the low pressure.101 Wind gusts are defined as “rapid fluctuations in the wind speed with a variation of 10 knots or more between peaks and lulls.” 102

Wind hazards in California take several forms: High Wind, Strong Winds, Thunderstorm Winds, Mountain-Valley (Downslope) Winds, and Tornadoes. These hazards are encountered across California, and have the potential to cause harm to or loss of life and/or property throughout California and the CSU system (including Stanislaus State University).

**High Winds, Strong Winds, and Thunderstorm Winds**

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The National Weather Service reports three (3) types of wind events that occur areas over land: High Winds, Strong Winds, and Thunderstorm Winds. Collectively, these reports are used to determine the frequency with which wind hazard events have affected areas across the U.S., including California.

**High Winds**

High winds are defined as sustained non-convective winds of 35 knots (40 mph) or greater lasting for 1 hour or longer, or gusts of 50 knots (58 mph) or greater for any duration (or otherwise locally/regionally defined). In some mountainous areas, the above numerical values are 43 knots (50 mph) and 65 knots (75 mph), respectively.\(^\text{103}\)

**Strong Winds**

Strong winds are defined as non-convective winds gusting less than 50 knots (58 mph), or sustained winds less than 35 knots (40 mph), resulting in a fatality, injury, or damage.\(^\text{104}\)

**Thunderstorm Winds**

Thunderstorm winds are winds that arise from thunderstorm convection (occurring within 30 minutes of lightning being observed or detected), with speeds of at least 50 knots (58 mph). They can also be winds of any speed (non-severe thunderstorm winds below 50 knots (58 mph)) producing a fatality, injury, or damage.\(^\text{105}\)

Please note: **Straight-line wind** is a term used to define any thunderstorm wind that is not associated with rotation. It is used mainly to differentiate from the rotational winds found in tornado-producing storms.\(^\text{106}\) However, it is not a term used in the NCEI Storm Events Database, and therefore cannot be used to determine severe weather history of or potential impacts to CSU campuses.

**Tornadoes**

A tornado is an extreme severe weather wind hazard. A tornado is a rapidly rotating column of air extending from a thunderstorm to the surface of the Earth.\(^\text{107}\) This column extends between cloud and the Earth’s surface. The damage from tornadoes comes from the strong winds they contain and the flying debris they create. It is generally believed


\(^{106}\) NOAA Retrieved on 07.15.2021 from https://www.nssl.noaa.gov/education/svrwx101/wind/types/

\(^{107}\) EarthWorks Retrieved on 07.15.2021 from https://www.earthnetworks.com/tornado/
that rotational wind speeds can be as high as 300 mph in the most violent tornadoes.\textsuperscript{108}

On a local scale, tornadoes are the most violent and most destructive of all atmospheric phenomena.\textsuperscript{109}

\textbf{Mountain-Valley (Downslope) Wind Systems: Santa Ana, Diablo, and Sundowner Winds.}

\textbf{Santa Ana Winds.} A type of wind hazard that is peculiar to Southern California is called a \textit{Santa Ana Wind}. Santa Ana winds are strong, topographically-enhanced, extremely dry downslope winds that originate inland and affect coastal southern California and northern Baja California (Mexico).\textsuperscript{110} They occur when air from a region of high pressure over the dry, desert region of the southwestern U.S. flows westward towards low pressure located off the California coast. This creates dry winds that flow east to west through the mountain passages in Southern California. These winds have a strong seasonal component; they are most common during the cooler months of the year, occurring from September through May. Santa Ana winds typically feel warm (or even hot) because as the cool desert air moves down the side of the mountain, it is compressed, which causes the temperature of the air to rise. If strong enough, Santa Ana winds can cause major property damage, and may present difficulties for airborne and seagoing transportation. They also may increase wildfire risk because of the dryness of the winds and the speed at which they can spread a flame across the landscape.\textsuperscript{111} (Note: The Wildfire hazard is profiled elsewhere in this document.)

The following figure illustrates the mechanisms involved in the generation of Santa Ana winds across Southern California.

\textbf{Figure 26-16: What Drives a Santa Ana Wind?}\textsuperscript{112}

\begin{flushleft}
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\end{flushleft}

\begin{flushleft}
\textsuperscript{108} NOAA Retrieved on 07.15.2021 from https://www.nssl.noaa.gov/education/svrwx101/tornadoes/faq/
\end{flushleft}

\begin{flushleft}
\textsuperscript{109} Weather Retrieved on 07.15.2021 from https://www.weather.gov/bgm/severedefinitions
\end{flushleft}

\begin{flushleft}
\end{flushleft}

\begin{flushleft}
\end{flushleft}

\begin{flushleft}
\textsuperscript{112} Retrieved on 07.14.2021 from https://twitter.com/nwslosangeles/status/933049473034579968
\end{flushleft}
**Diablo Winds.** The Diablo wind is another type of topographically-enhanced downslope wind phenomenon that occurs in the North-Central areas of California. Diablo winds are offshore wind events that flow northeasterly over Northern California’s Coast Ranges, often creating high wind speeds downwind of major canyons and over ridges, and extreme fire danger for the San Francisco Bay Area. Diablo winds are driven by a surface pressure gradient that forms in response to an inverted pressure trough that develops over California.113

**Sundowner Winds.** Sundowner winds are significant and potentially damaging downslope wind and warming events that periodically occur along a short segment of the southern California coast in the vicinity of Santa Barbara, CA. The unique topography of this coastal region promotes the development of Sundowner wind events: over a length of about 100 km, the coastline is oriented approximately west–east, with the adjoining narrow coastal plain bounded by a steeply rising (to elevations greater than 1200 m) and coast-parallel mountain range. Called Sundowner winds because they often begin in the late afternoon or early evening, their onset is typically associated with a rapid rise in temperature and decrease in relative humidity, and the winds tend to blow from the north.

from the Santa Ynez Mountains to the coast of Santa Barbara County, California. During the more intense Sundowner wind events, wind speeds can be of gale force 39-54 miles per hour or higher, and can even reach hurricane force (≥ 74 miles per hour) in the most extreme cases. Temperatures over the coastal plain, and even at the coast itself, can rise significantly above 37.8°C (100°F). Seasonally, Sundowner winds peak in March, April, and May, with a minimum during summer and a secondary peak in winter that often corresponds with Santa Ana winds. In addition to causing a dramatic change from the more typical marine-influenced local weather conditions, Sundowner wind episodes have produced significant wind-related property and agricultural damage, as well as conditions of extreme fire danger.114 115 116

**Hail**

Hail is a form of precipitation consisting of solid ice that forms inside thunderstorm updrafts.117 It is roughly round in shape and at least 0.2’ in diameter. Hail develops in the upper atmosphere as ice crystals that are bounced about by high velocity updraft winds; the ice crystals accumulate frozen droplets and fall after developing enough weight. The size of hailstones varies and is a direct consequence of the severity and size of the storm that produces them – the higher the temperatures at the Earth’s surface, the greater the strength of the updrafts and the amount of time hailstones are suspended, and therefore the greater the size of the hailstone.118

**Lightning**

Lightning is an electrical discharge produced by a thunderstorm. Lightning rapidly heats the air in its immediate vicinity to about 50,000°F - about five times the temperature of the surface of the sun. This compresses the surrounding air and creates a supersonic shock wave, which decays to an acoustic wave that is heard as thunder.119

The discharge may occur within or between clouds, between the cloud and air, between a cloud and the ground, or between the ground and a cloud.120 Lightning that is produced

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from thunderstorms in which precipitation evaporates before reaching the ground is called “dry lightning.”

Location of the Hazard

Severe weather is a non-spatial hazard, and can occur anywhere in the CSU system, including either at the Stanislaus State University main campus or at satellite campus facilities owned by the school. No one area of the campus – or of the surrounding community – is subject to experiencing severe weather more than any other area.

There is geographic variability among the different types of mountain and valley wind events (as a sub-category of the severe weather hazard). Santa Ana winds occur in Southern California, Diablo winds occur in North-Central California, and Sundowner winds occur almost exclusively in Santa Barbara County, California.

Extent of the Hazard

Severe weather hazards are non-spatial hazards that potentially affect all Stanislaus State University campus areas equally. However, the smallest geographic unit of measurement for almost all official severe weather event data is at the county level. Because the severe weather data used do not exist at the campus level, it is assumed that the same (or similar) severe weather risks to Stanislaus State University campuses reflect those of the surrounding community and County. As a result, all assets and people at Stanislaus State University campuses are at risk from the effects of severe weather and can expect to experience at least some (or the complete range of) endemic severe weather hazards. In consideration of the campus’ design, layout, and operations, the severe weather history and degree of severity in the Turlock (Stanislaus County) and Stockton (San Joaquin County) areas, and the history and degree of severity of each severe weather sub-type identified by the extent scales (below), the campus planning committee ranks the overall extent of the Severe Weather hazard as MODERATE. See each sub-hazard below for the planning committee’s sub-type extent ranking.

Wind Hazard: Non-Rotational

The Beaufort Scale is an empirical measure that relates wind speed to observed conditions at sea or on land. Its full name is the Beaufort wind force scale. First developed in 1805, it is still used today to estimate wind strengths.  

121 Retrieved on 07.15.2021 from https://www.rmets.org/resource/beaufort-scale

Table 26-26: Beaufort Wind Force Scale

<table>
<thead>
<tr>
<th>Force</th>
<th>Speed (mph)</th>
<th>Speed (knots)</th>
<th>Description</th>
<th>Specifications for use at sea</th>
<th>Specifications for use on land</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0-1</td>
<td>0-1</td>
<td>Calm</td>
<td>Sea like a mirror.</td>
<td>Calm; smoke rises vertically.</td>
</tr>
<tr>
<td>1</td>
<td>1-3</td>
<td>1-3</td>
<td>Light Air</td>
<td>Ripples with the appearance of scales are formed, but without foam crests.</td>
<td>Direction of wind shown by smoke drift, but not by wind vanes.</td>
</tr>
<tr>
<td>2</td>
<td>4-7</td>
<td>4-6</td>
<td>Light Breeze</td>
<td>Small wavelets, still short, but more pronounced. Crests have a glassy appearance and do not break.</td>
<td>Wind felt on face; leaves rustle; ordinary vanes moved by wind.</td>
</tr>
<tr>
<td>3</td>
<td>8-12</td>
<td>7-10</td>
<td>Gentle Breeze</td>
<td>Large wavelets. Crests begin to break. Foam of glassy appearance.</td>
<td>Leaves and small twigs in constant motion; wind extends light flag.</td>
</tr>
<tr>
<td>4</td>
<td>13-18</td>
<td>11-16</td>
<td>Moderate Breeze</td>
<td>Small waves, becoming larger; fairly frequent white horses.</td>
<td>Raises dust and loose paper; small branches are moved.</td>
</tr>
<tr>
<td>5</td>
<td>19-24</td>
<td>17-21</td>
<td>Fresh Breeze</td>
<td>Moderate waves, taking a more pronounced long form; many white horses are formed.</td>
<td>Small trees in leaf begin to sway; crested wavelets form on inland waters.</td>
</tr>
<tr>
<td>6</td>
<td>25-31</td>
<td>22-27</td>
<td>Strong Breeze</td>
<td>Large waves begin to form; the white foam crests are more extensive everywhere.</td>
<td>Large branches in motion; whistling heard in telegraph wires; umbrellas used with difficulty.</td>
</tr>
</tbody>
</table>

123 Retrieved on 07.15.2021 from https://www.weather.gov/mfl/beaufort
<table>
<thead>
<tr>
<th>7</th>
<th>32-38</th>
<th>28-33</th>
<th>Near Gale</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Sea heaps up and white foam from breaking waves begins to be blown in streaks along the direction of the wind.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Whole trees in motion; inconvenience felt when walking against the wind.</td>
</tr>
<tr>
<td>8</td>
<td>39-46</td>
<td>34-40</td>
<td>Gale</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Moderately high waves of greater length; edges of crests begin to break into spindrift. The foam is blown in well-marked streaks along the direction of the wind.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Breaks twigs off trees; generally impedes progress.</td>
</tr>
<tr>
<td>9</td>
<td>47-54</td>
<td>41-47</td>
<td>Severe Gale</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>High waves. Dense streaks of foam along the direction of the wind. Crests of waves begin to topple, tumble and roll over. Spray may affect visibility.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Slight structural damage occurs (chimney-pots and slates removed)</td>
</tr>
<tr>
<td>10</td>
<td>55-63</td>
<td>48-55</td>
<td>Storm</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Very high waves with long overhanging crests. The resulting foam, in great patches, is blown in dense white streaks along the direction of the wind. On the whole the surface of the sea takes on a white appearance. The tumbling of the sea becomes heavy and shock-like. Visibility affected.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Seldom experienced inland; trees uprooted; considerable structural damage occurs.</td>
</tr>
<tr>
<td>11</td>
<td>64-72</td>
<td>56-63</td>
<td>Violent Storm</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Exceptionally high waves (small and medium-size ships might be for a time lost to view behind the waves). The sea is completely covered with long white patches of foam lying along the direction of the wind. Everywhere the edges of the wave crests are blown into froth. Visibility affected.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Very rarely experienced; accompanied by widespread damage.</td>
</tr>
<tr>
<td>12</td>
<td>73+</td>
<td>64+</td>
<td>Hurricane</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>The air is filled with foam and spray. Sea completely white with driving spray; visibility very seriously affected.</td>
</tr>
</tbody>
</table>
Based on those extent ranking factors identified (above), the planning committee ranks the extent of non-rotational wind hazards as MODERATE.

**Extent: Tornado**

Tornadoes have their own severity/extent scale. Until 2007, tornadoes were measured and described according to the Fujita Scale.124

In February 2007, use of the Fujita Scale was discontinued. In its place, the Enhanced Fujita (EF) Scale is used. The Enhanced Fujita scale considers how most structures are designed and is thought to be a much more accurate representation of the surface wind speeds in the most violent tornadoes. Like the original Fujita scale, the Enhanced Fujita scale is a set of wind estimates (not measurements) based on damage.

It is important to note the **date** that a tornado occurred. Tornadoes that occurred prior to February, 2007 are classified using the original Fujita scale and will not be converted to the Enhanced Fujita Scale.

Table below illustrates the Fujita Scale in use prior to February 2007.

Table 26-27: Fujita Tornado Scale (Pre-February 2007) 125

<table>
<thead>
<tr>
<th>F-Scale Number</th>
<th>Intensity Phrase</th>
<th>Wind Speed</th>
<th>Type of Damage</th>
</tr>
</thead>
<tbody>
<tr>
<td>F0</td>
<td>Gale tornado</td>
<td>40-72 mph</td>
<td>Some damage to chimneys; breaks branches off trees; pushes over shallow-rooted trees; damages sign boards.</td>
</tr>
<tr>
<td>F1</td>
<td>Moderate tornado</td>
<td>73-112 mph</td>
<td>The lower limit is the beginning of hurricane wind speed; peels surface off roofs; mobile homes pushed off foundations or overturned; moving autos pushed off the roads; attached garages may be destroyed.</td>
</tr>
<tr>
<td>F2</td>
<td>Significant tornado</td>
<td>113-157 mph</td>
<td>Considerable damage. Roofs torn off frame houses; mobile homes demolished; boxcars pushed over;</td>
</tr>
</tbody>
</table>

---


<table>
<thead>
<tr>
<th>Level</th>
<th>Description</th>
<th>Wind Speed</th>
<th>Impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>F3</td>
<td>Severe tornado</td>
<td>158-206 mph</td>
<td>Roof and some walls torn off well-constructed houses; trains overturned; most trees in forest uprooted.</td>
</tr>
<tr>
<td>F4</td>
<td>Devastating tornado</td>
<td>207-260 mph</td>
<td>Well-constructed houses leveled; structures with weak foundations blown off some distance; cars thrown and large missiles generated.</td>
</tr>
<tr>
<td>F5</td>
<td>Incredible tornado</td>
<td>261-318 mph</td>
<td>Strong frame houses lifted off foundations and carried considerable distances to disintegrate; automobile sized missiles fly through the air in excess of 100 meters; trees debarked; steel reinforced concrete structures badly damaged.</td>
</tr>
<tr>
<td>F6</td>
<td>Inconceivable tornado</td>
<td>319-379 mph</td>
<td>These winds are very unlikely. The small area of damage they might produce would probably not be recognizable along with the mess produced by F4 and F5 wind that would surround the F6 winds. Missiles, such as cars and refrigerators would do serious secondary damage that could not be directly identified as F6 damage. If this level is ever achieved, evidence for it might only be found in some manner of ground swirl pattern, for it may never be identifiable through engineering studies.</td>
</tr>
</tbody>
</table>

Table below illustrates the Enhanced Fujita (EF) Scale, currently in use. Tornadoes that have occurred since February, 2007 are classified using the Enhanced Fujita Scale.
Table 26-28: Enhanced Fujita Scale (February 2007 and Later) \(^\text{126}\)

<table>
<thead>
<tr>
<th>Enhanced Fujita Category</th>
<th>Wind Speed</th>
<th>Potential Damage</th>
</tr>
</thead>
<tbody>
<tr>
<td>EF0</td>
<td>65-85 mph</td>
<td>Light damage. Peels surface off some roofs; some damage to gutters or siding; branches broken off trees; shallow-rooted trees pushed over.</td>
</tr>
<tr>
<td>EF1</td>
<td>86-110 mph</td>
<td>Moderate damage. Roofs severely stripped; mobile homes overturned or badly damaged; loss of exterior doors; windows and other glass broken.</td>
</tr>
<tr>
<td>EF2</td>
<td>111-135 mph</td>
<td>Considerable damage. Roofs torn off well-constructed houses; foundations of frame homes shifted; mobile homes completely destroyed; large trees snapped or uprooted; light-object missiles generated; cars lifted off ground.</td>
</tr>
<tr>
<td>EF3</td>
<td>136-165 mph</td>
<td>Severe damage. Entire stories of well-constructed houses destroyed; severe damage to large buildings such as shopping malls; trains overturned; trees debarked; heavy cars lifted off the ground and thrown; structures with weak foundations blown away some distance.</td>
</tr>
<tr>
<td>EF4</td>
<td>166-200 mph</td>
<td>Devastating damage. Well-constructed houses and whole frame houses completely leveled; cars thrown and small missiles generated.</td>
</tr>
<tr>
<td>EF5</td>
<td>&gt;200 mph</td>
<td>Incredible damage. Strong frame houses leveled off foundations and swept away; automobile-sized missiles fly through the air in excess of 100 m (107 yd); high-rise buildings have significant structural deformation; incredible phenomena will occur.</td>
</tr>
</tbody>
</table>

Based on the extent ranking factors identified (above), the planning committee ranks the extent of tornados as **LOW**.

**Extent: Hail**

The National Oceanic and Atmospheric Administration and the Tornado and Storm Research Organization (TORRO) have combined efforts to create the Hailstorm Intensity Scale. Table below provides details of this scale.

Table 26-29: Combined NOAA/TORRO Hailstorm Intensity Scale

<table>
<thead>
<tr>
<th>Size Code</th>
<th>Intensity Category</th>
<th>Typical Hail Diameter</th>
<th>Approximate Size</th>
<th>Typical Damage Impacts</th>
</tr>
</thead>
<tbody>
<tr>
<td>H0</td>
<td>Hard Hail</td>
<td>Up to 0.33”</td>
<td>Pea</td>
<td>No damage</td>
</tr>
<tr>
<td>H1</td>
<td>Potentially Damaging</td>
<td>0.33” – 0.60”</td>
<td>Marble or Mothball</td>
<td>Slight damage to plants and crops</td>
</tr>
<tr>
<td>H2</td>
<td>Potentially Damaging</td>
<td>0.60” – 0.80”</td>
<td>Dime or grape</td>
<td>Significant damage to fruit, crops, and vegetation</td>
</tr>
</tbody>
</table>

---

<table>
<thead>
<tr>
<th>H3</th>
<th>Severe</th>
<th>0.80” – 1.20”</th>
<th>Nickel to Quarter</th>
<th>Severe damage to fruit and crops, damage to glass and plastic structures, paint and wood scored</th>
</tr>
</thead>
<tbody>
<tr>
<td>H4</td>
<td>Severe</td>
<td>1.20” – 1.60”</td>
<td>Half Dollar to Ping Pong Ball</td>
<td>Widespread glass damage, vehicle body damage</td>
</tr>
<tr>
<td>H5</td>
<td>Destructive</td>
<td>1.60” – 2.0”</td>
<td>Silver Dollar to Golf Ball</td>
<td>Wholesale destruction of glass, damage to tiled roofs, significant risk of injuries</td>
</tr>
<tr>
<td>H6</td>
<td>Destructive</td>
<td>2.0” – 2.4”</td>
<td>Lime or Egg</td>
<td>Aircraft body dented; brick walls pitted</td>
</tr>
<tr>
<td>H7</td>
<td>Very Destructive</td>
<td>2.4” – 3.0”</td>
<td>Tennis Ball</td>
<td>Severe roof damage, risk of serious injuries</td>
</tr>
</tbody>
</table>
Based on those extent ranking factors identified (above), the planning committee ranks the extent of the hail hazard as **LOW**.

**Extent: Lightning**

The National Weather Service (NWS) uses a Lightning Activity Level (LAL) scale to indicate the frequency and character of cloud-to-ground (C/G) lightning. The scale uses a range of 1 – 6, with 6 being the high end of the scale. Table below provides details of the LAL scale.

Table 26-30: Lightning Activity Level (LAL) Scale\(^{128}\)

<table>
<thead>
<tr>
<th>Rank</th>
<th>Cloud and Storm Development</th>
<th>Areal Coverage</th>
<th>Counts C/G per 5 Minutes</th>
<th>Counts C/G per 15 Minutes</th>
<th>Average C/G per Minute</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>No Thunderstorms</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
</tr>
</tbody>
</table>

# Lightning Activity Level Scale

<table>
<thead>
<tr>
<th>Rank</th>
<th>Cloud and Storm Development</th>
<th>Areal Coverage</th>
<th>Counts C/G per 5 Minutes</th>
<th>Counts C/G per 15 Minutes</th>
<th>Average C/G per Minute</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>Cumulus clouds are common but only a few reaches the towering stage. A single thunderstorm must be confirmed in the rating area. The clouds mostly produce virga, but light rain will occasionally reach ground. Lightning is very infrequent.</td>
<td>&lt;15%</td>
<td>1-5</td>
<td>1-8</td>
<td>&lt;1</td>
</tr>
<tr>
<td>3</td>
<td>Cumulus clouds are common. Swelling and towering cumulus cover less than 2/10 of the sky. Thunderstorms are few, but 2 to 3 occur within the observation area. Light to moderate rain will reach the ground, and lightning is infrequent.</td>
<td>15% to 24%</td>
<td>6-10</td>
<td>9-15</td>
<td>1-2</td>
</tr>
<tr>
<td>4</td>
<td>Swelling cumulus and towering cumulus cover 2-3/10 of the sky. Thunderstorms are scattered but more than three must occur within the observation area. Moderate rain is commonly produced, and lightning is frequent.</td>
<td>25% to 50%</td>
<td>11-15</td>
<td>16-25</td>
<td>2-3</td>
</tr>
<tr>
<td>5</td>
<td>Towering cumulus and thunderstorms are numerous. They cover more than 3/10 and occasionally obscure the sky. Rain is moderate to heavy, and lightning is frequent and intense.</td>
<td>&gt;50%</td>
<td>&gt;15</td>
<td>&gt;25</td>
<td>&gt;3</td>
</tr>
</tbody>
</table>
Based on those extent ranking factors identified (above), the planning committee ranks the extent of the lightning hazard as **LOW**.

**Extent: Thunderstorms that Generate Wind, Tornado, Hail, and Lightning Hazard Events**

Thunderstorms are not explicitly identified as a severe weather category for this hazard profile. However, they are responsible for most tornado, lightning, and hail hazard events – as well as a significant number of wind hazard events – across California and the CSU system. While individual thunderstorms affect relatively small areas, there are many instances in which thunderstorms can cluster together and/or travel in a line over long distances, producing significant damage over large geographic areas.

A thunderstorm is classified as “severe” when certain meteorological parameters within the thunderstorm are reached (i.e., damaging winds or speeds of 58 mph (50 knots) or greater, hail 1 inch in diameter or larger, and/or a tornado). However, there is currently no established, objective severity scale for thunderstorms.\(^ {129} \)\(^ {130} \) That said, according to the *Glossary of Meteorology* published by the American Meteorological Society (AMS), a thunderstorm is reported as *light*, *medium*, or *heavy* according to following five (5) characteristics:

- the nature of the lightning and thunder;
- the type and intensity of the precipitation, if any;
- the speed and gustiness of the wind;
- the appearance of the clouds; and

\(^ {129} \) Retrieved on 07.15.2021 from https://www.noaa.gov/explainers/severe-storms

\(^ {130} \) Retrieved on 07.15.2021 from https://www.weather.gov/safety/thunderstorm
- the effect upon surface temperature.\textsuperscript{131}

A thunderstorm may also be classified by the nature of the overall weather situation in which the thunderstorm is produced, including:

- **Airmass Thunderstorm**: A thunderstorm produced by local convection within an unstable air mass;\textsuperscript{132}
- **Frontal Thunderstorm**: An individual thunderstorm the initiation of which results from rising motion associated with a front, or a thunderstorm within a convective system generated and organized by frontal rising motion;\textsuperscript{133} or
- **Squall-line Thunderstorm**: An individual thunderstorm included within a squall line (i.e., a continuous or broken line of active deep moist convection frequently associated with thunder).\textsuperscript{134, 135}

Based on the extent ranking factors identified (above) in relation to campus layout and operations, and past event low degree of severity, the planning committee ranks the extent of the thunderstorm hazard as **LOW**.

**History of the Hazard**

Severe weather hazards have been an annual occurrence in Stanislaus County and on the Stanislaus State University main campus. Severe weather hazards have also been an annual occurrence in San Joaquin County and on the Stanislaus State University – Stockton satellite campus. Historical data for these hazards are presented below.

**Historical Storm Data Collection: NCEI Storm Events Database**

Historical information regarding severe weather hazards can be found using The National Centers for Environmental Information (NCEI) Storm Events Database. The Storm Events Database contains searchable, archived National Weather Service (NWS) storm data from January 1950 to April 2021, as entered by NOAA’s National Weather Service (NWS). Due to changes in the data collection and processing procedures over time, there are unique

\begin{itemize}
\end{itemize}
periods of record available depending on the event type.\(^{136}\) For example, from 1950 through 1954, only tornado events were recorded; from 1955 through 1995, only tornado, thunderstorm wind, and hail events were introduced into the database; from 1996 to present, 45 additional event types are recorded, including high wind, strong wind, and lightning events.\(^{137}\) To obtain the most accurate portrayal of severe weather event frequency, searches of the Storm Events Database are conducted using data collected since 01/01/1996. As a reminder, all official severe weather event data is at the county level. Severe weather data do not exist at the campus level. That said, it may be the case that the campus to some degree experiences the severe weather events reported for the surrounding community and County.

**Stanislaus County**

**Wind Hazards (excluding Tornadoes)**

Information obtained from the NCEI Storm Event Database website shows the number of events (or occurrences) of wind hazard events in Stanislaus County since 1996.\(^{138}\) Here, wind hazard events include all “High Wind,” “Strong Wind,” and “Thunderstorm Wind” storm reports.\(^{139}\)

- **High Wind:** at least 19 events, or approximately 0.75 events per year\(^ {140}\)
- **Strong Wind:** at least 6 events, or 0.24 events per year\(^ {141}\)


\(^{140}\) National Climatic Data Center. Storm Events Database. Retrieved 07.31.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28Z%29+High+Wind&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=STANISLAUS%3A99&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA

\(^{141}\) National Climatic Data Center. Storm Events Database. Retrieved 07.31.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28Z%29+Strong+Wind&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=STANISLAUS%3A99&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA
- **Thunderstorm Wind:** at least 7 events, or approximately 0.28 events per year\(^{142}\)

- **All Wind Hazard events** (excluding Tornadoes): at least 26 events, or approximately 1.03 events per year.\(^{143}\) (Note: This was determined by conducting a simultaneous search of the component wind hazards of high wind, strong wind and thunderstorm wind.)

Overall, in Stanislaus County, there have been at least 26 wind hazard events since 1996, excluding tornadoes.\(^{144}\) That translates to an approximate average historical frequency of occurrence of 1.03 wind hazard events per year.

Please note: Differences between the sums of individual component severe weather hazard event Database searches (i.e., 32 events) and simultaneous Database searches of all severe weather hazard events (i.e., 26 events) may be due to the following factors: (1) multiple event types are in the same record (e.g., “Thunderstorm Wind/Hail” or “Hail/Tornado;” and/or (2) severe weather hazard events such as “Thunderstorm Wind” or “Hail” that are reported for Stanislaus County have actually taken place hundreds of miles away, but are erroneously recorded as events that have occurred in the County.\(^{145}\) When such a discrepancy arises, the more conservative aggregate hazard wind event value (i.e., 26 events) is used to determine the historical frequency of occurrence for the severe weather hazard. The origin of this discrepancy is unknown at this time.

### Historical Wind Hazard Losses for Stanislaus County since 1996

According to the NCEI Storm Events Database, the wind hazard events that Stanislaus County has experienced since 1996 have been costly. There have been 2 deaths and 5

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\(^{142}\) National Climatic Data Center. Storm Events Database. Retrieved 07.31.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Thunderstorm+Wind&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=STANISLAUS%3A99&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA

\(^{143}\) National Climatic Data Center. Storm Events Database. Retrieved 07.31.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28Z%29+High+Wind&eventType=%28Z%29+Strong+Wind&eventType=%28C%29+Thunderstorm+Wind&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=STANISLAUS%3A99&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA

\(^{144}\) National Climatic Data Center. Storm Events Database. Retrieved 07.31.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28Z%29+High+Wind&eventType=%28Z%29+Strong+Wind&eventType=%28C%29+Thunderstorm+Wind&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=STANISLAUS%3A99&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA

injuries, and property damage estimates have totaled approximately $5,213,000; no crop damage has been reported.146

**Tornado Wind Hazards**

Information from the NCEI Storm Events Database indicates that since 1996, there have been 7 reported events of tornadoes in Stanislaus County, which translates to approximately 0.28 tornado events per year.147 Almost half of the tornadoes have had severity ratings of F1/EF1, while the remaining tornadoes have been rated F0/EF0.148

**Historical Tornado Hazard Losses for Stanislaus County since 1996**

According to the NCEI Storm Events Database, the tornado hazard events that Stanislaus County has experienced since 1996 have been costly. While there have been no deaths or injuries, property and crop damage estimates have totaled approximately $1,046,000 and $200,000, respectively.149

**Hail**

Information from the NCEI Storm Events Database indicates that since 1996, there have been 4 reported events of hail in Stanislaus County, which translates to approximately 0.16 hail events per year.150 (Note: The NCEI Storm Event Database search results for hail

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146 National Climatic Data Center. Storm Events Database. Retrieved 07.31.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28Z%29+High+Wind&eventType=%28Z%29+Strong+Wind&eventType=%28Z%29+Thunderstorm+Wind&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=STANISLAUS%3A99&hailfilter=0.00&tornfilter=0&windfilter=0&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA

147 National Climatic Data Center. Storm Events Database. Retrieved 07.31.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Tornado&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=STANISLAUS%3A99&hailfilter=0.00&tornfilter=0&windfilter=0&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA

148 National Climatic Data Center. Storm Events Database. Retrieved 07.31.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Tornado&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=STANISLAUS%3A99&hailfilter=0.00&tornfilter=0&windfilter=0&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA

149 National Climatic Data Center. Storm Events Database. Retrieved 07.31.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Tornado&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=STANISLAUS%3A99&hailfilter=0.00&tornfilter=0&windfilter=0&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA

150 National Climatic Data Center. Storm Events Database. Retrieved 07.31.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Hail&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=STANIS
indicate that there has been a total of five (5) reports of hail since 1996. However, one (1) entry is for a hail event in San Diego County, hundreds of miles away from Stanislaus County. The origin of this error is unknown at this time.)

**Historical Hail Hazard Losses for Stanislaus County since 1996**

According to the NCEI Storm Events Database, the hail hazard events that Stanislaus County has experienced since 1996 have been moderate. There have been no deaths, injuries, or crop damage, and property damage estimates have totaled approximately $5,110.151 (Note: The San Diego County hail event that was included erroneously in the search results for hail hazard events in Stanislaus County accounted for all injuries (i.e., 5) and crop damage estimates (i.e., $300,000) presented in the search results.)

**Lightning**

Information from the NCEI Storm Events Database indicates that since 1996, there have been three (3) reported events of lightning in Stanislaus County, which translates to approximately 0.12 lightning events per year.152

**Historical Lightning Hazard Losses for Stanislaus County since 1996**

According to the NCEI Storm Events Database, the lightning hazard events that Stanislaus County has experienced since 1996 have been costly. While there have been no deaths, injuries, or crop losses, property damage estimates have totaled approximately $220,000.153

**All Severe Weather Hazard Events Recorded by the NCEI Storm Events Database (Stanislaus County)**

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151 National Climatic Data Center. Storm Events Database. Retrieved 07.31.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Hail&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=STANISLAUS%3A99&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA

152 National Climatic Data Center. Storm Events Database. Retrieved 07.31.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Lightning&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=STANISLAUS%3A99&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA

153 National Climatic Data Center. Storm Events Database. Retrieved 07.31.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Lightning&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=STANISLAUS%3A99&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA
Information obtained from the NCEI Storm Events Database indicates that there have been 40 occurrences of the severe weather hazard in Stanislaus County. This translates to 1.58 severe weather hazard occurrences per year.\textsuperscript{154}

Please note: Differences between the sums of individual component severe weather hazard event Database searches (i.e., 47 events) and simultaneous Database searches of all severe weather hazard events (i.e., 40 events) may be due to the following factors: (1) multiple event types are in the same record (e.g., "Thunderstorm Wind/Hail" or "Hail/Tornado;" and/or (2) severe weather hazard events such as “Thunderstorm Wind” or “Hail” that are reported for Stanislaus County have actually taken place hundreds of miles away, but are erroneously recorded as events that have occurred in the County.\textsuperscript{155}

When such a discrepancy arises, the more conservative aggregate hazard wind event value (i.e., 40 events) is used to determine the historical frequency of occurrence for the severe weather hazard. The origin of this discrepancy is unknown at this time.

**Historical, Aggregated Severe Hazard Losses for Stanislaus County since 1996**

According to the NCEI Storm Events Database, the severe weather events that Stanislaus County has experienced since 1996 have been costly. There have been 2 deaths and 5 injuries, and property and crop damage estimates have totaled approximately $6,484,000 and $200,000, respectively.\textsuperscript{156} It is important to note that for all Stanislaus County severe weather hazard events recorded on the Storm Events Database, all deaths and injuries, as well as over 80% of all estimated property damages, have been attributed to wind hazard events alone. All reported crop damages have been attributed solely to lightning hazard events.

**San Joaquin County**

*Wind Hazards (excluding Tornadoes)*

\textsuperscript{154} National Climatic Data Center. Storm Events Database. Retrieved 07.31.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29%2C+Hail&eventType=%28Z%29%2C+High+Wind&eventType=%28C%29%2C+Lightning&eventType=%28Z%29%2C+Strong+Wind&eventType=%28C%29%2C+Thunderstorm+Wind&eventType=%28C%29%2C+Tornado&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=STANISLAUS%3A99&hailfilter=0.00&torndfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA


\textsuperscript{156} National Climatic Data Center. Storm Events Database. Retrieved 07.31.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29%2C+Hail&eventType=%28Z%29%2C+High+Wind&eventType=%28C%29%2C+Lightning&eventType=%28Z%29%2C+Strong+Wind&eventType=%28C%29%2C+Thunderstorm+Wind&eventType=%28C%29%2C+Tornado&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=STANISLAUS%3A99&hailfilter=0.00&torndfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA
Information obtained from the NCEI Storm Event Database website shows the number of events (or occurrences) of wind hazard events in San Joaquin County since 1996.\(^{157}\) Here, wind hazard events include all “High Wind,” “Strong Wind,” and “Thunderstorm Wind” storm reports.\(^{158}\)

- **High Wind:** at least 39 events, or approximately 1.54 events per year\(^ {159}\)
- **Strong Wind:** at least 10 events, or 0.39 events per year\(^ {160}\)
- **Thunderstorm Wind:** at least 8 events, or approximately 0.32 events per year\(^ {161}\)
- **All Wind Hazard events:** (excluding Tornadoes): at least 51 events, or approximately 2.01 events per year.\(^ {162}\) (Note: This was determined by conducting a simultaneous search of the component wind hazards of high wind, strong wind and thunderstorm wind.)

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\(^{159}\) National Climatic Data Center. Storm Events Database. Retrieved on 08.05.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28Z%29+High+Wind&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=SAN%2BJOQUIN%3A77&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA

\(^{160}\) National Climatic Data Center. Storm Events Database. Retrieved on 08.05.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28Z%29+Strong+Wind&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=SAN%2BJOQUIN%3A77&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA

\(^{161}\) National Climatic Data Center. Storm Events Database. Retrieved on 08.05.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Thunderstorm+Wind&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=SAN%2BJOQUIN%3A77&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA

\(^{162}\) National Climatic Data Center. Storm Events Database. Retrieved on 08.05.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28Z%29+High+Wind&eventType=%28Z%29+Strong+Wind&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=SAN%2BJOQUIN%3A77&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA
Overall, in San Joaquin County, there have been at least 51 wind hazard events since 1996, excluding tornadoes.¹⁶³ That translates to an approximate average historical frequency of occurrence of 2.01 wind hazard events per year.

Please note: Differences between the sums of individual component severe weather hazard event Database searches (i.e., 57 events) and simultaneous Database searches of all severe weather hazard events (i.e., 51 events) may be due to the following factors: (1) multiple event types are in the same record (e.g., "Thunderstorm Wind/Hail" or "Hail/Tornado;" and/or (2) severe weather hazard events such as “Thunderstorm Wind“ or “Hail” that are reported for San Joaquin County have actually taken place hundreds of miles away, but are erroneously recorded as events that have occurred in the County.¹⁶⁴ When such a discrepancy arises, the more conservative aggregate hazard wind event value (i.e., 51 events) is used to determine the historical frequency of occurrence for the severe weather hazard. The origin of this discrepancy is unknown at this time.

**Historical Wind Hazard Losses for San Joaquin County since 1996**

According to the NCEI Storm Events Database, the wind hazard events that San Joaquin County has experienced since 1996 have been costly. There have been three (3) deaths and five (5) injuries, and property and crop damage estimates have totaled approximately $7,123,000 and $2,000, respectively.¹⁶⁵

**Tornado Wind Hazards**

Information from the NCEI Storm Events Database indicates that since 1996, there have been eight (8) reported events of tornadoes in San Joaquin County, which translates to

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¹⁶³ National Climatic Data Center. Storm Events Database. Retrieved on 08.05.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28Z%29+High+Wind&eventType=%28Z%29+Strong+Wind&eventType=%28C%29+Thunderstorm+Wind&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=SAN%2BJOAQUIN%3A77&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitButton=Search&statefips=6%2CCALIFORNIA


¹⁶⁵ National Climatic Data Center. Storm Events Database. Retrieved on 08.05.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28Z%29+High+Wind&eventType=%28Z%29+Strong+Wind&eventType=%28C%29+Thunderstorm+Wind&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=SAN%2BJOAQUIN%3A77&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitButton=Search&statefips=6%2CCALIFORNIA
approximately 0.32 tornado events per year.\textsuperscript{166} All tornadoes reported in San Joaquin County since 1996 have had severity ratings of F0/EF0.\textsuperscript{167}

**Historical Tornado Hazard Losses for San Joaquin County since 1996**

According to the NCEI Storm Events Database, the tornado hazard events that San Joaquin County has experienced since 1996 have been costly. While there have been no deaths or injuries, property and crop damage estimates have totaled approximately $41,000 and $80,000, respectively.\textsuperscript{168}

**Hail**

Information from the NCEI Storm Events Database indicates that since 1996, there have been two (2) reported events of hail in San Joaquin County, which translates to approximately 0.08 hail events per year.\textsuperscript{169} (Note: The NCEI Storm Event Database search results for hail indicate that there has been a total of three (3) reports of hail since 1996. However, one (1) entry is for a hail event in San Diego County, hundreds of miles away from San Joaquin County. The origin of this error is unknown at this time.)

**Historical Hail Hazard Losses for San Joaquin County since 1996**

According to the NCEI Storm Events Database, there have been no deaths, injuries, property damages, or crop damages since 1996 attributed to hail hazard events.\textsuperscript{170} (Note:

\begin{itemize}
  \item 166 National Climatic Data Center. Storm Events Database. Retrieved on 08.05.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Tornado&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=SAN%2BJOAQUIN%3A77&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA
  \item 167 National Climatic Data Center. Storm Events Database. Retrieved on 08.05.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Tornado&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=SAN%2BJOAQUIN%3A77&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA
  \item 168 National Climatic Data Center. Storm Events Database. Retrieved on 08.05.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Hail&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=SAN%2BJOAQUIN%3A77&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA
  \item 169 National Climatic Data Center. Storm Events Database. Retrieved on 08.05.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Hail&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=SAN%2BJOAQUIN%3A77&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA
  \item 170 National Climatic Data Center. Storm Events Database. Retrieved on 08.05.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Hail&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=SAN%2BJOAQUIN%3A77&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA
\end{itemize}
The San Diego County hail event that was included erroneously in the search results for hail hazard events in San Joaquin County accounted for all injuries (i.e., 5) and crop damage estimates (i.e., $300,000) presented in the search results.

Lightning

Information from the NCEI Storm Events Database indicates that since 1996, there have been two (2) reported events of lightning in San Joaquin County, which translates to approximately 0.08 lightning events per year.\(^{171}\)

Historical Lightning Hazard Losses for San Joaquin County since 1996

According to the NCEI Storm Events Database, the lightning hazard events that San Joaquin County has experienced since 1996 have been costly. While there have been no lightning-related deaths, property damage, or crop damage reported, there have been four (4) injuries.\(^{172}\)

All Severe Weather Hazard Events Recorded by the NCEI Storm Events Database (San Joaquin County)

Information obtained from the NCEI Storm Events Database indicates that there have been 63 occurrences of the severe weather hazard in San Joaquin County since 1996. This translates to 2.49 severe weather hazard occurrences per year.\(^{173}\)

Please note: Differences between the sums of individual component severe weather hazard event Database searches (i.e., 70 events) and simultaneous Database searches of all severe weather hazard events (i.e., 63 events) may be due to the following factors: (1)
multiple event types are in the same record (e.g., "Thunderstorm Wind/Hail" or "Hail/Tornado;" and/or (2) severe weather hazard events such as “Thunderstorm Wind” or “Hail” that are reported for San Joaquin County have actually taken place hundreds of miles away, but are erroneously recorded as events that have occurred in the County. When such a discrepancy arises, the more conservative aggregate hazard wind event value (i.e., 63 events) is used to determine the historical frequency of occurrence for the severe weather hazard. The origin of this discrepancy is unknown at this time.

Historical, Aggregated Severe Hazard Losses for San Joaquin County since 1996

According to the NCEI Storm Events Database, the severe weather events that San Joaquin County has experienced since 1996 have been costly. There have been three (3) deaths and nine (9) injuries, and property and crop damage estimates have totaled approximately $7,165,000 and $82,000, respectively. It is important to note that for all San Joaquin County severe weather hazard events recorded on the Storm Events Database, all deaths, five (5) out of nine (9) all injuries, and almost all (99.4%) of all property damage estimates have been attributed to wind hazard events alone. Lighting events have been associated with the remaining four (4) injuries, and almost all (i.e., 97.6%) of the reported crop damage estimates have been attributed to one (1) tornado event in 2005.

Wind Hazards Not Included in the NCEI Storm Events Database

Santa Ana Winds

Santa Ana wind events occur at least twice per month from October through April. From 1948 to 2012, total of 2056 events on the 65-year record were recorded in the Southern California region, yielding an average of 32 occurrences per year. Typical Santa Ana wind events last 1–2 days and represent 27% of the occurrences, with events lasting


175 National Climatic Data Center. Storm Events Database. Retrieved on 08.05.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Hail&eventType=%28Z%29+High+Wind&eventType=%28C%29+Lightning&eventType=%28Z%29+Strong+Wind&eventType=%28C%29+Thunderstorm+Wind&eventType=%28C%29+Tornado&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=SAN%2BJOAQUIN%3A77&hailfilter=0.00&tornfilter=0.0&windfilter=0.000&sort=DT&submitButton=Search&statefips=6%2CCALIFORNIA

up to 6 days accounting for 90% of all occurrences. The remaining 10% are made up almost entirely of events lasting between 7 and 12 days.\footnote{177} \footnote{178}

Figure below shows the mean monthly frequency per season of Santa Ana Wind events detected from 1948 to 2012. Extreme Santa Ana wind events are shown in dark red, and are defined as those events that are above the 90th percentile of all events on record.

**Diablo Winds**

Diablo wind events occur approximately 2.5 events per year. These events are most frequent during the fall and early winter seasons, with the highest frequency of events occurring in October. As a result, the highest risk of Diablo-wind-related damage is in the fall and early winter.  

Figure below shows the monthly frequency of Diablo winds (along with average live fuel moisture content). The Diablo Wind data are derived from a 17-year climatology of San Francisco Bay Area regional surface weather stations.\textsuperscript{182}

Figure 26-18: Monthly Frequency of Diablo Winds and Average Live Fuel Moisture Content (Dashed Line)\textsuperscript{183}

\textbf{Sundowner Winds}

Strong sundowner wind events occur approximately 2-3 times per year. These events can create sharp temperature rises, local gale force winds, and significant weather-related problems. Rare, “explosive” types of sundowner wind events occur about 6 times per century that present dangerous weather situations, generating extremely strong and hot winds that can reach gale force or higher speeds.\textsuperscript{184}

\textbf{Historical Frequency of All Severe Weather Hazards}

Table below shows the average historical frequency of severe weather hazard events for Stanislaus County since 1996.)

\begin{table}[h]
\centering
\begin{tabular}{|c|c|c|c|c|c|c|c|c|}
\hline
Month & Jan & Feb & Mar & Apr & May & Jun & Jul & Aug & Sep \\
\hline
Frequency & 0.5 & 0.5 & 0.5 & 0.5 & 0.5 & 0.5 & 0.5 & 0.5 & 0.5 \\
\hline
\end{tabular}
\end{table}

\begin{table}[h]
\centering
\begin{tabular}{|c|c|c|c|c|c|c|c|c|}
\hline
Live Fuel Moisture (%) & 70 & 80 & 90 & 100 & 110 & 120 & 130 \\
\hline
\end{tabular}
\end{table}

\textsuperscript{182} Retrieved on 07.15.2021 from https://www.fireweather.org/diablo-winds

\textsuperscript{183} Retrieved on 07.13.2021 from https://www.fireweather.org/diablo-winds

### Table 26-31: Severe Weather Hazard Event

Frequencies for Stanislaus County since 1996.

<table>
<thead>
<tr>
<th>Severe Weather Hazard Category</th>
<th>Average Number of Hazard Events Per Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wind (Includes High, Strong and Thunderstorm Winds ONLY)</td>
<td>1.03</td>
</tr>
<tr>
<td>Tornado</td>
<td>0.28</td>
</tr>
<tr>
<td>Hail</td>
<td>0.16</td>
</tr>
<tr>
<td>Lightning</td>
<td>0.12</td>
</tr>
<tr>
<td>Diablo Wind</td>
<td>2.5</td>
</tr>
<tr>
<td>Santa Ana Wind*</td>
<td>32</td>
</tr>
<tr>
<td>Sundowner Wind*</td>
<td>2 to 3</td>
</tr>
</tbody>
</table>

* Note: The Santa Ana and Sundowner wind hazards are not present in Stanislaus County. They are included here for information purposes only.

Table below shows the average historical frequency of severe weather hazard events for San Joaquin County since 1996.)

### Table 26-32: Severe Weather Hazard Event

Frequencies for San Joaquin County since 1996.

<table>
<thead>
<tr>
<th>Severe Weather Hazard Category</th>
<th>Average Number of Hazard Events Per Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wind (Includes High, Strong and Thunderstorm Winds ONLY)</td>
<td>2.01</td>
</tr>
<tr>
<td>Tornado</td>
<td>0.32</td>
</tr>
<tr>
<td>Hail</td>
<td>0.08</td>
</tr>
<tr>
<td>Lightning</td>
<td>0.08</td>
</tr>
</tbody>
</table>
Diablo Wind  
Santa Ana Wind*  
Sundowner Wind*  

* Note: The Santa Ana and Sundowner wind hazards are not present in San Joaquin County. They are included here for information purposes only.

Potential Impacts of the Hazard

The significance (or priority) of a hazard’s potential impacts is based primarily on the frequency and resulting damage caused by the hazard, including deaths/injuries and property, crop, and economic damage. All assets and people within Stanislaus State University campus areas are at risk from the effects of severe weather hazards.

**Wind Hazards (Including Tornadoes)**

Wind hazard events have the potential to impact people, property, and operations on campuses across the CSU system. People caught in the open during an extreme wind event are exposed to high winds and debris, and could be injured or killed.

The habitability of buildings can be compromised (by damaging roofs, windows, or other weak points in the building envelope), leading to long-term operational issues for the campus. As with most university campuses, space is always at a premium at the Stanislaus State University campus, and the loss of any currently utilized space due to building or structural damage would likely disrupt operations and the University’s mission.

Extreme wind events can result in power failure, which would impact the operation of the campus. Fallen tree limbs and other potential transportation hazards may also cause disruption to the surrounding community and limit ingress/egress to the campus.

**Stanislaus State University Main Campus, Turlock (Stanislaus County)**

The 2017 Stanislaus County Local Hazard Mitigation Plan does not profile wind hazards (including tornadoes), as they are not considered to be significant severe weather hazards for Stanislaus County. As a result, wind hazards are considered to be of low significance, and therefore to have a minimal potential impact on the County and (by extension) the Stanislaus State University main campus.  

**Stanislaus State University – Stockton Campus, Stockton (San Joaquin County)**

The 2018 San Joaquin County Local Hazard Mitigation Plan does not profile wind hazards (including tornadoes), as they are not considered to be significant severe weather hazards for San Joaquin County. As a result, wind hazards are considered to be of low significance, and therefore to have a minimal potential impact on the County and (by extension) the Stanislaus State University – Stockton campus.186

**Hail**

Hail typically impacts property by damaging structures, cars, and utilities as it falls. Dents in cars, broken glass, and holes in roofs are common impacts of hail. Injuries to people from hail are less common, though they can happen, as hail is a hard object falling in an unpredictable manner at a fairly high rate of speed.

**Stanislaus State University Main Campus, Turlock (Stanislaus County)**

The 2017 Stanislaus County Local Hazard Mitigation Plan does not profile hail, as it is not considered to be a significant severe weather hazard for Stanislaus County. As a result, the hail hazard is considered to be of low significance, and therefore to have a minimal potential impact on the County and (by extension) the Stanislaus State University main campus.187

**Stanislaus State University – Stockton Campus, Stockton (San Joaquin County)**

The 2018 San Joaquin County Local Hazard Mitigation Plan does not profile hail, as it is not considered to be a significant severe weather hazard for San Joaquin County. As a result, the hail hazard is considered to be of low significance, and therefore to have a minimal potential impact on the County and (by extension) the Stanislaus State University – Stockton Campus.188

**Lightning**

Lightning strikes the United States about 20-25 million times a year.189 Although most lightning occurs in the summer months, people can be struck at any time of year. Since 1990, lightning has killed an average of 39 people each year in the United States, and hundreds more have been injured.190 Property losses due to lightning have been very

costly across the U.S. For example, from 2005 through 2020, U.S. homeowner’s insurance claim payouts for lightning losses totaled approximately $15,334,600,000, or $958,412,500 worth of payouts per year.\(^{191}\) (Commercial claim payouts for lightning losses for the U.S. were not available.)

**Stanislaus State University Main Campus, Turlock (Stanislaus County)**

The 2017 Stanislaus County Local Hazard Mitigation Plan does not profile lightning, as it is not considered to be a significant severe weather hazard for Stanislaus County. As a result, the lightning hazard is considered to be of low significance, and therefore to have a minimal potential impact on the County and (by extension) on the Stanislaus State University main campus.\(^{192}\)

**Stanislaus State University – Stockton Campus, Stockton (San Joaquin County)**

The 2018 San Joaquin County Local Hazard Mitigation Plan does not profile hail, as it is not considered to be a significant severe weather hazard for San Joaquin County. As a result, the hail hazard is considered to be of low significance, and therefore to have a minimal potential impact on the County and (by extension) the Stanislaus State University – Stockton campus.\(^{193}\)

**Probability of Future Occurrence of the Hazard**

Areas throughout California, including all California State University (CSU) campuses, experience severe weather events every year. Future occurrences of such events are projected to increase in both their frequency and intensity.

**Stanislaus State University Main Campus, Turlock (Stanislaus County)**

The 2017 Stanislaus County Local Hazard Mitigation Plan does not address any severe weather hazards, as severe weather is not considered to be a hazard with significant potential to occur in the County.\(^{194}\) However, according to the NCEI Storm Events Database, some of these same severe weather hazards have occurred in Stanislaus County at least once per year. Furthermore, while the severe weather hazard is a non-spatial hazard that affects all areas of the Stanislaus State University main campus equally, the smallest geographic unit of measurement for almost all official severe weather event data is at the county level. Because the severe weather data used in this assessment do not exist at the campus level, it is assumed that the severe weather

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probabilities for the Stanislaus State University main campus reflect those of the surrounding community and County identified in the Table below.

Based on the data available from both the 2017 Stanislaus County Local Hazard Mitigation Plan and the NCEI Storm Events Database, the severe weather hazard is expected to occur on (or otherwise impact) the Stanislaus State University campus at least once on an annual basis. Therefore, the probability of future occurrence of the severe weather hazard for the Stanislaus State University main campus is HIGHLY LIKELY.

**Stanislaus State University – Stockton Campus, Stockton (San Joaquin County)**

The 2018 San Joaquin County Local Hazard Mitigation Plan does not address any severe weather hazards, as severe weather is not considered to be a hazard with significant potential to occur in the County. However, during the hazard assessment stage of Plan development in 2017, the hazard mitigation planning team provided qualitative rankings of all known hazards in the County; both “High Winds” and “Tornadoes/Thunderstorms” hazards received overall rankings of “Occasional/Likely.” However, according to the NCEI Storm Events Database, wind hazards have occurred in San Joaquin County more than once per year. Furthermore, while the severe weather hazard is a non-spatial hazard that affects all areas of the Stanislaus State University – Stockton campus equally, the smallest geographic unit of measurement for almost all official severe weather event data is at the county level. Because the severe weather data used in this assessment do not exist at the campus level, it is assumed that the severe weather probabilities for the Stanislaus State University – Stockton campus reflect those of the surrounding community and County identified in the Table below.

Based on the data available from both the 2018 San Joaquin County Local Hazard Mitigation Plan and the NCEI Storm Events Database, the severe weather hazard is expected to occur on (or otherwise impact) the Stanislaus State University – Stockton campus at least once on an annual basis. Therefore, the probability of future occurrence of the severe weather hazard for Stanislaus State University – Stockton is HIGHLY LIKELY.

**Stanislaus State University – All Campus Areas**

The probability of future occurrence of the severe weather hazard for all Stanislaus State University campus areas is HIGHLY LIKELY.

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The following tables show the probabilities of future occurrence for component severe weather hazards for Stanislaus State University campuses in Stanislaus County and San Joaquin County.

Table 33: Severe Weather Hazard Probabilities of Future Occurrence for Stanislaus County and Stanislaus State University.

<table>
<thead>
<tr>
<th>Severe Weather Hazard Category</th>
<th>Average Number of Hazard Events Per Year</th>
<th>Probability of Future Occurrence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wind (Includes High, Strong and Thunderstorm Winds ONLY)</td>
<td>1.03</td>
<td>Highly Likely</td>
</tr>
<tr>
<td>Tornado</td>
<td>0.28</td>
<td>Possible</td>
</tr>
<tr>
<td>Hail</td>
<td>0.16</td>
<td>Possible</td>
</tr>
<tr>
<td>Lightning</td>
<td>0.12</td>
<td>Possible</td>
</tr>
<tr>
<td>Diablo Wind</td>
<td>2.5</td>
<td>Highly Likely</td>
</tr>
<tr>
<td>Santa Ana Wind**</td>
<td>32</td>
<td>Not Rated</td>
</tr>
<tr>
<td>Sundowner Wind**</td>
<td>2 to 3</td>
<td>Not Rated</td>
</tr>
<tr>
<td>** Severe Weather Hazard</td>
<td>** Highly Likely</td>
<td></td>
</tr>
</tbody>
</table>

** Note: The Santa Ana and Sundowner wind hazards are not present in Stanislaus County, and therefore are not rated for probability of future occurrence. They are included here for information purposes only.
Table 26-34: Probabilities of Future Occurrence for San Joaquin County and Stanislaus State University – Stockton Campus.

<table>
<thead>
<tr>
<th>Severe Weather Hazard Category</th>
<th>Average Number of Hazard Events Per Year</th>
<th>Probability of Future Occurrence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wind (Includes High, Strong and Thunderstorm Winds ONLY)</td>
<td>2.01</td>
<td>Highly Likely</td>
</tr>
<tr>
<td>Tornado</td>
<td>0.32</td>
<td>Possible</td>
</tr>
<tr>
<td>Hail</td>
<td>0.08</td>
<td>Unlikely</td>
</tr>
<tr>
<td>Lightning</td>
<td>0.08</td>
<td>Unlikely</td>
</tr>
<tr>
<td>Diablo Wind</td>
<td>2.5</td>
<td>Highly Likely</td>
</tr>
<tr>
<td>Santa Ana Wind**</td>
<td>32</td>
<td>Not Rated</td>
</tr>
<tr>
<td>Sundowner Wind**</td>
<td>2 to 3</td>
<td>Not Rated</td>
</tr>
</tbody>
</table>

** Note: The Santa Ana and Sundowner wind hazards are not present in San Joaquin County, and therefore are not rated for probability of future occurrence. They are included here for information purposes only.

Vulnerability to the Hazard

People, structures, and assets on both Stanislaus State University campuses are all vulnerable to the impacts associated with severe weather. Infrastructure can be damaged or destroyed by hail, wind, tornadoes, thunderstorms, and lightning, which can result in service interruptions and outages. Structures can be damaged or destroyed by hail, wind, tornadoes, thunderstorms, and lightning. People can be injured or killed by lightning, flying debris, hail, or extreme wind events. Stanislaus State University also has vehicles that are all vulnerable to a severe weather event.

Estimate of Potential Losses

Severe weather is a non-spatial hazard that affects both Stanislaus State University campuses. Each of the hazards associated with severe weather can result in losses throughout the planning area.
All structures at both Stanislaus State University campuses are at risk from severe weather. There are approximately 133 buildings that could be damaged by wind, hail, and/or lightning. If even a fraction of these assets were to be damaged, the resulting estimated losses would still be in the millions of dollars. The total replacement costs due to severe weather hazard are $162,376,793 for 86 buildings, and are unknown for the remaining 47 buildings. An analysis of projected dollar losses to campus buildings from severe weather as a percentage of building replacement costs is also not currently available, though CSU leadership may pursue such data in the future.

The population at Stanislaus State University varies throughout the day. As of Fall, 2019, Stanislaus State University had a total of 10,614 students and 1,276 faculty and staff. All are at risk from severe weather events, with 11,890 being directly vulnerable in this scenario.

Vulnerability Assessment Conclusions

Severe weather presents a variety of hazards to both Stanislaus State University campuses. People, assets, infrastructure, and vehicles can all be damaged by this hazard, and losses can quickly begin to rise. In the aggregate, severe weather is a frequently occurring hazard (mostly in the form of wind hazard events) that presents a variety of risks to Stanislaus State University.

It is evident that Stanislaus State University has vulnerabilities to and risks from severe weather hazard incidents, and that pre-event planning, communication, and mitigation efforts should be implemented. Public education and outreach regarding areas of shelter that could be used by campus populations during severe weather events is considered by campus leadership to be one viable mitigation option. The campus planning committee will continue to look for feasible and cost-effective options for the mitigation of severe weather risks going forward.

Identified Data Limitations

Numerous federal agencies maintain a variety of records regarding losses associated with hazards. Unfortunately, no single source is considered to offer a definitive accounting of all losses. The Federal Emergency Management Agency (FEMA) maintains records on federal expenditures associated with declared major disasters. The US Army Corps of Engineers (USACE) and the Natural Resources Conservation Service (NRCS) collect data on losses during the course of some of their ongoing projects and studies. Additionally, the National Oceanic and Atmospheric Administration’s (NOAA) National Centers for Environmental Information (NCEI) collects and maintains data about natural


hazards in summary format, as well as occurrences, dates, injuries, deaths, and estimated costs for individual storm events. Many of these databases and other data collection services, including the NCEI, have inherent data limitations when searching for information at a scale as small as a single campus.

The best available data and records have been used throughout this section. Where no data or records exist or could be located, that deficiency is noted.
26.4 Social Resilience Assessment

Overview

While every person is vulnerable to risk, individuals from diverse populations such as those with access and functional needs are disproportionately more vulnerable and may be at a higher risk to harm in a disaster event. In addition to physical vulnerabilities, the intersectionality between physical hazard risks and population social vulnerabilities must be considered to holistically address overall campus risk.

As inclusivity is a high priority for CSU, addressing campus risk and resilience must be done through the lens of inclusion and equity. Addressing social vulnerability is an increasingly critical requirement of state and national doctrines and described in Section 4.4 of the HVRA Base Plan. Every individual of the campus’s richly diverse population group needs to have the capacity, skills, and knowledge in order to understand, access, and participate in risk reduction and disaster response in ways that are meaningful to their own unique situation. In a campus community, having strong social support networks and active involvement in community disaster responses may negatively or positively impact these opportunities and reduce the resilience-building process. This section offers a glimpse into the Stanislaus State University campus’s unique social construct, population demographics, strengths and concerns and presents a high-level assessment of the resilience, coping capacities and potential social vulnerabilities of students, staff and faculty. The research variables that were asked are often considered sensitive subjects, and few are traditionally included in emergency management/hazard mitigation planning.

This social resilience assessment of college campuses is the first of its kind in the nation. The research methodology unfolded as the interviews with campuses progressed. The assessment data presented are not definitive or authoritative. The answers, analysis, and suggested trends are strictly indicators for potential social risk. They do not represent an accurate data capture as limitations on the data gathering process influenced an ability to provide accuracy. This assessment provides indications of increased risk, not accuracy of response or a true reflection of the situation of the campus. The information presented is to be considered in the context of the more detailed system-wide CSU social vulnerability assessment that is included in the baseline HVRA.

Campus-Identified Populations of Concern

During the campus interview, the following responses were provided when asked, “In considering the diverse population group(s) amongst student body, faculty and staff, which are of the most concern in your emergency management planning?”

Note: CSU Bakersfield was early interview, so interview process and question structure were not yet fully defined enough to include this section.
Resilience Variables Related to Campus Emergency Management

The interviewees were asked to reflect on a set of 12 variables for the campus populations of student, faculty and staff: homelessness (*housing insecurity*), food security, health and wellness, disability/access and functional needs (AFN), racial equity, digital equity, communications, international students, immigrants/immigration status issues (*undocumented, DACA, etc.*), LGBTQI (Lesbian Gay Bisexual Transgender Questioning (or queer) Intersex), and transportation dependency. They were also offered an opportunity to add any other factor they wanted to include. The following two questions were asked:

- Is this factor a particular issue of concern for emergency management on your campus? Responses were summarized as *Very High, High, Medium, Low*
- Is this factor reflected in the emergency plans and processes for your campus? Responses were summarized as *Yes, No, In Progress, NA*

In order to provide a high-level qualitative response for the answers, the approach of averaging response was taken. If conflicting answers were expressed by the interviewees, the answer (code) was averaged out. A detailed explanation of the response averaging approach is included in the base HVRA.
Table 26-35: Graph of campus-specific emergency management issues of concern and inclusion in emergency management plans and processes.

<table>
<thead>
<tr>
<th>Issue of Concern</th>
<th>Issue of Concern</th>
<th>Plans &amp; Processes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Homelessness (Housing Insecurity)</td>
<td>Low</td>
<td>N/A</td>
</tr>
<tr>
<td>Food Security</td>
<td>Low</td>
<td>No</td>
</tr>
<tr>
<td>Health &amp; Wellness</td>
<td>Medium</td>
<td>In Progress</td>
</tr>
<tr>
<td>AFN</td>
<td>Low</td>
<td>Yes</td>
</tr>
<tr>
<td>Digital Equity</td>
<td>Low</td>
<td>No</td>
</tr>
<tr>
<td>Comms.</td>
<td>Low</td>
<td>No</td>
</tr>
<tr>
<td>International Students / Immigrants / Immigration Status</td>
<td>Medium</td>
<td>No</td>
</tr>
<tr>
<td>LGBTQI</td>
<td>Low</td>
<td>No</td>
</tr>
</tbody>
</table>

Qualitative Narrative: Campus Overview of Potential Resilience Vulnerabilities

The following are interview notes of interest:

- EOP has only one paragraph on AFN.
- Seeing a spike now in health and wellness issues. They have rep on the infectious response team and in EOC and talk all the time with county EOC.
- Counselors are available through Telehealth services.
- EAP is encouraged because the isolation is affecting people; can provide services. Student health center is small, and employees are in the high-risk category, but reached out to another health care provider and doing telehealth – so services are available.
- Trained with county for a Point of Distribution (POD).
- Support possible for first responders for isolation.
- Been asked by American Red Cross to be a shelter, if needed.
This section provides a brief introduction to the link between socially vulnerable populations and a particular hazard type. While extensive research has been conducted on the impacts of hazards, not all linkages have been documented or published, and detail for finding them are beyond the scope of this assessment. It’s important to note, the intersectional nature of what makes an individual’s personal experience and resilience to an event is played out by unique factors for that individual or population. The nuanced social vulnerabilities often come from the social and physical environment in which a person is embedded.

In order to aid in further assessing campus resilience, below is a general description of the known impacts. From some hazards, the descriptions are robust, while others are only brief introductions.

Table 26-36: Stanislaus State University *Highly Likely, Likely* and *Potential* Hazards

<table>
<thead>
<tr>
<th>Hazard</th>
<th>Future Occurrence Probability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Communicable Disease</td>
<td>Highly Likely</td>
</tr>
<tr>
<td>Drought</td>
<td>Highly Likely</td>
</tr>
<tr>
<td>Earthquake</td>
<td>Possible</td>
</tr>
<tr>
<td>Erosion</td>
<td>Likely</td>
</tr>
<tr>
<td>Extreme Temperature</td>
<td>Possible (Heat only)</td>
</tr>
<tr>
<td>Flood</td>
<td>Possible</td>
</tr>
<tr>
<td>Power Outage</td>
<td>Likely</td>
</tr>
<tr>
<td>Wildfire</td>
<td>Unlikely (Fire); Possible (Smoke)</td>
</tr>
</tbody>
</table>
**Drought**

The 2012-2016 drought had severe effects on two vulnerable sectors of our population: those in low-income brackets, and those, especially Native Americans, who rely on subsistence fishing for their livelihoods.\(^{198}\) Water bills increased throughout the state. Due to rising water prices, for the working poor, many have paid four to five percent of their income for water. Since many CSU students are commuters, and many living with families, future drought impacts may potentially affect a percentage of non-resident students. NASA’s modeling shows that future droughts are likely to last longer and be more intense, even leading to “megadroughts” in the western states.\(^{199}\) Fresh water supplies are predicted to be full of extremes, with both droughts and extreme precipitation events being more severe. The interrelationship between drought and other hazard conditions may lead to a set of secondary impacts. Drought conditions lead to water quality issues due to loss of drinking water, increased fire danger that leads to drought-induced fires and elevated AQI levels, as well as extreme heat or prolonged heat events.

**Earthquake**

Impacts on populations from earthquakes are complex, with long-term implications on social stability for all populations. In addition to the physical impact exposure during a no-notice earthquake event and the social and logistical challenges of a recovering community, an earthquake can have lasting impacts long afterwards due to post traumatic stress disorder (PTSD).

Socioeconomic vulnerabilities of populations at risk were analyzed in the hypothetical yet scientifically realistic earthquake sequence that is being used to better understand hazards for the San Francisco Bay region during and after a magnitude-7 earthquake (mainshock) on the Hayward Fault and its aftershocks. In this study, the at-risk populations located in areas of concentrated damage are anticipated to experience longer recovery trajectories, increased long term housing displacement, and transportation impacts due to dependencies on transit dependencies. When neighborhood schools close, families with school age children may move to other areas to keep their children in schools. Persons with access and functions needs are likely to be more dependent on access to functioning medical, social and personal health care services that would be overwhelmed by the event and therefore increasing their vulnerabilities. For the homeless populations, the loss of social community services and damages to shelters could add to protracted relocations. For the young and mobile populations who rent, the


major disruption to housing, jobs and transit will also drive relocation. Widespread housing damage and preexisting housing market constraints will make it “extremely challenging” for the socially and economically vulnerable populations to find alternative housing near their home communities. Those who utilize interim and irregular housing for months and years after a disaster are more vulnerable to physical, social, and mental disorders, including suicide, substance abuse, and physical and verbal abuse. Aftershocks and post disaster conditions delay population return and increase outmigration.200

**Erosion**

Risk from erosion relates to earthen and infrastructural losses. The degree of vulnerability to these events and their impacts depends on human behavior and the traditional social factors such as situational awareness, prior knowledge of hazards, social capital and decision-making capabilities, as well as increased vulnerability due to social factors, such as racial and economic disparities.

**Extreme Temps**

People susceptible to respiratory ailments (asthma, lower and upper respiratory disease) disproportionately suffer from the effects of fire, smoke, air pollutions, allergens, heat and PSPS. Those with limited income or without resources are affected disproportionately due to the inability to provide safe shelter, air conditioning, cooling, air purification, medical care, and quality foods, and are also least able to obtain information related to climate risks and adaptation strategies.

**Heat**

Heatstroke, cardiovascular disease, respiratory disease and cerebrovascular disease are related to extreme heat events. Increased number of heat waves creates heat-related physical stress on populations and is exacerbated in the metropolitan areas where greater amounts of heat-absorbing surfaces (e.g., asphalt and concrete) trap heat and emit higher temperatures throughout the night.

The heat also extends the geographic range and the distribution of disease-carrying insects and pests. Health professionals are concerned that California’s warming climate will allow species to acclimate. Such vectors include such pests as ticks that carry Lyme disease, and mosquitos that transmit Zika, dengue fever, West Nile, plague and tularemia. Some others, such as chikungunya, Chagas disease, and Rift Valley fever virus, are threats as well.

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Some communities of color and some low-income, homeless, and immigrant populations are more exposed to heat waves, as these groups often reside in urban areas affected by heat island effects. In addition, these populations are likely to have limited adaptive capacity due to a lack of adequately insulated housing, inability to afford or to use air conditioning, inadequate access to public shelters such as cooling centers, and inadequate access to both routine and emergency health care. These social, economic, and health risk factors give rise to the observed increase in deaths and disease from extreme heat in some immigrant and impoverished communities.

Heat stroke, the most serious heat-related illness, occurs when the body is unable to control its temperature. Body temperature rises rapidly, the sweating mechanism fails, and the body cannot cool down. In extreme causes, heat stroke can cause confusion and unconsciousness, so the victim is unable to seek treatment without assistance.

There are several groups of people who are uniquely vulnerable to the effects of extreme heat, such as infants and children, older adults aged 65 and up, athletes and outdoor workers, low-income households, and individuals with certain chronic medical conditions.

When dealing with an extreme heat event, the most common impacts are those generally felt by the people living in the targeted area. For people in particular, heat can kill when the body is pushed beyond its limits. Most heat disorders occur because the victim has been overexposed to heat. As discussed, the major human risks associated with extreme heat include dehydration, sunburn, fatigue, heat exhaustion, heat stroke, and in severe cases, death.

Some portions of the population are more at risk to the effects of extreme heat. The very young, the elderly, and certain groups with chronic medical conditions (such as asthma or other pulmonary illnesses, heart disease, poor blood circulation, neurological illnesses, and obesity) are generally more vulnerable to the effects of extreme heat, and are more likely to suffer illness or death as a result.

This is especially true if exposure is extended for a period of time and preventative measures are not taken immediately. Distributional implications of impacts, and even less on distributional implications of adaptation actions.  

**Flood**

Risk from floods relates to community risk, exposure and infrastructural losses. The degree of vulnerability to these events and their impacts depends on human behavior and the traditional social factors such as situational awareness, prior knowledge of hazards, social capital and decision-making capabilities. The exposure of humans to

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floods continues to increase, driven by changes in hydrology and land use. The adverse impacts on socially vulnerable populations are amplified because a disproportionately high number live in flood-prone areas. Research has shown that places of social vulnerabilities are places characterized by housing and racial disparities, such as mobile home parks, structural fragility and poverty, and higher percentages of populations such as Black and Native Americans, and others with shared histories of discrimination, marginalization and exclusion. 202

Health impacts from flooding are well recognized due to the extensive history of flooding in California and around the nation. The impacts range from waterborne illnesses from contaminated waters, respiratory illnesses that impact the lungs, throat, and airways from airborne particles, mold on flooded buildings that can trigger asthma, allergies and other illnesses—all which are particularly impactful to older, younger and individuals with pre-existing health condition. Foodborne illnesses can increase if there are issues with power outages or sewer overflows. Individuals with increased mental health concerns can be impacted by the stress or anxiety from the impacts of the flood. Poor quality housing can increase vulnerability to many flood risks, including flood inundation, power outages, mold growth, rodent vectors, and serious health impacts. For those with limited finances, flood inundation and impacts to infrastructure or farmlands may lead to extensive income losses.

The poorest residents suffer disproportionately to flood situations, especially those who have been less able to fund homeowner’s insurance to protect against flood losses. Loss of life is not unusual in flooding situations, as is loss of property, livestock, pets, workplaces, and tourist industries. There is a strong interrelationship between water events and other hazards. Flooding, storms and water quality are related to each other. Drought conditions can exacerbate floods as the surface soils are hardened and not as ready to allow surface water absorption. Extreme heat events can cause snowmelt, inundating waterways and causing flood and water quality issues. Flooding and storm events can have impacts on public health, environmental health, agricultural heath and economic system health. Mental health issues are reported for all people who have experience flood losses, including anxiety, fear, anger, anger, sadness and grief. 203 Additionally, waterborne disease outbreaks are reported weeks after the flood events. Mold contamination leads to indoor air issues. Damp indoor environments lead to increased prevalence of asthma, and also upper and lower respiratory symptoms.


These issues may influence the diverse CSU populations, both on and off campus, in a number of ways long after a flood event, or the related hazards impacts, has concluded.

**Power Outage/Public Safety Power Shutdowns (PSPS)**

Loss of power creates economic hardship to a region experiencing regular PSPS events, such as those experienced throughout the state over the recent years. Many businesses close, including gas stations, grocery stores, and local retail establishments. These impacts may deeply impact students dependent on support jobs, as well impacting family members of campus staff and faculty. PSPS increases risks to the public due to inability to use medical devices, spoilage of food and medicines, and disruption to infrastructure, such as supply of clean water and electricity used to run home medical equipment, such as lift chairs and ventilators.

**Wildfire**

Increased wildfire threat occurs especially in the end of fall, when conditions are driest, but before the winter rains have come; an east-to-west wind gusts exacerbate fire risk. Wildfire threats have the concomitant threat of Public Safety Power Shutoffs (PSPS). And, in the case of an actual wildfire, danger exists both from fire and from the smoke. Recent wildfires have demonstrated that some demographics are disproportionately affected. Native Americans are six times more likely to be affected than white people. Blacks and Hispanic people are 50 percent more vulnerable. These values take into account the likelihood of a community being affected and the greater difficulty of that community to recover. These statistics reflect the lack of access to resources to pay for insurance, to rebuild and recover, to implement fire safety measures, and to access other resources. Price gouging after a fire (such as documented in Sonoma County after the 2017 Tubbs Fire) further exacerbates the disparity. 204 Furthermore, the disabled and the elderly are at particular risk from extreme wildfire conditions, as they are often not as able to effectively evacuate. Of the 85 people who died in the Camp Fire in Butte in 2018, 62 of them were at least 65 years old. 205

Smoke from wildfires creates a significant public health threat. Especially vulnerable are individuals who have heart or lung issues, such heart disease, lung disease or asthma. Those most vulnerable include the medically fragile, elderly and children. Air Quality


Indexes track the level of the following:²⁰⁶ particulate matter, surface levels of ozone, carbon monoxide, sulfur dioxide, and nitrogen dioxide. All of these can cause respiratory distress and harm lungs. ²⁰⁷

The California Department of Public Health reports the increased public health risks, and risk indicators that include: heat-related ED visits, populations living in wildfire areas, adults with multiple chronic conditions, populations living in poverty, race/ethnicity, outdoor workers, public transit access, air conditioner ownership and tree canopy.²⁰⁸

**Hazard Mitigation and Emergency Management Planning**

The goal of this high-level assessment is to provide a starting point to encourage further exploring campus social risks and vulnerabilities, as well as to inform and to enhance holistic emergency management and hazard mitigation decision making, planning processes and future adaptive risk management strategies. By including the social resilience factors, mitigation investments may move beyond standardized planning and regulations, structure and infrastructure projects, and natural systems protections to embrace a more expanded, customized emergency operations plan and an education and outreach program unique to the campus.

A more robust social resilience inquiry is strongly encouraged to develop an accurate picture, based on methodical and scientific research-based data. Such an effort would be envisioned through both nuanced discussions with a variety of campus stakeholders and the invitation of nontraditional stakeholders to join in a collaborative resilience partnership. Such a forward-leaning effort would be directly in keeping with CSU’s commitment to inclusion and equity in risk reduction.

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27.1 Chancellor’s Office Profile

University History

The individual California State Colleges were brought together as a system by the Donahoe Higher Education Act of 1960. In 1972, the system became The California State University and Colleges and in 1982, the system became The California State University. Today, the campuses of the CSU include comprehensive and polytechnic universities and, since July 1995, the California State University Maritime Academy, a specialized campus.

The oldest campus, San José State University, was founded in 1857 and became the first institution of public higher education in California. The newest campus, California State University, Channel Islands, opened in fall 2002, with freshmen arriving in fall 2003.

University Governance

In 1960, the Donahoe Higher Education Act brought the individual California State Colleges together as a system. Responsibility for the system is vested in a Board of Trustees, made up of ex officio members, alumni and faculty representatives, and members appointed by the Governor. The Chancellor acts as chief executive officer of the system while the Presidents act as chief executive officers of the respective campuses; both are appointed by the Trustees. Together, the Trustees, Chancellor, and Presidents develop systemwide policy.

University Mission

“The mission of the California State University is:

- To advance and extend knowledge, learning, and culture, especially throughout California.
- To provide opportunities for individuals to develop intellectually, personally, and professionally.
- To prepare significant numbers of educated, responsible people to contribute to California's schools, economy, culture, and future.
- To encourage and provide access to an excellent education to all who are prepared for and wish to participate in collegiate study.
- To offer undergraduate and graduate instruction leading to bachelor's and higher degrees in the liberal arts and sciences, the applied fields, and the professions, including the doctoral degree when authorized.
- To prepare students for international, multi-cultural society.
- To provide public services that enrich the university and its communities.”
To actualize the CSU system’s mission the CSU has committed to the following; quality instruction, value and support a lucrative and inspiring environment for education, help create responsible citizens within a democracy, inspires and educates graduate students to attain the acmes of their educational levels, create opportunity, serve communities throughout California, embrace all cultures and heritage, encourage free scholarly inquiry and curiosity, offer an array of degree programs to all academic and applied areas, and, finally, Offers or proposes to offer instruction at the doctoral level jointly with the University of California and with private institutions of postsecondary education, or independently in the fields of education, nursing, physical therapy, or audiology, where the need is clearly demonstrated.

University Location

The CSU Chancellor’s Office is located in Los Angeles County’s second largest city, Long Beach, California. The office is located along the bay of San Pedro and Long Beach. Long Beach is the southernmost point of Los Angeles County.

University Population

As of 2021, the CSU Chancellor’s Office as system has 481,200 students that attend the university. The CSU produces 62% of the bachelor’s degrees awarded in agriculture, 54% in business, 44% in health and medicine, 64% in hospitality and tourism, 45% in engineering, and 44% of those in media, culture and design. Over the last 10 years, the CSU has significantly enhanced programs towards the underserved. 56% of bachelor’s degrees granted to Latinos in the state are from the CSU, while 60% of bachelor’s awarded to Filipinos were from the CSU system.

27.2 Interim Final Rule for Hazard Vulnerability and Risk Assessment

Requirement §201.6(c)(2): The plan shall include a risk assessment that provides the factual basis for activities proposed in the strategy to reduce losses from identified hazards. Local risk assessments must provide sufficient information to enable the jurisdiction to identify and prioritize appropriate mitigation actions to reduce losses from identified hazards.

Requirement §201.6(c)(2)(i): [The risk assessment shall include a] description of the type...location and extent of all natural hazards that can affect the jurisdiction. The plan shall include information on previous occurrences of hazard events and on the probability of future hazard events.

Requirement §201.6(c)(2)(ii): [The risk assessment shall include a] description of the jurisdiction’s vulnerability to the hazards described in paragraph (c)(2)(i) of this section. This description shall include an overall summary of each hazard and its impact on the community.
Requirement §201.6(c)(2)(ii): [The risk assessment] must also address National Flood Insurance Program (NFIP) insured structures that have been repetitively damaged floods.

Requirement §201.6(c)(2)(ii)(A): The plan should describe vulnerability in terms of the types and numbers of existing and future buildings, infrastructure, and critical facilities located in the identified hazard area.

Requirement §201.6(c)(2)(ii)(B): [The plan should describe vulnerability in terms of an] estimate of the potential dollar losses to vulnerable structures identified in paragraph (c)(2)(ii)(A) of this section and a description of the methodology used to prepare the estimate..

Requirement §201.6(c)(2)(ii)(C): [The plan should describe vulnerability in terms of] providing a general description of land uses and development trends within the community so that mitigation options can be considered in future land use decisions.

Requirement §201.6(c)(2)(iii): For multi-jurisdictional plans, the risk assessment must assess each jurisdiction's risks where they vary from the risks facing the entire planning area.

27.3 Hazard Identification and Risk Assessment

Overview of California State University, Chancellor’s Office History of Hazards

Numerous federal agencies maintain a variety of records regarding losses associated with hazards. Unfortunately, no single source is considered to offer a definitive accounting of all losses. The Federal Emergency Management Agency (FEMA) maintains records on federal expenditures associated with declared major disasters. The US Army Corps of Engineers (USACE) and the Natural Resources Conservation Service (NRCS) collect data on losses during the course of some of their ongoing projects and studies. Additionally, the National Oceanic and Atmospheric Administration’s (NOAA) National Centers for Environmental Information (NCEI) database collects and maintains data about natural hazards in summary format. The data includes occurrences, dates, injuries, deaths, and estimated costs. Many of these databases and other data collection services, including the NCEI, have inherent data limitations when searching for information at a university scale.

The best available data and records were used throughout this assessment.

Hazard Identification

As part of the initial hazard identification process, the Campus Assessment Team considered potential hazards with the highest chance to significantly affect the planning area. The hazards include those that have occurred in the past and may occur in the future. A variety of sources were used to develop the list of hazards considered including national, regional, and local sources such as emergency operations plans, FEMA’s How-
To Series, websites, published documents, databases, and maps, as well as discussion among the Campus Assessment Team members.

In the initial phase of the planning process, the Campus Assessment Team considered XX hazards and the risks they create for the University and its material assets, population, and operations. The hazards initially considered, and the determinations as to the treatment of those hazards, are shown in Table 27-1 (following).

Table 27-1: Hazard Identification Determinations

<table>
<thead>
<tr>
<th>Hazard</th>
<th>Determination (Yes/No)</th>
<th>Reason for Determination</th>
<th>Future Occurrence Probability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Communicable Disease</td>
<td>Yes</td>
<td>Hazard of concern for campus</td>
<td>Highly Likely</td>
</tr>
<tr>
<td>Dam and Levee Failure</td>
<td>Yes</td>
<td>Hazard of concern for campus</td>
<td>Unlikely</td>
</tr>
<tr>
<td>Drought</td>
<td>Yes</td>
<td>Hazard of concern for campus</td>
<td>Highly Likely</td>
</tr>
<tr>
<td>Earthquake</td>
<td>Yes</td>
<td>Hazard of concern for campus</td>
<td>Possible</td>
</tr>
<tr>
<td>Erosion</td>
<td>Yes</td>
<td>Hazard of concern for campus</td>
<td>Likely</td>
</tr>
<tr>
<td>Extreme Temperature</td>
<td>Yes - Heat No - Cold</td>
<td>Hazard of concern for campus</td>
<td>Possible (Heat only)</td>
</tr>
<tr>
<td>Flood</td>
<td>Yes</td>
<td>Hazard of concern for campus</td>
<td>Possible</td>
</tr>
<tr>
<td>Hazardous Materials</td>
<td>Yes</td>
<td>Hazard of concern for campus</td>
<td>Highly Likely</td>
</tr>
<tr>
<td>Landslide</td>
<td>Yes</td>
<td>Hazard of concern for campus</td>
<td>Unlikely</td>
</tr>
<tr>
<td>Power Outage</td>
<td>Yes</td>
<td>Hazard of concern for campus</td>
<td>Likely</td>
</tr>
<tr>
<td>Sea Level Rise</td>
<td>Yes</td>
<td>Hazard of concern for the campus</td>
<td>Highly Likely</td>
</tr>
<tr>
<td>Tsunami</td>
<td>Yes</td>
<td>Hazard of concern for campus</td>
<td>Likely</td>
</tr>
<tr>
<td>Volcano</td>
<td>Yes</td>
<td>Hazard of concern for campus</td>
<td>Unlikely</td>
</tr>
<tr>
<td>Wildfire</td>
<td>Yes</td>
<td>Hazard of concern for campus</td>
<td>Unlikely (Fire); Possible (Smoke)</td>
</tr>
</tbody>
</table>

**Future Occurrence Probability**

In order to determine the probability of future occurrences of each hazard profiled, the following scale was developed:

- **Highly Likely** - 76%-100% that the hazard would occur annually.
• **Likely**- 50%-75% that the hazard would occur annually.
• **Possible**- 11%-49% that the hazard would occur each annually.
• **Unlikely**- 0%-10% that the hazard would occur each annually.
**Communicable Disease**

**Description of the Hazard**

Communicable diseases are illnesses that occur due to infectious agents or their toxic products and are infectious due to their potential of transmission from one person or species to another by a replicating agent. They may be transmitted from a reservoir to a susceptible host either directly as from an infected person or animal or indirectly through the agency of an intermediate plant or animal host, vector, or the inanimate environment. Communicable diseases are clinically evident illness resulting from the presence of pathogenic microbial agents, including pathogenic viruses, pathogenic bacteria, fungi, protozoa, multi-cellular parasites, and aberrant proteins known as prions. The degree of spread of a communicable disease depends on both the ability of an organism to enter, survive and multiply in the host and the comparative ease with which the disease is transmitted to other hosts.

Some ways in which communicable diseases spread are by:

- Travel through the air, such as tuberculosis, measles, or COVID-19;
- Physical contact with an infected person, such as through touch (staphylococcus), sexual intercourse (gonorrhea, HIV), fecal/oral transmission (hepatitis A), or droplets (influenza, TB, COVID-19);
- Contact with a contaminated surface or object (Norwalk virus), food (salmonella, E. coli), blood (HIV, hepatitis B), or water (cholera); and
- Bites from insects or animals capable of transmitting the disease (mosquito: malaria and yellow fever; flea: plague)

Collectively, the twenty-three (23) campuses and Chancellor’s Office of the California State University (CSU) system have identified nine (9) communicable disease hazards that have had significant impacts on their respective student, faculty, and staff populations. Of these communicable diseases, COVID-19 is considered to be the most prominent and widespread agent across all CSU campuses. (See 27-2 below.)

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Table 27-2: Communicable Diseases at Identified CSU Campuses

<table>
<thead>
<tr>
<th>Collective List of Communicable Diseases Identified by All CSU Campuses</th>
<th>Number of CSU Campuses (Including Chancellor’s Office) Identifying Communicable Disease Having Significant Impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>COVID-19 (SARS-CoV-2)</td>
<td>24</td>
</tr>
<tr>
<td>Meningitis</td>
<td>7</td>
</tr>
<tr>
<td>Measles</td>
<td>6</td>
</tr>
<tr>
<td>Influenza (Including H1N1/Swine Flu)</td>
<td>6</td>
</tr>
<tr>
<td>Tuberculosis</td>
<td>5</td>
</tr>
<tr>
<td>Norovirus</td>
<td>4</td>
</tr>
<tr>
<td>Mumps</td>
<td>2</td>
</tr>
<tr>
<td>E. Coli</td>
<td>2</td>
</tr>
<tr>
<td>Sexually Transmitted Diseases (STDs)</td>
<td>2</td>
</tr>
</tbody>
</table>

(Source: Interviews with CSU campus staff at CSU campuses and at CSU Chancellor’s Office.)

With the exception of COVID-19, there is variability among CSU campuses regarding which communicable diseases have had the greatest impact on individual campus communities. Table 27-3 shows the communicable disease hazards that have had the greatest impact on each CSU campus.

Table 5-3: Communicable Disease Hazards at CSU Campuses with Greatest Impact

<table>
<thead>
<tr>
<th>CSU Campus</th>
<th>Identified Communicable Disease Hazards with the Greatest Impact on CSU Campus</th>
</tr>
</thead>
<tbody>
<tr>
<td>CSU Bakersfield</td>
<td>COVID-19, Meningitis</td>
</tr>
<tr>
<td>CSU Channel Islands</td>
<td>COVID-19, Measles</td>
</tr>
<tr>
<td>Chico State</td>
<td>COVID-19, Tuberculosis</td>
</tr>
<tr>
<td>CSU Dominguez Hills</td>
<td>COVID-19</td>
</tr>
<tr>
<td>Cal State East Bay</td>
<td>COVID-19, Meningitis</td>
</tr>
<tr>
<td>Fresno State</td>
<td>COVID-19, Meningitis, Tuberculosis</td>
</tr>
<tr>
<td>Cal State Fullerton</td>
<td>COVID-19, Influenza</td>
</tr>
<tr>
<td>Humboldt State</td>
<td>COVID-19, Measles, Norovirus, Influenza, STDs</td>
</tr>
<tr>
<td>Cal State Long Beach</td>
<td>COVID-19</td>
</tr>
</tbody>
</table>
Cal State LA | COVID-19, E. coli, Measles
---|---
Cal Maritime | COVID-19
CSU Monterey Bay | COVID-19
CSUN (Northridge) | COVID-19, Measles
Cal Poly Pomona | COVID-19, Influenza (Swine Flu - H1N1)
Sacramento State | COVID-19
Cal State San Bernardino | COVID-19, Tuberculosis
San Diego State | COVID-19, Meningitis, Mumps
San Francisco State | COVID-19
San José State | COVID-19, H1N1
Cal Poly San Luis Obispo | COVID-19, Meningitis, Norovirus
CSU San Marcos | COVID-19
Sonoma State | COVID-19, H1N1, Norovirus
Stanislaus State | COVID-19, Tuberculosis
**Office of the Chancellor** | COVID-19
---|---
CSU System-Wide | COVID-19, Meningitis, Measles, Tuberculosis, Influenza-Swine Flu-H1N1, Mumps, Norovirus, E. coli, STDs

(Source: Interviews with CSU campus staff at CSU campuses and at CSU Chancellor’s Office.)

**Descriptions of Identified Communicable Disease Hazards at CSU Office of the Chancellor**

The CSU Office of the Chancellor has identified one (1) communicable disease hazard that has had the greatest impact on its office – COVID-19. The following is a brief description of the communicable disease hazard at the CSU Office of the Chancellor.

**COVID-19 (SARS-CoV-2)**

Coronaviruses are a family of viruses that can cause illnesses such as the common cold, severe acute respiratory syndrome (SARS) and Middle East respiratory syndrome (MERS). In 2019, a new coronavirus was identified as the cause of a disease outbreak that originated in China. This virus is now known as the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2). The disease it causes is called Coronavirus Disease 2019 (COVID-19). In March 2020, the World Health Organization (WHO) declared the COVID-19 outbreak a pandemic.
Signs and symptoms of coronavirus disease 2019 (i.e., COVID-19) may appear two to 14 days after exposure. Common signs and symptoms can include fever, cough, and tiredness. Early symptoms of COVID-19 may also include a loss of taste or smell.

The virus that causes COVID-19 spreads easily among people, and more continues to be discovered over time about how it spreads. Data has shown that the COVID-19 virus spreads mainly from person to person among those in close contact (within about 6 feet, or 2 meters). The virus is transmitted by respiratory droplets being released when someone with the virus coughs, sneezes, breathes, sings or talks. These droplets can be inhaled or land in the mouth, nose or eyes of a person nearby. In some situations, the COVID-19 virus can spread by a person being exposed to small droplets or aerosols that stay in the air for several minutes or hours (i.e., airborne transmission). It's not yet known how common it is for the virus to spread this way. The COVID-19 virus can also spread if a person touches a surface or object with the virus on it and then touches his or her mouth, nose or eyes; however, this is not considered to be a main way it spreads.

The severity of COVID-19 symptoms can range from very mild to severe. Some people may have only a few symptoms, and some people may have no symptoms at all. However, some people may experience worsened symptoms, such as worsened shortness of breath and pneumonia. People who are older have a higher risk of serious illness from COVID-19, and the risk increases with age. People who have existing medical conditions also may have a higher risk of serious illness from COVID-19. In some cases, the disease can cause severe medical complications and may even lead to death.  

Location of the Hazard

Communicable diseases have the potential to affect the entire CSU Office of the Chancellor space equally. As a result, the communicable disease hazard can be found at the CSU Office of the Chancellor located in the City of Long Beach, CA (Los Angeles County). Because of the ubiquitous nature of many communicable diseases, staff at (and visitors to) the CSU Office of the Chancellor are at risk of exposure to the communicable disease hazard.

Extent of the Hazard

Various communicable diseases are categorized by the Center for Disease Control and Prevention (CDC) by levels of containment called Biosafety Levels (or BSLs). The higher the BSL, the greater the level of containment and level of effort necessary to prevent transmission of the disease, and therefore the greater the hazard. Biosafety Levels prescri...
(e.g., biosafety cabinets), secondary barriers, facility design, air handling, laboratory security, etc. BSLs are graded from 1 to 4; as the BSL increases so does the relative risk of the agent/procedures as well the stringency of procedures and facility design.

Figure 27-2 describes the different BSLs, and provides examples of communicable diseases that would typically fall into these classifications, as well as the typical protections that would be necessary to prevent transmission of each of the diseases.

Figure 27-1: Biosafety Levels (BSLs)\(^6\)

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The Extent of CSU Office of the Chancellor Communicable Disease Hazards Except COVID-19:

Besides COVID-19, there was no information provided on other communicable disease hazards at the CSU Office of the Chancellor.

The Extent of CSU Office of the Chancellor COVID-19 Communicable Disease Hazard:

As a microorganism, the SARS-CoV-2 (COVID-19) virus requires a high level of containment. It is therefore classified at BSL-3.\(^7\)

*No COVID-19 case data could be found for the CSU Office of the Chancellor.*

History of the Hazard

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Most communicable disease data are maintained by at the state and at the county levels, and are not generally available at the municipal or campus levels, unless (a) the CSU campus falls under the jurisdiction of a city-level health department, or (b) a geographically specific outbreak occurs on campus or in the local community. The exception to this is the current COVID-19 pandemic, where both campus and County-level case data have been collected. As a result, it is important to provide COVID-19 case statistics for both CSU campuses and the counties where CSU campus assets are located. CSU COVID data can be accessed from a publicly available dashboard.

Tables 27-4 and 27-5 show the city- and County-level COVID-19 case data for the City of Long Beach and Los Angeles County, respectively. (The City of Long Beach, where the CSU Chancellor’s Office is located, has its own Health Department that governs public health regulations in that city.) Both the city and County case data are updated on at least a weekly basis.

(Please note that the COVID-19 case numbers here may not reflect the most recent updates.)

Table 27-4: Confirmed COVID-19 Statistics for City of Long Beach COVID-19 (as of 03/17/2021): 8

<table>
<thead>
<tr>
<th>COVID-19 Classification</th>
<th>Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cases</td>
<td>51,709</td>
</tr>
<tr>
<td>Deaths</td>
<td>888</td>
</tr>
</tbody>
</table>

Table 27-5: Confirmed COVID-19 Statistics for Los Angeles County COVID-19 (as of 03/17/2021): 9

<table>
<thead>
<tr>
<th>COVID-19 Classification</th>
<th>Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cases</td>
<td>1,149,878</td>
</tr>
<tr>
<td>Deaths</td>
<td>21,449</td>
</tr>
</tbody>
</table>

Potential Impacts of the Hazard

Communicable disease outbreaks and pandemics have (and will continue to have) direct impact on life, health, and safety across the CSU system, including the CSU Chancellor’s Office. The extent of this impact is contingent on the type of infection or contagion, the severity of the outbreak, and the speed at which it is transmitted. Property and


infrastructure integrity may be affected if large numbers of Chancellor’s Office employees contract communicable diseases at the same time and are therefore unable to perform maintenance, operations, and educational tasks. This would be particularly disruptive if those impacted are essential personnel. Long-term outbreaks affecting large numbers of Chancellor’s Office employees could result in disruptions to the office workflow and, by extension, to the CSU System’s mission. This has already occurred with the current COVID-19 pandemic and could occur again with more virulent strains of communicable diseases, including COVID-19.

Communicable disease hazards found across the CSU system (including at the CSU Chancellor’s Office) vary both by level of containment (BSL) (described previously) and by level of individual/public health risk, or Risk Group (RG) level. While BSLs describe the procedures and required levels of containment in a laboratory setting, Risk Groups (RGs) reflect the potential effects of disease exposure on humans or animals. Like BSLs, RGs range from Level 1 (RG1) to Level 4 (RG4), with Level 1 (RG1) posing minimal risk to healthy individuals and public health and Level 4 (RG4) posing a very serious or extreme risks to individuals and public. BSLs generally correlate with Risk Group (RG) Levels (e.g., a RG2 agent is worked with at BSL-2), but there are exceptions (e.g., production volumes, high-risk procedures, etc.).

The World Health Organization’s (WHO) Laboratory Biosafety Manual, 3rd ed., NIH Guidelines, categorizes Risk Groups (RGs) in the following way:

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Table 27-6: WHO Risk Group Categorization

<table>
<thead>
<tr>
<th>Risk Group (RG)</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>RG1</td>
<td>Rarely associated with disease in healthy adult humans or animals and pose no-to-little public health risk (e.g., Saccharomyces cerevisiae, E. coli K-12 strain derivatives often used for recombinant/molecular biology, many environmental organisms)</td>
</tr>
<tr>
<td>RG2</td>
<td>Associated with mild to moderate disease for which preventative measures or post exposure treatments are often available; public health impact is limited (e.g., Streptococcus pyogenes, Salmonella, hepatitis B virus)</td>
</tr>
<tr>
<td>RG3</td>
<td>Associated with serious to lethal human disease for which preventative vaccines or post-exposure therapies may be scarce. Public health impact is limited-to-moderate (e.g., Mycobacterium tuberculosis, hantaviruses, West Nile virus, SARS)</td>
</tr>
<tr>
<td>RG4</td>
<td>Associated with serious to lethal human disease for which preventative vaccines or post exposure therapies are not usually available. Public health impact is high (e.g., Ebola virus, Marburg virus, smallpox virus, etc.)</td>
</tr>
</tbody>
</table>

Table 27-7 describes the four (4) Risk Group Levels (RGs), and provides examples of communicable diseases that would typically fall in to these classifications, and the typical protections that would be necessary to prevent transmission of the disease. It is important to note that all but two (2) communicable disease hazards identified by CSU campuses fall under either the lower-risk RG1 or RG2 categories. COVID-19 and tuberculosis are the two (2) communicable diseases fall under the higher-risk RG3 category. However, with the advent of the recently-developed COVID-19 vaccine, and with the expectation of an increasingly robust vaccine supply, it is possible that the RG level for COVID-19 could be lowered in the future, thereby reducing both the extent and the potential impact of COVID-19.

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Table 27-7: Risk Group Levels (RGs) with Example Diseases and Recommended Precautions

<table>
<thead>
<tr>
<th>Level</th>
<th>Examples</th>
<th>Typical Protection to Prevent Transmission</th>
</tr>
</thead>
<tbody>
<tr>
<td>RG I</td>
<td>E. Coli</td>
<td>Precautions are minimal, most likely involving gloves and some sort of facial protection. Usually, contaminated materials are left in open (but separately indicated) waste receptacles. Decontamination procedures for this level are similar in most respects to modern precautions against everyday viruses (i.e.: washing one's hands with anti-bacterial soap, washing all exposed surfaces of the lab with disinfectants, etc.).</td>
</tr>
<tr>
<td>RG 2</td>
<td>Chicken Pox, Hepatitis A, B, C, Lyme disease, Salmonella, Mumps, Measles, Malaria, Scrapie, Dengue Fever, HIV</td>
<td>These bacteria and viruses cause mild disease in humans or are difficult to contract via aerosol. Routine diagnostic work with clinical specimens can be done safely at BSL-2, using BSL-2 practices and procedures.</td>
</tr>
</tbody>
</table>

Anthrax
West Nile Virus
SARS Virus (Including COVID-19)
Tuberculosis
Typhus
Yellow Fever
Hantaviruses
Avian Flu

These bacteria and viruses cause severe to fatal disease in humans, but vaccines or other treatments do exist to combat them. Laboratory personnel have specific training in handling pathogenic and potentially lethal agents and are supervised by competent scientists who are experienced in working with these agents. This is considered a neutral or warm zone.

H5N1 (Bird Flu)
Dengue Hemorrhagic Fever
Marburg Virus
Ebola Virus
Smallpox
Lassa Fever
Crimean-Congo Hemorrhagic Fever
Other Hemorrhagic Diseases

These viruses and bacteria cause severe to fatal disease in humans, for which vaccines or other treatments are not available. When dealing with biological hazards at this level the use of a Hazmat suit and a self-contained oxygen supply is mandatory. The entrance and exit of a BSL-4 lab will contain multiple showers, a vacuum room, an ultraviolet light room, autonomous detection system, and other safety precautions designed to destroy all traces of the biohazard. Multiple airlocks are employed and are electronically secured to prevent both doors opening at the same time. All air and water service going to and coming from a BSL-4 lab will undergo similar decontamination procedures to eliminate the possibility of an accidental release.

Probability of Future Occurrence of the Hazard

There have been cases of a variety of communicable disease throughout the CSU system, including COVID-19 (SARS-CoV-2), Meningitis, Measles, Influenza (Including H1N1/Swine Flu), Tuberculosis, Norovirus, Mumps, E. Coli, and Sexually Transmitted Diseases (STDs). However, there are significant data limitations regarding non-COVID-19 communicable disease cases, as the information thereof is outdated, anecdotal, and/or inadequate. As a result, it is not feasible to provide quantitative probabilities of future occurrence for non-COVID-19 communicable disease hazards. However, based on the limited data, it is feasible to present qualitative probabilities of future occurrence based on ranges of communicable disease frequency.
Table 27-8 shows a probability scale of future occurrence for the nine (9) communicable disease hazards profiled in this assessment. This scale is divided into four (4) levels of probability:

Table 27-8: Likelihood of Future Hazard Occurrence

<table>
<thead>
<tr>
<th>Likelihood</th>
<th>Parameters for Determining Likelihood</th>
</tr>
</thead>
<tbody>
<tr>
<td>Highly Likely</td>
<td>76 – 100% probability that hazard will occur annually (high to very high frequency)</td>
</tr>
<tr>
<td>Likely</td>
<td>50 – 75% probability that hazard will occur annually (moderate to high frequency)</td>
</tr>
<tr>
<td>Possible</td>
<td>11 – 49% probability that hazard will occur annually (low to moderate frequency)</td>
</tr>
<tr>
<td>Unlikely</td>
<td>0 – 10% probability that hazard will occur annually (very low to low frequency)</td>
</tr>
</tbody>
</table>

Due to significant data limitations surrounding non-COVID communicable diseases, the probability of future occurrence of CSU-system-wide communicable disease is measured by the proportion of campuses that have identified a particular communicable disease as having an impact on the campus community. In this measure, the more frequent a communicable disease is seen as impactful CSU-wide, the greater the probability of future occurrence. Note: Each communicable disease’s probability of future occurrence ranking CSU-system-wide reflects the ranking at the individual CSU campus level unless noted otherwise.

Table 27-9: Probability of Future Occurrence of Communicable Disease Hazard for CSU System

<table>
<thead>
<tr>
<th>Collective List of Communicable Diseases Identified by All CSU Campuses</th>
<th>Number of CSU Campuses (Including Chancellor’s Office) Identifying Communicable Disease Having Significant Impact</th>
<th>Proportion of CSU Campuses Identifying Communicable Disease as Having Significant Impact System-Wide</th>
<th>CSU System-Wide Probability Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>COVID-19 (SARS-CoV-2)</td>
<td>24</td>
<td>1.00</td>
<td>Highly Likely</td>
</tr>
<tr>
<td>Meningitis</td>
<td>7</td>
<td>0.29</td>
<td>Possible</td>
</tr>
<tr>
<td>Measles</td>
<td>6</td>
<td>0.25</td>
<td>Possible</td>
</tr>
<tr>
<td>Influenza (Including H1N1/Swine Flu)</td>
<td>6</td>
<td>0.25</td>
<td>Possible</td>
</tr>
<tr>
<td>Tuberculosis</td>
<td>5</td>
<td>0.21</td>
<td>Possible</td>
</tr>
</tbody>
</table>
### Norovirus

<table>
<thead>
<tr>
<th>Disease</th>
<th>Score</th>
<th>Probability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Norovirus</td>
<td>4</td>
<td>0.17</td>
</tr>
<tr>
<td>Mumps</td>
<td>2</td>
<td>0.08</td>
</tr>
<tr>
<td>E. Coli</td>
<td>2</td>
<td>0.08</td>
</tr>
<tr>
<td>Sexually Transmitted</td>
<td>2</td>
<td>0.08</td>
</tr>
<tr>
<td>Diseases (STDs)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

(Source: Interviews with staff at CSU campuses and at the CSU Chancellor’s Office.)

### Vulnerability to the Hazard

Vulnerability to a communicable diseases hazard resides in the population of a given area – both human and animal – not in the infrastructure or physical assets. While CSU assets and infrastructure could be impacted indirectly by the communicable disease hazard, these impacts would be secondary to the impact that the communicable disease hazard would have on staff and visitors at the CSU Chancellor’s Office.

CSU campus settings are geographically diverse, with locations ranging from small towns to medium-sized cities to densely populated urban areas. Hundreds of thousands of people work, study, and/or pass through CSU campuses on any given day. (As of Fall 2019, the CSU System had 480,541 students and 53,763 faculty and staff.) Each of these persons is vulnerable to communicable disease, particularly if it is a pathogen that individual has not been immunized against, or for which no immunization exists.

Prolonged outbreaks could result in a loss of services, failure of infrastructure (from lack of operators or maintenance), and closure of facilities. Due to a lack of information on the COVID-19 statistics for the CSU Chancellor’s Office, it is unclear if this scenario has played out at that location in the current COVID-19 pandemic.

### Estimate of Potential Losses

**COVID-19 Pandemic Health Impact on CSU Campuses and Surrounding Communities**

The most prescient metric for estimating losses from COVID-19 is loss of life. The nationwide campus-related COVID-19 death rate of 0.02% remains well below the average COVID-19 death rate in the U.S. However, due to data limitations, there is no information on CSU-campus-specific deaths by COVID-19 or by any other communicable diseases. In fact, COVID-19 is the only communicable disease for which case reports have been readily available for CSU campuses.

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13 The California State University. *Enrollment.* Retrieved 05.03.2021 from: https://www2.calstate.edu/csu-system/about-the-csu/facts-about-the-csu/enrollment/Pages/default.aspx

14 The California State University. *Employee Head Count by Campus.* Retrieved 05.03.2021 from: https://www2.calstate.edu/csu-system/faculty-staff/employee-profile/csu-workforce/Pages/employee-headcount-by-campus.aspx
At some point in the future, CSU campuses and the Chancellor’s Office will return to full capacity. Without adequate surveillance regarding building access and employee interaction, the Chancellor’s Office is at risk of developing an extreme incidence of COVID-19, and may become a “super-spreader” for adjacent communities.  

The emergence of more virulent COVID-19 variants would only add to the potential for high negative impacts on life safety, operations, and service delivery at the Chancellor’s Office. (Other communicable diseases would also re-emerge, but with low to moderate negative impacts on life safety, operations, and service delivery.)

**Economic Impact of COVID-19 Pandemic on CSU Financial Health**

During the first few months of the COVID-19 pandemic in 2020, the CSU system suffered tremendous negative fiscal impacts. From March through July of 2020 alone, over $146 million worth of revenue losses were sustained across the CSU system due to refunds to students for parking, housing and dining service fees during Spring Semester, 2020. (See Figure 27-2 below for the economic impact to the campus). Several CSU campuses saw refund losses surpass $10 million. (See Figure 27-2.)

Figure 27-2: CSU COVID-19 Cost Tracking Showing Revenue Refund Losses and Increased Costs.

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Mitigative Relief from Federal Assistance

The $1.5 billion in total federal assistance sent to the CSU system will help relieve the losses of revenues from services like dorms, parking and dining services during a year of mainly empty campuses. (See Table 27-10.) (Note: There is no information on federal assistance to the Chancellor’s Office.)

Table 27-10: Total Federal Assistance to CSU for COVID-19 Related Losses, 2020 – 2021\textsuperscript{16,17,18}

<table>
<thead>
<tr>
<th>Institution</th>
<th>December 2020 Stimulus</th>
<th>CARES Act</th>
<th>APLU Projection of HEERF Total ARP Act Funding Allocation</th>
<th>Total Estimated Federal COVID Relief Funding</th>
</tr>
</thead>
<tbody>
<tr>
<td>California Polytechnic State University</td>
<td>$20,752,799</td>
<td>$14,725,000</td>
<td>$37,000,928</td>
<td>$72,478,727</td>
</tr>
<tr>
<td>California State Polytechnic University, Pomona</td>
<td>$48,614,353</td>
<td>$31,102,000</td>
<td>$86,044,649</td>
<td>$165,761,002</td>
</tr>
<tr>
<td>California State University Channel Islands</td>
<td>$14,288,099</td>
<td>$8,512,000</td>
<td>$24,915,170</td>
<td>$47,715,269</td>
</tr>
<tr>
<td>California State University Maritime Academy</td>
<td>$1,381,700</td>
<td>$1,204,000</td>
<td>$2,472,622</td>
<td>$5,058,322</td>
</tr>
<tr>
<td>California State University - Sacramento</td>
<td>$59,891,260</td>
<td>$35,643,000</td>
<td>$104,900,133</td>
<td>$200,434,393</td>
</tr>
</tbody>
</table>


<table>
<thead>
<tr>
<th>University</th>
<th>Fall 2012</th>
<th>Spring 2012</th>
<th>Summer 2012</th>
<th>Total 2012</th>
</tr>
</thead>
<tbody>
<tr>
<td>California State University, Bakersfield</td>
<td>$22,855,632</td>
<td>$12,483,000</td>
<td>$40,285,565</td>
<td>$75,624,197</td>
</tr>
<tr>
<td>California State University, Chico</td>
<td>$31,603,856</td>
<td>$20,019,000</td>
<td>$55,754,538</td>
<td>$107,377,394</td>
</tr>
<tr>
<td>California State University, Dominguez Hills</td>
<td>$31,843,563</td>
<td>$18,312,000</td>
<td>$55,915,410</td>
<td>$106,070,973</td>
</tr>
<tr>
<td>California State University, East Bay</td>
<td>$24,243,652</td>
<td>$14,394,000</td>
<td>$42,929,208</td>
<td>$81,566,860</td>
</tr>
<tr>
<td>California State University, Fresno</td>
<td>$52,725,317</td>
<td>$32,557,000</td>
<td>$92,926,594</td>
<td>$178,208,911</td>
</tr>
<tr>
<td>California State University, Fullerton</td>
<td>$67,736,949</td>
<td>$41,088,000</td>
<td>$120,859,884</td>
<td>$229,684,833</td>
</tr>
<tr>
<td>California State University, Long Beach</td>
<td>$67,421,424</td>
<td>$41,202,000</td>
<td>$119,508,329</td>
<td>$228,131,753</td>
</tr>
<tr>
<td>California State University, Los Angeles</td>
<td>$61,905,561</td>
<td>$40,067,000</td>
<td>$108,543,672</td>
<td>$210,516,233</td>
</tr>
<tr>
<td>California State University, Monterey Bay</td>
<td>$13,455,716</td>
<td>$8,705,000</td>
<td>$23,922,768</td>
<td>$46,083,484</td>
</tr>
<tr>
<td>California State University, Northridge</td>
<td>$74,004,088</td>
<td>$47,458,000</td>
<td>$131,021,450</td>
<td>$252,483,538</td>
</tr>
<tr>
<td>California State University, San Bernardino</td>
<td>$42,438,131</td>
<td>$27,924,000</td>
<td>$74,982,459</td>
<td>$145,344,590</td>
</tr>
<tr>
<td>California State University, San Marcos</td>
<td>$26,602,684</td>
<td>$15,542,000</td>
<td>$46,496,808</td>
<td>$88,641,492</td>
</tr>
<tr>
<td>California State University, Stanislaus</td>
<td>$22,007,207</td>
<td>$12,928,000</td>
<td>$38,636,391</td>
<td>$73,571,598</td>
</tr>
<tr>
<td>Humboldt State University</td>
<td>$16,130,016</td>
<td>$11,146,000</td>
<td>$28,831,619</td>
<td>$56,107,635</td>
</tr>
</tbody>
</table>
Vulnerability Assessment Conclusions

Before the COVID-19 pandemic, populations at all CSU campuses and CSU-affiliated facilities were substantial. Collectively, as of Fall 2019, CSU campuses had 480,541 students and 53,763 faculty and staff. All were at risk from the communicable disease events, with 534,304 people being directly vulnerable. The COVID-19 pandemic has caused campus population numbers to plummet to a small fraction of full capacity.

At some point in the future, campus population numbers will return to their pre-pandemic levels, and students, faculty, and staff will again be vulnerable to the communicable disease hazard. If just 10% of the total CSU population were to become ill with a highly infective communicable disease like influenza or another strain of SARS, this would mean that approximately 53,430 people would be sick at the same time. This scenario would likely overwhelm available on-campus medical services could even overwhelm portions of the larger community’s medical resources – especially if there were large numbers of infected people with immune system compromises or other underlying health problems. Table 27-11 shows the “10% outbreak scenario” projections both for each CSU campus and for the entire CSU system.

Table 27-11: Scenario of Communicable Disease Hazard Affecting 10% of the CSU Population

<table>
<thead>
<tr>
<th></th>
<th>Approximate Enrollment Population (Fall 2019)</th>
<th>Approximate Total FT/PT Faculty/Staff Population (Fall 2019)</th>
<th>Total Combined Approximate Student and Faculty/Staff Combined</th>
<th>10% Outbreak Scenario (Students and Faculty/Staff Combined)</th>
</tr>
</thead>
<tbody>
<tr>
<td>San Diego State University</td>
<td>$45,914,127</td>
<td>$30,394,000</td>
<td>$80,592,385</td>
<td>$156,900,512</td>
</tr>
<tr>
<td>San Francisco State University</td>
<td>$47,404,409</td>
<td>$30,000,000</td>
<td>$83,075,470</td>
<td>$160,479,879</td>
</tr>
<tr>
<td>San Jose State University</td>
<td>$46,631,939</td>
<td>$30,977,000</td>
<td>$82,976,130</td>
<td>$160,585,069</td>
</tr>
<tr>
<td>Sonoma State University</td>
<td>$13,980,795</td>
<td>$9,153,000</td>
<td>$24,732,994</td>
<td>$47,866,789</td>
</tr>
<tr>
<td>CSU System-Wide Totals</td>
<td>$853,833,277</td>
<td>$535,535,000</td>
<td>$1,507,325,177</td>
<td>$2,896,693,454</td>
</tr>
</tbody>
</table>


<table>
<thead>
<tr>
<th>CSU Campus</th>
<th>Population</th>
<th>Faculty/Staff Population</th>
<th>CSU System-Wide</th>
</tr>
</thead>
<tbody>
<tr>
<td>CSU Bakersfield</td>
<td>11,199</td>
<td>12,476</td>
<td>480,541</td>
</tr>
<tr>
<td>CSU Channel Islands</td>
<td>7,093</td>
<td>8,087</td>
<td>53,763</td>
</tr>
<tr>
<td>Chico State</td>
<td>17,019</td>
<td>18,988</td>
<td>534,304</td>
</tr>
<tr>
<td>CSU Dominguez Hills</td>
<td>17,027</td>
<td>18,788</td>
<td>53,430</td>
</tr>
<tr>
<td>Cal State East Bay</td>
<td>14,705</td>
<td>16,469</td>
<td></td>
</tr>
<tr>
<td>Fresno State</td>
<td>24,139</td>
<td>26,673</td>
<td></td>
</tr>
<tr>
<td>Cal State Fullerton</td>
<td>39,868</td>
<td>43,604</td>
<td></td>
</tr>
<tr>
<td>Humboldt State</td>
<td>6,983</td>
<td>8,154</td>
<td></td>
</tr>
<tr>
<td>Cal State Long Beach</td>
<td>38,074</td>
<td>42,078</td>
<td></td>
</tr>
<tr>
<td>Cal State LA</td>
<td>26,361</td>
<td>29,182</td>
<td></td>
</tr>
<tr>
<td>Cal Maritime</td>
<td>91</td>
<td>1,240</td>
<td></td>
</tr>
<tr>
<td>CSU Monterey Bay</td>
<td>7,123</td>
<td>8,182</td>
<td></td>
</tr>
<tr>
<td>CSUN (Northridge)</td>
<td>38,391</td>
<td>42,223</td>
<td></td>
</tr>
<tr>
<td>Cal Poly Pomona</td>
<td>27,914</td>
<td>30,564</td>
<td></td>
</tr>
<tr>
<td>Sacramento State</td>
<td>31,156</td>
<td>34,384</td>
<td></td>
</tr>
<tr>
<td>Cal State San Bernardino</td>
<td>20,311</td>
<td>22,429</td>
<td></td>
</tr>
<tr>
<td>San Diego State</td>
<td>35,081</td>
<td>38,783</td>
<td></td>
</tr>
<tr>
<td>San Francisco State</td>
<td>28,880</td>
<td>32,281</td>
<td></td>
</tr>
<tr>
<td>San José State</td>
<td>33,282</td>
<td>36,850</td>
<td></td>
</tr>
<tr>
<td>Cal Poly San Luis Obispo</td>
<td>21,242</td>
<td>24,113</td>
<td></td>
</tr>
<tr>
<td>CSU San Marcos</td>
<td>14,519</td>
<td>16,206</td>
<td></td>
</tr>
<tr>
<td>Sonoma State</td>
<td>8,649</td>
<td>9,987</td>
<td></td>
</tr>
<tr>
<td>Stanislaus State</td>
<td>10,614</td>
<td>11,890</td>
<td></td>
</tr>
<tr>
<td>Office of the Chancellor</td>
<td>0</td>
<td>673</td>
<td></td>
</tr>
<tr>
<td>CSU System-Wide</td>
<td>480,541</td>
<td>534,304</td>
<td>53,430</td>
</tr>
</tbody>
</table>
While the case numbers of COVID-19 have been significantly lower (about 1% of the total CSU population) than those in the 10% scenario, the degree of virulence and resultant morbidity and mortality caused by COVID-19 have led to widespread campus shutdowns, educational and business disruption, and economic harm to the CSU system, including to the CSU Chancellor’s Office. In short, the real-time COVID-19 communicable disease outbreak scenario has proven far more devastating than the 10% simulated scenario.

Identified Data Limitations

There is a wealth of technical information available for communicable disease. However, there is also limited non-COVID-19 communicable disease data available regarding risk or vulnerability of specific populations throughout the CSU. Much of the data that does exist is protected by privacy policies, and therefore cannot be obtained for more specific populations. As a result, performing a detailed quantitative assessment for this hazard is difficult.

Data that could be collected prior to the next update in order to improve this methodology includes:

- Data regarding infection rates at the campus level and for specific populations;
- Data regarding communicable disease case numbers and outcomes, by CSU campus;
- Data regarding projected population changes;
- Data regarding absenteeism; and
- Data regarding increased operating costs as a result of absenteeism (i.e., temporary shifting of duties resulting in business interruption).

**Dam and Levee Failure**

Description of the Hazard

A dam failure represents the structural collapse of a dam that stores water in a reservoir behind the dam. These failures are typically the result of structural age, damage to the structure caused by earthquake or flooding, inadequate discharge or spillway capacity, inadequate maintenance, improper construction materials, or extreme inflow of water into the reservoir. Prolonged precipitation may result in overtopping of the dam resulting in structural compromise. The tremendous energy generated by a sudden breach of the dam will have significant downstream effects. Flood damage resulting from dam failures potentially will result in economic losses, environmental damage, destruction of agriculture, and human casualties. This type of incident is extremely dangerous as it can
occur rapidly, with no warning resulting in an inability to effectively evacuate threatened communities.

A levee failure is similar to dam failures as the result will be a breach causing flooding on the dry side of the levee. Levees are embankments whose primary purpose is to furnish flood protection from seasonal high water or divert the flow of water. Most levees in California are intended to withstand peak water levels generated by heavy precipitation or rapid snowmelt in a watershed. Other levees are designed to withstand fluctuating water levels on a continuous basis such as those in the California Delta exposed to tidal influences. Levees routinely extend for lengthy distances immediately protecting communities. Levees can be found throughout the state but are most prominent in the Sacramento and San Joaquin Valleys.

Levee failures can vary from over toppings to small uncontrolled discharge to catastrophic failure. Areas downstream of the failure will be subject to inundation dependent on the volume of water released. These levee failures are also typically the result of structural age, damage to the structure caused by earthquake or flooding, slumping, seepage underneath the levee, high velocity flows eroding the levee, inadequate capacity, inadequate maintenance, improper construction materials, or extreme inflow of water into the system. Flood damage resulting from levee failures potentially will result in economic losses, environmental damage, destruction of agriculture, and human casualties.

Dam or levee failure flooding will vary depending on a number of factors including the extent of the collapse or breach, the volume of water behind the structure, and the nature of the exposed downstream features. This unpredictable flooding presents a threat to life and property in addition to critical infrastructure. Lifelines and supply routes will likely be damaged or made impassible by flood erosion or standing water. Water quality and health concerns would likely be cascading effects of dam or levee failures.

Location of the Hazard

Los Angeles County is home to a variety of flood control facilities and levee systems mostly along the base of the various mountains and hills throughout the county. Levees have been constructed along numerous flood control channels providing community protection. The CSU Chancellor’s Office is in general proximity to dams upstream along the Los Angeles River and Rio Hondo systems in addition to flood control channels lined with levees.

Figure 27-3: Dams and Levees near CSU Chancellor’s Office
Extent of the Hazard

Dams are classified according to the hazard that they pose to life and property in the event of failure, rather than the likelihood of that failure.

- **High hazard potential dams** may result in loss of human life, and will likely result in economic, environmental, or lifeline losses.
- **Significant hazard potential dams** are not expected to result in loss of life, but are expected to cause economic, environmental, and lifeline losses.
- **Low hazard potential dams** are not expected to result in loss of life, and there is a low expectation of economic, environmental, or lifeline losses. What losses do occur are generally limited to the dam owner.

Dams classified as high hazard are required to have Emergency Action Plans (EAP). EAPS are formal documents that identify potential emergency conditions at the dam and specify preplanned actions to be followed in case of failure. An EAP is required for all high hazard dams and is recommended for all significant hazard dams.
Table 27-12: Los Angeles County Dams Upstream from CSU Chancellor’s Office

<table>
<thead>
<tr>
<th>River</th>
<th>Dam</th>
<th>Storage</th>
<th>Hazard Severity</th>
</tr>
</thead>
<tbody>
<tr>
<td>San Gabriel</td>
<td>Morris</td>
<td>27,500af</td>
<td>High Hazard</td>
</tr>
<tr>
<td>San Gabriel</td>
<td>San Gabriel</td>
<td>45,832af</td>
<td>High Hazard</td>
</tr>
<tr>
<td>San Gabriel</td>
<td>Santa Fe</td>
<td>45,409af</td>
<td>High Hazard</td>
</tr>
<tr>
<td>San Gabriel</td>
<td>Whittier Narrows</td>
<td>66,702af</td>
<td>High Hazard</td>
</tr>
</tbody>
</table>

The CSU Chancellor’s Office lies outside of the inundation zone of the dams listed above. In the event of a catastrophic failure of the identified dams, the CSU Chancellor’s Office is expected to remain out of the inundation area. The inundation area is expected to spread water in areas upstream from the campus and remain within the flood control channels in proximity to the campus. However, there are multiple transportation corridors that lie within the dam inundation zones that could compromise transportation routes and areas the campus community reside or work. Based on these conditions, the planning committee ranks the extent of the hazard on campus as **Low**.

**Extent – Levee Failure**

Levees are used along numerous flood control channels and other waterways including the Los Angeles River, San Gabriel River, and Los Cerritos Channel. The CSU Chancellor’s Office lies outside of the levee flood protected area. In the event any of these channels were flowing at elevated levels and a failure of a levee were to occur, while the campus would not experience direct impacts, the community surrounding the campus would likely experience flood related damages. This specific hazard could alter the ability of the campus to maintain operations as damages would be extensive. Depending on the location of a breach, the campus community would be heavily affected with the loss of life and homes, access to campus would be limited, and student financial capacity to support ongoing education being diminished. Based on these conditions, the planning committee ranks the extent of the levee failure hazard as **Low**.

**History of the Hazard**

There are no records of dam or levee failures in areas that present a threat to the CSU Chancellor’s Office. The City of Long Beach has not identified a history of dam or levee failures elsewhere in the city. Los Angeles County has experienced the following dam failures:

Table 12-13: Los Angeles County Dam Failures

<table>
<thead>
<tr>
<th>Date</th>
<th>Dam</th>
<th>Release</th>
<th>Damage</th>
</tr>
</thead>
</table>

---

<table>
<thead>
<tr>
<th>Date</th>
<th>Location</th>
<th>Volume (af)</th>
<th>Impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>3/12/1928</td>
<td>St. Francis</td>
<td>38,000</td>
<td>Extensive; 450 fatalities</td>
</tr>
<tr>
<td>12/14/1963</td>
<td>Baldwin Hills</td>
<td>770</td>
<td>277 residences, 5 fatalities</td>
</tr>
</tbody>
</table>

Potential Impacts of the Hazard

**Dam Failure Impacts**

While the campus is not within a dam inundation zone, transportation routes, critical infrastructure, and campus community members may reside within inundation zones. Water that is released due to a dam that has failed generates tremendous energy and force causing a flood that will be catastrophic to life and property. Water levels from the failed dam could be significantly higher than those experienced in worst case scenario flood events. Areas closer to the failed dam will be more likely to experience complete devastation while other areas within the inundation zone will see varying levels of flood waters. The extent of the impacts of a failed dam would vary based on a number of factors such as the volume of water released, the base flow of the river, the time of the failure, the amount of warning provided, and the distance from the dam. Impacts resulting from a dam failure include:

- Loss of life
- Property destruction or damage
- Loss of property contents
- Infrastructure damage
- Flooded or destroyed lifelines/supply routes
- Damaged or destroyed utilities
- Loss of community economic base
- Employment losses
- Agricultural (crops and livestock) damages or destruction
- Environmental damage
- Floods generating threats to public health
- Flood generated debris
- Damage or destruction of academic materials, fine arts, and research
- Damage or destruction of university computer systems and networks
- Damaged university infrastructure
- Reduced or eliminated student engagement with academic programs
- Reductions in campus revenues
The area downstream from the San Gabriel, Morris, Santa Fe, and Whittier Narrows Dams includes the populated areas of Los Angeles County. Members of the campus community who reside or are employed in these areas would be most impacted. The campus may experience the same effects from a dam inundation event that would be experienced by the broader region. This would primarily be in the form of transportation routes and other community critical infrastructure being impacted by the inundation. This specific hazard would substantially alter the ability of the campus to maintain operations as damages would be extensive, the campus community in these areas would be heavily affected with the loss of life and homes, and student financial capacity to support ongoing education being diminished.

Levee Failure Impacts

A levee failure may result in substantial amounts of water to enter into developed areas protected by the levee. The force and volume of water that is generated by a levee failure may cause extensive structural damage in close proximity to the breach and effects of flooding spreading well beyond the point of the failure. The extent of the impacts would vary based on a number of factors such as the volume of water released, the time of the failure, the amount of warning provided, the location of the breach, elevation, and distance from the breach. Potential impacts resulting from a levee failure include:

- Loss of life
- Property destruction or damage
- Loss of property contents
- Infrastructure damage
- Public health hazards resulting from mold, mildew, and disease due to flood water
- Flooded or destroyed lifelines/supply routes
- Damaged or destroyed utilities
- Loss of community economic base
- Employment losses
- Agricultural (crops and livestock) damages or destruction
- Environmental damage
- Prolonged periods of necessary dewatering
- Disruptions to education delivery to community
- Damage or destruction of academic materials, fine arts, and research
- Damage or destruction of university computer systems and networks
- Damaged university infrastructure
- Reduced or eliminated student engagement with academic programs
Reductions in campus revenues

Probability of Future Occurrence of the Hazard

The location of the CSU Chancellor’s Office downstream from the Santa Fe Springs Dam and other flood control facilities along the San Gabriel River and Coyote Creek demonstrates that the potential exists for future dam or levee related secondary impacts. However, the distance from the river channel provides an additional mitigating factor, meaning that the City of Long Beach including the CSU Chancellor’s Office resides outside of known dam inundation zones. Los Angeles River 39 levee system resides immediately to the east of the campus; however, the campus is outside of the levee protected zone. There are no official recurrence intervals that have been calculated for dam or levee failures. Based on historical experience and occurrences and based on consistent dam and levee monitoring and maintenance protocols, the probability of future occurrence for both dam and levee failures is Unlikely.

Vulnerability to the Hazard

The CSU Chancellor’s Office is not subject to the direct effects of flooding resulting from compromised dams and levees. The effects would rather be mostly indirect affecting members of the campus community and regional transportation networks and services. In the case of dam failure, the amount of time to respond to the needs of the campus community prior to inundation will be limited.

The most significant challenge regarding dam failures is they generally result in catastrophic outcomes. It is likely that response action will not be fully implemented until the incident situational intelligence provides adequate information as to compromised locations. These variables place all those working and living within the dam inundation and flood protection zones in vulnerable locations.

The distributed placement of levees, most near development may expose significant vulnerabilities to other areas of the region even if the campus is unaffected. There is potential the office community will be affected as a breach may cause flooding and damages to the homes of students, faculty, and staff or to access/supply routes, utilities, or other critical services. The potential for flood damaged structures being left uninhabitable including campus residence halls will result in numerous displaced individuals and households. The lack of flood insurance will cause extreme financial burdens on those affected.

Vulnerability to a dam or levee failure on the CSU Chancellor’s Office will vary depending on when the failure was to occur. The risk to the office population will be lessened during periods outside of traditional work hours. Conversely, during the days and hours that personnel are at their workplaces, the human vulnerability increases. However, in region-wide events this vulnerability may be shared with the homes and workplaces of members of the campus community and their families.
Certain office populations will experience greater challenges to a post-flood / failure environment. Vulnerable populations will likely need to navigate through flood generated debris, face extreme health safety issues from flood waters, experience extreme stresses of a disaster, an inability to communicate to or gain access to support networks, and find difficulty in accessing equipment or supplies to aid in a specific need.

**Estimate of Potential Losses**

Estimates of potential losses will be influenced by a variety of factors. The volume and force of the water will determine the scale of damages affecting office infrastructure, equipment, and other impacted features. The proximity to the failure and elevation above flood waters will affect the level of damage and individuals exposed. The time of the academic year, the day of week, and hour in which the failure was to occur will influence the number of people on campus and potential casualties. Losses will be generated by the physical damages, the loss of revenue, loss of academic research, loss of building contents, and community wide economic reductions.

Based on estimate replacement costs of facilities and structures on site, the total replacement costs due to dam or levee failure are unknown. However, it is unlikely for a dam or levee failure event to cause catastrophic destruction at CSU Chancellor’s Office.

**Vulnerability Assessment Conclusions**

While the occurrence of dam and levee failures have not been historically relevant near the CSU Chancellor’s Office, the potential for hazards related to the region’s levees and dams still exist. However, the presence of earthquake faults in proximity to the existing dam and levee structures presents a valid danger to downstream locations in the event of an earthquake. The consequences of a dam failure would generate catastrophic results to downstream communities. The potential for dam or levee failure further generates the added potential for a number of cascading effects such as disruptions to the local economy, utility failures, disruptions to providing for the needs of the community, and development of public health hazards. These effects would be exacerbated by effects of seasonal flooding, ongoing heavy precipitation, or excessive run-off from the watershed contributing to the river system. The potential for widespread flooding and damage of structures due to the force of water has exponentially powerful impacts on particular populations among the office community including those with access or functional needs, international students, the homeless, and students residing in the residence halls.

**Identified Data Limitations**

Data limitations include missing campus structural replacement costs, and an incomplete inventory of both building construction features and mitigation efforts to lessen the impact due to flood inundation.
**Drought**

Description of the Hazard

Drought is defined as a condition where moisture levels fall significantly below normal for an extended period of time over a large area that adversely affects plants, animal life, and humans. Drought is a gradual phenomenon. Although droughts are sometimes characterized as emergencies, they differ from typical emergency events. Most natural disasters, such as floods or forest fires, occur relatively rapidly and afford little time for preparing for disaster response. Droughts occur slowly, over a multi-year period, and it is often not obvious or easy to quantify when a drought begins and ends.

Throughout California, one dry year does not normally constitute a drought. California’s extensive system of water supply infrastructure (reservoirs, groundwater basins, and conveyance assets) mitigates the effect of short-term dry periods for most water users. Defining when a drought begins is a function of drought impacts to water users. Drought in one location may not constitute a drought for all water users, as some users in relative proximity may have a different water supply. For example, individual water suppliers may use a combination of sources such as rainfall/runoff, water in storage, or expected supply from a water wholesaler to define their water supply conditions.

Drought can be characterized as one or more of the four following types:

- **Meteorological drought** is defined on the basis of the degree of dryness (in comparison to some “normal” or average amount) and the duration of the dry period. A meteorological drought must be considered as region-specific since the atmospheric conditions that result in deficiencies of precipitation are highly variable from region to region.

- **Hydrological drought** is associated with the effects of periods of precipitation (including snowfall) shortfalls on surface or subsurface water supply (e.g., streamflow, reservoir and lake levels, ground water). The frequency and severity of hydrological drought is often defined on a watershed or river basin scale. Although all droughts originate with a deficiency of precipitation, hydrologists are more concerned with how this deficiency plays out through the hydrologic system. Hydrological droughts are usually out of phase with or lag the occurrence of meteorological and agricultural droughts. It takes longer for precipitation deficiencies to show up in components of the hydrological system such as soil moisture, streamflow, and ground water and reservoir levels. As a result, these impacts are out of phase with impacts in other economic sectors.

- **Agricultural drought** focus is on soil moisture deficiencies, differences between actual and potential evaporation, reduced ground water or reservoir levels, and so forth. Plant water demand depends on prevailing weather conditions, biological characteristics of the specific plant, its stage of growth, and the physical and biological properties of the soil.
- **Socioeconomic drought** refers to when physical water shortage begins to affect health, well-being, and quality of life of people, or when the drought starts to affect the supply and demand of an economic product that relies on water.

The drought issue in California is further compounded by water rights. The central challenge is how to prioritize water usage among a broad variety of contexts. It is for this reason that water is a commodity possessed and utilized under a variety of legal doctrines. As such, many competing sets of interests create a dynamic prioritization process between, for example, farming and federally protected fish habitats and water supply for municipal/public use, versus water usage for wildfire abatement or natural resource protection.

**Location of the Hazard**

Drought conditions have been identified throughout Los Angeles County and in the city of Long Beach, where the Chancellor’s Office is located. Drought is not a location-specific hazard and affects the entire planning area equally. Drought location is not isolated to the campus footprint but occurs as a geographic sub-set of drought conditions occurring at larger scales. From 2000-2020, drought conditions existed continuously in the state, with 80-100% of the state impacted for 12 of the last 20 years. 23

**Extent of the Hazard**

Given the historical occurrence of drought impacts throughout Los Angeles County which surrounds the planning area and the potential future impact exacerbated by climate change, the CSU Planning Committee recognizes that drought will continue to pose a high degree of risk statewide, potentially impacting crops, livestock, water resources, the natural environment at large, buildings and infrastructure (from land subsidence), and local economies.

In addition, although drought affects the entire CSU system-wide planning area, the potential impacts may be variable and specific to each campus/jurisdiction, depending on contextual factors such as the degree of assets and activities, historically impacted by drought within each jurisdiction. As such, the planning committee reports the extent of drought to be low for the Chancellor’s Office. Likewise, the City of Long Beach Hazard Mitigation Plan reports a low extent ranking for drought.

In addition, land subsidence has occurred statewide and will continue in areas where the groundwater basin has been subject to overdraft and long-term recharge is inadequate to maintain the water table elevation, leaving underground voids. Subsidence levels have been measured up to 30-feet in California with subsidence bowls covering hundreds of square miles. As such, drought-related subsidence may result in serious structural

damage to buildings, roads, irrigation ditches, underground utilities, and pipelines. Though these effects are not reported for the Chancellor’s Office, they remain potential issues of concern over the long term.

The CSU Planning Committee ranks the extent of drought as Low for the Chancellor’s Office (corresponding to D0-D1 in the table below), but recognizes that climate change and other factors affecting water supply and usage may increase the extent of the hazard in the future.

The U.S. Drought Monitor developed tables of impacts reported during past droughts in California in order to depict the extent of drought risk for each level of drought on the U.S. These possible extent conditions for California complement the general impacts column of the U.S. Drought Monitor Classification Scheme.

Table 27-14: Impacts of Drought Levels as Determined by US Drought Monitor\textsuperscript{24}

<table>
<thead>
<tr>
<th>Category</th>
<th>Impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>D0</td>
<td>Soil is dry; irrigation delivery begins early</td>
</tr>
<tr>
<td></td>
<td>Dryland crop germination is stunted</td>
</tr>
<tr>
<td></td>
<td>Active fire season begins</td>
</tr>
<tr>
<td></td>
<td>Winter resort visitation is low; snowpack is minimal</td>
</tr>
<tr>
<td>D1</td>
<td>Dryland pasture growth is stunted; producers give supplemental feed to cattle</td>
</tr>
<tr>
<td></td>
<td>Landscaping and gardens need irrigation earlier; wildlife patterns begin to change</td>
</tr>
<tr>
<td></td>
<td>Stock ponds and creeks are lower than usual</td>
</tr>
<tr>
<td>D2</td>
<td>Grazing land is inadequate</td>
</tr>
<tr>
<td></td>
<td>Producers increase water efficiency methods and drought-resistant crops</td>
</tr>
<tr>
<td></td>
<td>Fire season is longer, with high burn intensity, dry fuels, and large fire spatial extent; more fire crews are on staff</td>
</tr>
<tr>
<td></td>
<td>Wine country tourism increases; lake- and river-based tourism declines; boat ramps close</td>
</tr>
<tr>
<td></td>
<td>Trees are stressed; plants increase reproductive mechanisms; wildlife diseases increase</td>
</tr>
<tr>
<td></td>
<td>Water temperature increases; programs to divert water to protect fish begin</td>
</tr>
<tr>
<td></td>
<td>River flows decrease; reservoir levels are low and banks are exposed</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>D3</th>
<th>Livestock need expensive supplemental feed, cattle and horses are sold; little pasture remains, producers find it difficult to maintain organic meat requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Fruit trees bud early; producers begin irrigating in the winter</td>
</tr>
<tr>
<td></td>
<td>Federal water is not adequate to meet irrigation contracts; extracting supplemental groundwater is expensive</td>
</tr>
<tr>
<td></td>
<td>Dairy operations close</td>
</tr>
<tr>
<td></td>
<td>Marijuana growers illegally tap water out of rivers</td>
</tr>
<tr>
<td></td>
<td>Fire season lasts year-round; fires occur in typically wet parts of state; burn bans are implemented</td>
</tr>
<tr>
<td></td>
<td>Ski and rafting business is low, mountain communities suffer</td>
</tr>
<tr>
<td></td>
<td>Orchard removal and well drilling company business increase; panning for gold increases</td>
</tr>
<tr>
<td></td>
<td>Low river levels impede fish migration and cause lower survival rates</td>
</tr>
<tr>
<td></td>
<td>Wildlife encroach on developed areas; little native food and water is available for bears, which hibernate less</td>
</tr>
<tr>
<td></td>
<td>Water sanitation is a concern, reservoir levels drop significantly, surface water is nearly dry, flows are very low; water theft occurs</td>
</tr>
<tr>
<td></td>
<td>Wells and aquifer levels decrease; homeowners drill new wells</td>
</tr>
<tr>
<td></td>
<td>Water conservation rebate programs increase; water use restrictions are implemented; water transfers increase</td>
</tr>
<tr>
<td></td>
<td>Water is inadequate for agriculture, wildlife, and urban needs; reservoirs are extremely low; hydropower is restricted</td>
</tr>
<tr>
<td></td>
<td>Fields are left fallow; orchards are removed; vegetable yields are low; honey harvest is small</td>
</tr>
<tr>
<td></td>
<td>Fire season is very costly; number of fires and area burned are extensive</td>
</tr>
<tr>
<td></td>
<td>Many recreational activities are affected</td>
</tr>
<tr>
<td></td>
<td>Fish rescue and relocation begins; pine beetle infestation occurs; forest mortality is high; wetlands dry up; survival of native plants and animals is low; fewer wildflowers bloom; wildlife death is widespread; algae blooms appear</td>
</tr>
<tr>
<td></td>
<td>Policy change; agriculture unemployment is high, food aid is needed</td>
</tr>
<tr>
<td></td>
<td>Poor air quality affects health; greenhouse gas emissions increase as hydropower production decreases; West Nile Virus outbreaks rise</td>
</tr>
<tr>
<td></td>
<td>Water shortages are widespread; surface water is depleted; federal irrigation water deliveries are extremely low; junior water rights are</td>
</tr>
</tbody>
</table>
curtailed; water prices are extremely high; wells are dry, more and deeper wells are drilled; water quality is poor;

History of the Hazard

Historically, drought has been so prevalent in California that its presence is almost continuous. According to the US Drought Monitor, Time Series data, Los Angeles County (which surrounds the planning area) has experienced 6 or more periods of drought covering 13 years from 2000-2021.

Figure 27-5: Periods of Drought in Los Angeles County, California, 2000 – 2021

According to the National Drought Mitigation Center, over 3,500 reports and publications covering 370 drought-related events took place across the state (many of which were statewide events) between 2000-2020. In addition, the National Center for Environmental Information (NCEI) reports more than 500 events statewide during this same time period. These events produced a comprehensive range of impacts to water supply, regulations and allocations to businesses and municipalities, budgets and resources for firefighting, water law and policy, and physical impacts to built and natural environments. As such, data records of previous occurrences can be viewed as separate time and event demarcations for a hazard almost continuously in effect across the state with cascading impact potential.

According to the Department of Water Resources, droughts exceeding three years are relatively common in Southern California, but relatively rare in Northern California - the region is the geographic source of much of the state’s developed water supply. The 1929-

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34 drought established the criteria commonly used in designing storage capacity and yield of large Northern California reservoirs. 26

According to the US Drought Monitor’s time series data, from 2000-2021 (with the exception of a 2–3-month period in 2000 and 2011), some degree of drought conditions has been continuously in effect somewhere in California. In fact, 80% - 100% of the state has been subjected to drought conditions for 12 of the last 20 years, with the most severe drought being the 100% state-wide event from 2012-2017.

Figure 27-6: Periods of Drought in State of California, 2001 – 202127

Given the extent of the drought risk in California, the following drought event was selected as an exemplar due to its broad and significant impacts on Los Angeles County which surrounds the CSU Chancellor’s Office campus planning area:

2012 – 2017 – Drought produced severe impacts to water wells throughout the state of California, with a high number of wells running dry. Land subsidence due to increased groundwater pumping also occurred in numerous areas of the state such as the San Joaquin and Central Valleys. Crop damage was widespread as well. Water allotments were drastically reduced in many towns and water agencies, with extremely high costs for procuring water. In addition, job loss occurred with many families requiring food supply assistance, and water supply assistance provided to homeowners with dry wells.

According to a report released by UC Davis Center for Watershed Sciences, the 2012-2017 period of the California drought cost the state’s agriculture industry about $1 billion in lost revenue, with a total statewide economic cost of the drought calculated to be $2.2 billion. The report says, ‘it is responsible for the greatest water loss ever seen in California agriculture - about one third less than normal”’. The report calls the groundwater situation in California "a slow-moving train wreck." Spring snowpack at


Donner Summit reached record low levels in 2014, exceeded in 2015 by a remarkable April 1 snow-water-equivalent value of only 5% of average. Decreased precipitation since contributed to near-record low levels in the Shasta Reservoir. The ongoing drought has contributed to declines in crop values across the state. For example, crops including cotton, corn silage and barley (the field crop category) fell by 42 percent.  

**Potential Impacts of the Hazard**

Drought impacts statewide are wide-reaching and may be economic, environmental, and/or societal. This assessment of its impact recognizes that although no drought impacts have occurred in the planning area, potential impacts exist based on impact risk being a sub-set of larger and inter-connected local and regional droughts, and that the (related) historic impacts provide a sound basis for understanding potential (future) impacts.

The most significant potential impact associated with drought across the state and for the CSU Chancellor’s Office planning area is a potential reduction in water availability for the municipal area tied to the campus. Other impacts include crop loss and damage to trees and other natural resources (See Tree Mortality below). The footprint of CSU Chancellor’s Office to some extent includes these vulnerable resources based on the campus landscape (trees and flora).

As a secondary impact of drought, wildfire is directly attributable to dry atmospheric conditions. Wildfires almost always coincide with drought in California, though not limited to such. However, the wildfire hazard is analyzed separately in this plan. (See wildfire hazard).

In reviewing the impacts of drought for Los Angeles County, the US Drought Monitor and the National Drought Mitigation Center report that tens of millions of trees died during the (2012-2017) state-wide drought disaster. Though data sources do not provide data for tree mortality specific to CSU Chancellor’s Office, the broad geographic extent of the impact makes it likely that tree mortality occurred to some degree on the campus. Due to the lasting and ongoing effects of drought on the landscape, trees will continue to be impacted within the municipalities, counties and regions wherein lies the CSU campus system as long as drought conditions continue.

Given the absence of data, in order for the CSU Committee to assess the impact of tree mortality, it is useful to view it as a risk sub-set to the probability, location, extent, severity and duration of the drought hazard within each campus-located municipality, county and region. Regarding potential impacts, standing dead trees could fall, posing a

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risk to people, buildings, power lines, roads and other infrastructure. In addition, drought-impacted trees become susceptible to diseases and insect infestations (bark beetle) further adding to the risk of tree mortality and related potential impacts. No data is currently available for tree mortality on campus; however, the CSU Planning Team will pursue data on this issue in the future.

As a potential tertiary impact, prolonged and repeated drought conditions over time can produce land subsidence and the risk of damage to building foundations and infrastructure on campus resulting from ground instability and collapse. Land subsidence is defined as the vertical sinking of the land over manmade or natural underground voids. Subsidence is often the direct result of groundwater over-extraction in response to drought conditions, as well as oil and gas extraction. Weight can accelerate the process of subsidence resulting from surface development and infrastructure such as roads and buildings, vibrations from construction blasting and heavy truck or train traffic. For example, the State Water Project’s 444-mile-long California Aqueduct has required repairs such as the raising of canal linings, bridges, and water control structures on the Aqueduct – in the Central Valley a five-mile reach of the Eastside Bypass was impacted by subsidence, and the Department of Water Resources estimated that it may cost in the range of $250 million to acquire flowage easements and levee improvements to restore the design capacity of the subsided area.  

At present, drought related damage to campus buildings and infrastructure at the CSU Chancellor’s Office has not been reported, but the potential for such impacts is possible. With regard to overall potential impact, water supply/availability for CSU Chancellor’s Office is ultimately tied to broader inter-dependent, and more intensive modes of water use at local and regional scales such as agriculture and ranching, wildfire protection, larger metropolitan/municipal usage, manufacturing and commerce, tourism, recreation, and wildlife preservation. During drought periods, the State of California’s regulated water allocations are modified and often reduced, which can result in reduced water availability for all usage contexts, including the CSU Chancellor’s Office. A reduction of electric power generation and water quality deterioration are also potential impact factors.

Table 27-15: Summary of Drought Impacts on Water Resources

<table>
<thead>
<tr>
<th>Resource</th>
<th>Type of Impact</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sea Level</td>
<td>Direct</td>
<td>Sea level is rising and will likely impact coastal areas</td>
</tr>
</tbody>
</table>


<table>
<thead>
<tr>
<th>Hazard</th>
<th>Type</th>
<th>Effect</th>
</tr>
</thead>
<tbody>
<tr>
<td>Soil Moisture</td>
<td>Direct</td>
<td>Prolonged dry seasons can lead to decreases in soil moisture; drier vegetation</td>
</tr>
<tr>
<td>Vegetation</td>
<td>Indirect</td>
<td>Longer and more intense fire season with increased extent of area burned</td>
</tr>
<tr>
<td>Stream Conditions</td>
<td>Direct</td>
<td>Increases in water temperature; potential effects on fish</td>
</tr>
<tr>
<td>Snowpack</td>
<td>Indirect</td>
<td>Increases in temperature will lead to decreases in snowpack</td>
</tr>
<tr>
<td>Runoff</td>
<td>Direct</td>
<td>Warmer temperatures are likely to lead to a shift in peak runoff from spring to winter and a likely decrease in summer base flow</td>
</tr>
<tr>
<td>Hydropower</td>
<td>Indirect</td>
<td>Decreased summer flows resulting from earlier snowmelt and a shift in peak runoff could affect hydropower generation during summer months</td>
</tr>
<tr>
<td>Precipitation</td>
<td>Direct</td>
<td>Warmer winter temperatures will result in a greater percentage of precipitation falling as rain rather than as snow</td>
</tr>
<tr>
<td>Groundwater</td>
<td>Indirect</td>
<td>Reduction in snowpack and extended periods of drought are likely to increase dependency on groundwater</td>
</tr>
</tbody>
</table>

**Probability of Future Occurrence of the Hazard**

**Highly Likely** — The US Drought Monitor’s time series data (2000-2020) indicates that some degree of drought has nearly a 100% probability of occurrence in the state in any given year. Given that CSU Chancellor’s Office lies within a consistently drought impacted region, it is prudent to extend this likelihood of occurrence to the planning area even though drought impacts have not reached the campus up to this point.

**Vulnerability to the Hazard**

In California, rising temperatures are projected to increase the average lowest elevation at which snow falls, reducing water storage in the snowpack, particularly at those lower mountain elevations which are now on the margins of reliable snowpack accumulation. Higher spring temperatures will also result in earlier melting of the snowpack. The shift in snow melt to earlier in the season is critical for California’s water supply because flood control rules require that water be allowed to flow downstream, and that water cannot be stored in reservoirs for use in the dry season. As such, state-level drought risk factors that have led to drought’s state-wide severity and extent, and potential impacts also create drought vulnerabilities at the level of the CSU Chancellor’s Office campus.
Moreover, climate change will likely adversely impact the vulnerability of watersheds and ecosystems in their ability to deliver important ecosystem services. These changes may limit the natural capacity of healthy forests to capture water and regulate stream flows. Sierra Nevada mountain winters and springs are warming, and on average, precipitation as snowfall relative to rain is decreasing. A warming climate with reduced snowpack will result in earlier snowmelt and will subsequently reduce downstream water availability during summer and early fall.

As such, the state and the CSU Chancellor’s Office planning area stakeholders potentially have less capacity to address future drought risks due to projected temperature increases and shortages in water; ground-water withdrawals have been occurring at a deficit rate of 1 – 2 million acre-feet per year, where the impacts of drought include decreased availability of water for agriculture and environmental uses. In forested and other vegetated areas, prolonged drought decreases the moisture content of forest fuels and increases the risk of high severity wildfires.

It should be pointed out that California is the single most productive agricultural state and its agricultural industry relies heavily on reservoir water supplied by snowmelt and rainfall runoff. Yearly variations in snowpack depths have implications for water availability as snowmelt from the winter snowpack feeds a network of reservoirs. Spring snowpack at Donner Summit reached record low levels in 2014, exceeded in 2015 by a remarkable April 1 snow-water-equivalent value of only 5% of average. Decreased precipitation since 2011 has contributed to near-record low levels in the Shasta Reservoir.

Vulnerability of Populations

Drought vulnerabilities on California’s population include agricultural sector job loss, secondary economic losses to local businesses and public recreational resources, increased cost to local and state government for large-scale water acquisition and delivery, and water rationing and water wells running dry for individuals and families. As drought is often accompanied by prolonged periods of extreme heat, negative health impacts such as dehydration can also occur, where children and elderly are most susceptible. Air quality often declines in times of drought which can affect those with respiratory ailments. These same vulnerabilities apply to the faculty and staff of the CSU - Chancellor’s Office campus over the long term.

Property Vulnerability

Drought vulnerabilities on property statewide include crop loss, injury and death of livestock and pets, and damage to infrastructure, homes and other buildings resulting

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from the secondary drought impact of land subsidence. The related drought impacts of tree mortality and land subsidence pose risks to vulnerable critical infrastructure and property. These same vulnerabilities may apply to the properties of the CSU Chancellor's Office campus over the long term.

**Natural Environment Vulnerability**

Drought vulnerabilities on the natural environment are widespread throughout public and private lands within the state, including tree mortality, impacts to all flora and fauna, and destabilization (subsidence) of land along streams and rivers, and within watersheds. These same vulnerabilities may apply to the landscaping and flora of the CSU Chancellor's Office campus over the long term.

The core issue shaping the impact of drought throughout California is water supply and demand. Several factors play into the issue including groundwater basins, surface water run-off, public and agricultural demand, and surface water storage water sheds. A USGS led analysis was first conducted in 2010 through the Forest and Rangeland Assessment and ongoing through the USGS Forest and Rangeland Ecosystem Science Center to identify threats and assets where water supply would benefit from environmental management designed to protect or enhance water resources, the key effort which, in part, both defines and mitigates the severity of drought risk and vulnerabilities.

With regard to overall threat and asset findings shaping the potential severity of drought, the watersheds in the Sierra region contribute most greatly to the state’s water supply, but are under threat from climate change, wildfire and development. In addition, groundwater basins in the San Joaquin Valley and Sacramento Valley bioregions are an abundant resource that is heavily threatened by over pumping.34

**Critical Facilities Vulnerabilities**

Drought vulnerabilities for the CSU Chancellor’s Office’s critical facilities include water shortfalls for facility operations and critical functions, and potential structural destabilization and damage resulting from land subsidence over the long term.

**Estimate of Potential Losses**

An estimate of potential losses from drought has not been calculated for the campus or the CSU system as a whole. However, drought related losses to the City of Long Beach and the surrounding region such as crop loss and cost increases for water resources have re-occurred over time. Please consult city and county level government, and/or state agricultural agencies for data on the financial impacts from drought.

**Vulnerability Conclusions**

34 USGS. Forest and Rangeland Ecosystem Science Center. Retrieved 4.29.2021 from: 
https://www.usgs.gov/centers/fresc
The CSU Planning Committee understands that the high degree of vulnerability posed by drought will be exacerbated by greater climate variation in the future and therefore greater variation and uncertainty regarding the availability of water supplies which are already under tremendous stress. In response to such vulnerability, state legislation passed in 2014 requires local governments to regulate pumping and recharge to better manage groundwater supplies, and groundwater-dependent regions are required to halt overdraft and bring basins into sustainable levels of pumping and recharge by the early 2040s. That said, the Committee will continue to work with local, regional and state partners and stakeholders to explore solutions for mitigating the drought hazard on its campuses (including the Chancellor’s Office) by accessing the best available data and resources on climate change and its relationship to drought.

**Identified Data Limitations**

Data is limited concerning campus-related agricultural assets as well as data on campus tree mortality.

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**Earthquake**

**Description of the Hazard**

An earthquake is a sudden motion or shaking caused by the release of pressure accumulated along the edge of tectonic plates covering the earth. These huge plates are constantly moving and move ever so slowly under, over, or by passing one another. This movement is gradual however the plates may lock together accumulating enormous amounts of energy. When this energy builds, stress develops, and the adjoining plates will eventually break free and result in ground shaking – an earthquake.

Large earthquakes may result in fissuring, ground settlement, and/or vertical or horizontal displacement. Earthquakes occur without warning and can result in extensive damages and human casualties. Damages associated to earthquake generated ground shaking is normally confined to a narrow area along fault trend from the earthquake epicenter. However, seismic waves may generate ground shaking resulting in damages in areas outside of the fault trend.

**Fault Rupture** – The rupture of faults is the differential movement of the two sides of the earth’s plates at the point of the fault. Horizontal or vertical displacement may be significant and occur over great distances. The movement and energy that occurs along a fault is released in waves resulting in ground shaking. The intensity of ground shaking varies based on the magnitude of the earthquake, the proximity to the earthquake epicenter, the composition of the ground sediment or rock the waves travel through, and the depth of the earthquake.

**Liquefaction** – In addition to the primary fault rupture that occurs right along a fault during an earthquake, the ground many miles away can also fail during intense shaking. As seismic waves travel through saturated granular soil; the soil begins to liquefy and act as a fluid. Soil strength and stability is lost causing the effects of ground shaking to
intensify and for ground deformation to occur. These water saturated soils when shaken quickly lose the ability to support buildings, bridges, utilities, and other structures. Areas susceptible to liquefaction include places where sandy sediments have been deposited by rivers along their course or by wave action along beaches. The greater the magnitude of an earthquake and longer duration of strong ground shaking will result in an enhanced potential for liquefaction to occur. Settlement can cause damage when the amount settlement varies significantly across the length of a structure. Lateral spreading occurs when liquefaction occurs on gently sloping ground and the liquefied material at depth allows the area to slide, often toward a vertical discontinuity or “free face” such as a creek or stream channel. Liquefaction can occur in susceptible soils below bodies of water, and settlement and lateral spreading can damage structures built on or adjacent to these areas. Transportation bridges across water bodies, wharves, piers and other structures at ports and harbors, and underwater utility lines can be severely damaged by this hidden hazard.

**Subsidence** - Changes in the local environment that cause subsidence or sinkholes are called triggering mechanisms. Water is the primary factor that affects the local environment and causes subsidence. Water level decline, changes in groundwater flow, increased loading, and deterioration (such as abandoned mines) are all triggering mechanisms. Water level decline may occur naturally, or it may be the result of human action. Factors that lead to water decline are pumping (from wells), localized drainage (for construction activities), dewatering, or drought. Changes in groundwater flow can result from an increase in the velocity of groundwater movement, and increase in the frequency of water table fluctuations, and changes in discharge (either increase or decrease). Increased loading can cause pressure in the soil, leading to the failure of underground cavities and space, such as caves. Vibrations from earthquakes, heavy machinery, and blasting may result in structural collapse, followed by surface resettlement.

**Location of the Hazard**

The State of California is particularly vulnerable to earthquake activity due to California’s location residing between two large tectonic plates. CSU Chancellor’s Office is located in the southern portion of the Los Angeles Basin. In general, fault systems surround and traverse through Los Angeles and Orange Counties including the area of CSU Chancellor’s Office. Throughout the basin the ground is saturated with sediment eroded from the mountains and foothills via multiple stream and river channels and resulting in liquefaction zones scattered across the region.

The Pacific Plate and the North American Plate come together at the San Andreas Fault 50-55 miles northeast of the CSU Chancellor’s Office. In addition to the San Andreas Fault, Los Angeles County is home to or near additional fault systems with the potential to generate strong ground shaking. The Newport-Inglewood Fault traverses south to north paralleling the Orange County coastline extending within ¾ mile of CSU Chancellor’s Office from the southwest corner of the office. The Palos Verdes Fault crosses the Palos Verdes Peninsula approximately 11 miles east of the campus. The 40-mile-long Compton Fault parallels the Palos Verdes Fault in a southeast to northwest
direction 9 miles east of the CSU Chancellor’s Office. The Whittier-Elsinore Fault extends from the eastern base of the Santa Ana Mountains and western base of the Puente Hills 15 miles to the northeast of the office. There are numerous additional faults in the area on all sides of the office.
The CSU Chancellor’s Office reside entirely within areas designated to be liquefaction zones. Additionally, substantial areas of the community surrounding the office to the north, east, and west also reside within the liquefaction zone. This includes major transportation corridors including Interstate 710, Interstate 405, State Route 1, Ocean Blvd., and Golden Shore Street. The liquefaction zone includes all office facilities.

Figure 27-8: Liquefaction Zones in Proximity to CSU Chancellor’s Office

Extent of the Hazard

The extent or severity of earthquake damage is expressed in terms of magnitude, intensity and duration. The amount of energy released during an earthquake is normally conveyed as a magnitude measured from a seismogram. Magnitude is expressed in numbers and decimals representing the physical size of the earthquake. The strength and effect of the shaking on the surface of the earth is classified as the intensity. Intensity is further defined from the effects the earthquake has on people, structures, and the natural environment. The intensity of an earthquake in terms of measuring magnitude and evaluating its effects is generally expressed using the Modified Mercalli (MM) Intensity Scale. Duration is the length of time the earthquake’s energy is released.

The Richter magnitude scale was developed in 1935 by Charles F. Richter of the California Institute of Technology as a mathematical device to compare the size of earthquakes. The Richter Scale (below) is the best-known scale for measuring the magnitude of earthquakes. The magnitude value is proportional to the logarithm of the amplitude of the strongest wave during an earthquake. A recording of 7, for example, indicates a disturbance with ground motion 10 times as large as a recording of 6. The energy
released by an earthquake increases by a factor of 31 for every unit increase in the Richter scale.

Table 27-16: Earthquake Intensity and Frequency Comparisons

<table>
<thead>
<tr>
<th>Magnitude</th>
<th>Mercalli Intensity</th>
<th>Potential Damage</th>
<th>Global Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 2.0</td>
<td>I</td>
<td>None</td>
<td>Continually</td>
</tr>
<tr>
<td>2.0 - 2.9</td>
<td>I to II</td>
<td></td>
<td>&gt; IM per year</td>
</tr>
<tr>
<td>3.0 - 3.9</td>
<td>II to IV</td>
<td></td>
<td>&gt; 100,000 per year</td>
</tr>
<tr>
<td>4.0 - 4.9</td>
<td>IV to VII</td>
<td>Light</td>
<td>10K to 15 K per year</td>
</tr>
<tr>
<td>5.0 - 5.9</td>
<td>VI to VII</td>
<td>Moderate</td>
<td>1K to 1,500 per year</td>
</tr>
<tr>
<td>6.0 - 6.9</td>
<td>VII to X</td>
<td>Heavy</td>
<td>100 to 150 per year</td>
</tr>
<tr>
<td>7.0 - 7.9</td>
<td>VII &lt;</td>
<td>Very Heavy</td>
<td>10 - 20 per year</td>
</tr>
<tr>
<td>8.0 - 8.9</td>
<td>VII &lt;</td>
<td></td>
<td>1 per year</td>
</tr>
<tr>
<td>&gt; 9.0</td>
<td>VII &lt;</td>
<td></td>
<td>1 per 10-50 years</td>
</tr>
</tbody>
</table>

The Modified Mercalli Intensity Scale provides descriptive values of earthquake intensity that may provide greater meaning to the broader population as the description of intensity refers to the effects actually experienced. This scale uses an arbitrary ranking based on observed earthquake effects. The scale is composed of increasing levels of intensity ranging from shaking that is not recognizable to intense shaking resulting in catastrophic damages and casualties. The Modified Mercalli Intensity Scale is demonstrated below:
Table 27-17: Modified Mercalli Intensity Scale

<table>
<thead>
<tr>
<th>Intensity</th>
<th>Shaking</th>
<th>Description / Damage</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Not felt</td>
<td>Not felt except by a very few under especially favorable conditions.</td>
</tr>
<tr>
<td>II</td>
<td>Weak</td>
<td>Felt only by a few persons at rest, especially on upper floors of buildings.</td>
</tr>
<tr>
<td>III</td>
<td>Weak</td>
<td>Felt quite noticeably by persons indoors, especially on upper floors of buildings. Many people do not recognize it as an earthquake. Standing motor cars may rock slightly. Vibrations similar to the passing of a truck. Duration estimated.</td>
</tr>
<tr>
<td>IV</td>
<td>Light</td>
<td>Felt indoors by many, outdoors by few during the day. At night, some awakened. Dishes, windows, doors disturbed; walls make cracking sound. Sensation like heavy truck striking building. Standing motor cars rocked noticeably.</td>
</tr>
<tr>
<td>V</td>
<td>Moderate</td>
<td>Felt by nearly everyone; many awakened. Some dishes, windows broken. Unstable objects overturned. Pendulum clocks may stop.</td>
</tr>
<tr>
<td>VI</td>
<td>Strong</td>
<td>Felt by all, many frightened. Some heavy furniture moved; a few instances of fallen plaster. Damage slight.</td>
</tr>
<tr>
<td>VII</td>
<td>Very strong</td>
<td>Damage negligible in buildings of good design and construction; slight to moderate in well-built ordinary structures; considerable damage in poorly built or badly designed structures; some chimneys broken.</td>
</tr>
<tr>
<td>VIII</td>
<td>Severe</td>
<td>Damage slight in specially designed structures; considerable damage in ordinary substantial buildings with partial collapse. Damage great in poorly built structures. Fall of chimneys, factory stacks, columns, monuments, walls. Heavy furniture overturned.</td>
</tr>
</tbody>
</table>

Damage considerable in specially designed structures; well-designed frame structures thrown out of plumb. Damage great in substantial buildings, with partial collapse. Buildings shifted off foundations.

Some well-built wooden structures destroyed; most masonry and frame structures destroyed with foundations. Rails bent.

The graph below illustrates the increasing intensity of energy that is released and as the measured magnitude increases. While each whole number increases in magnitude represents a tenfold increase in the measured amplitude, it represents an increasing rate of 32 times more energy released in the same increase in magnitude. As the magnitude of an earthquake is measured higher, the intensity of the earthquake worsens progressively from one category to the next.

![Figure 27-9: Earthquake Magnitude and Equivalent Energy Release](https://www.usgs.gov/media/images/graph-showing-earthquake-magnitudes-and-equivalent-energy-release)

Based on the history of earthquake occurrences in Los Angeles County, including a near catastrophic event in Long Beach, and the presence of 9 fault systems throughout the

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county, and ongoing predicted severe events statewide, the planning committee ranks the extent of the hazard as **Moderate**.

**History of the Hazard**

The State of California has a long history of chronic and destructive earthquakes throughout the state. On average, earthquakes strong enough to result in structural damages occur three to four times a year in California, while earthquakes Magnitude 6.0 to 6.9 occur once every two to three years. Los Angeles County also has a long history of earthquake activity. The entire area of Los Angeles County is at risk to seismic activity and has a history of significant earthquakes resulting in damages.

The most recent significant earthquake to occur in immediate proximity to Long Beach was in July of 1933. The earthquake occurred on the Newport-Inglewood Fault off of the coast of Newport Beach. The earthquake was felt throughout Southern California and resulted in damages in multiple counties. Long Beach experienced multiple fires, 127 water main breaks, and liquefaction was experienced along the waterfront. Regionally, including Long Beach, 120 people were killed, 5,000 injured, 20,000 homes were damaged, and 75% of schools were destroyed.

**Table 27-18: Historic Earthquakes Near Long Beach, CA**

<table>
<thead>
<tr>
<th>Date</th>
<th>Location</th>
<th>Magnitude</th>
<th>Damages</th>
</tr>
</thead>
<tbody>
<tr>
<td>12/8/1812</td>
<td>San Juan Capistrano</td>
<td>7.5</td>
<td>40 fatalities</td>
</tr>
<tr>
<td>7/11/1855</td>
<td>Los Angeles</td>
<td>6.0</td>
<td>Structural damages</td>
</tr>
<tr>
<td>3/10/1933</td>
<td>Long Beach</td>
<td>6.4</td>
<td>120 fatalities, $40 million</td>
</tr>
<tr>
<td>2/9/1971</td>
<td>San Fernando</td>
<td>6.6</td>
<td>58-65 fatalities, $553 million</td>
</tr>
<tr>
<td>1/1/1979</td>
<td>Malibu</td>
<td>5.2</td>
<td>Minor</td>
</tr>
<tr>
<td>10/1/1987</td>
<td>Whittier</td>
<td>5.9</td>
<td>8 fatalities, $358 million</td>
</tr>
<tr>
<td>2/28/1990</td>
<td>Upland</td>
<td>5.7</td>
<td>30 injuries, $12.7 million</td>
</tr>
<tr>
<td>6/28/1991</td>
<td>Sierra Madre</td>
<td>5.6</td>
<td>1 fatality, $40 million</td>
</tr>
<tr>
<td>1/17/1994</td>
<td>Northridge</td>
<td>6.7</td>
<td>57 fatalities, $40 billion</td>
</tr>
<tr>
<td>7/29/2008</td>
<td>Chino Hills</td>
<td>5.5</td>
<td>Minor</td>
</tr>
<tr>
<td>3/28/2014</td>
<td>La Habra</td>
<td>5.1</td>
<td>$10 million</td>
</tr>
</tbody>
</table>

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38 City of Long Beach Hazard Mitigation Plan, February 28, 2017

39 2019 County of Los Angeles All-Hazards Mitigation Plan, 2019
Other earthquakes of significance include, the more recent January 17, 1994 Northridge Earthquake estimated a Magnitude 6.7 earthquake struck at 4:52 am. The earthquake occurred in the San Fernando Valley about 20 miles northwest of Los Angeles. There was widespread damage from buildings, collapsed freeways, and other infrastructure damage. Damages from the earthquake were more than $20B.

The October 1, 1987 Whittier Narrows Earthquake shook a large part of southern California. The earthquake caused $358 million in damages, especially in the Alhambra, Pasadena, and Whittier areas. The earthquake resulted in extensive infrastructure damages, multiple injuries, and 8 fatalities. The earthquake was provided a federal disaster declaration (DR-799).

The February 9, 1971, Magnitude 6.5 San Fernando Earthquake struck the San Fernando Valley in Los Angeles just after 6am. The intense shaking caused the collapse of freeway overpasses, hospitals, and other infrastructure. It damaged thousands of homes and businesses, a reservoir, and critical infrastructure. 65 people were killed and 2,000 more were injured. The shaking was felt for 300 miles including in Las Vegas, Nevada. The earthquake was provided a federal disaster declaration (DR-299).

The Fort Tejon Earthquake, a Magnitude 7.9 earthquake, struck in 1857 along the San Andreas fault just north of Los Angeles County. The earthquake was able to shift the Kern River upstream and run four feet over its banks. Structural damage was limited as the area was sparsely populated at the time. The Fort Tejon Earthquake remains one of the greatest earthquakes ever recorded in the United States producing a surface rupture extending over 220 miles.

Potential Impacts of the Hazard

The shaking of the ground from earthquakes can result in building collapse, bridge failure, utility disruptions and other structural collapse. Large earthquakes can additionally cause natural gas lines to break resulting in structure fires. The proximity to the unstable soils surrounding the building presents a potential for liquefaction creating greater ground instability during seismic events. A major earthquake in the Los Angeles area would likely result in region-wide social disruptions in addition to structural damages. The region-wide structural damages may disrupt lifelines and supply chain routes limiting the campus from effective evacuation routes and receiving necessary supplies or equipment.

Most injuries resulting from earthquakes are from collapsing walls, flying glass, or other objects moved by ground shaking. The lack of warning allows individuals minimal time to react and find areas of safety. A moderate earthquake occurring near Long Beach could cause injuries or fatalities to members of the campus community or support networks the office relies on. These earthquake effects might be aggravated by collateral incidents such as fire, flooding, hazardous material spills, dam/levee compromises, and other cascading events. A catastrophic earthquake near Long Beach could result in extensive casualties, expansive structural damages, panic, widespread utility outages, communication failures, and secondary emergencies such as fire. A catastrophic earthquake would certainly
affect the broader Los Angeles County and Orange County region limiting immediate assistance that the campus may normally expect.

Local impacts to the CSU Chancellor’s Office caused by an earthquake could include:

- Damage to nearby refineries and petrol-chemical plants
- Damage and secondary fires to industrial buildings to the west of the office
- Potential hazardous material releases on and off facility
- Potential liquefaction-based effects to most areas of the campus and large areas of the surrounding cities
- Infrastructure to freeway system
- Structural damage to bridges over waterways and flood control channels
- Structural damage to flood control systems
- Potential isolation of office from community
- Potential isolation among office employees and visitors at the time of the event
- Structural damage to San Gabriel River and Los Cerritos Channel levees
- Structural damage to office buildings
- Structural damage to nearby residences
- Community members arriving on campus for refuge from damaged homes
- Damaged university communications, computer systems, and networks
- Considerable stress and fear among community
- Closure or reduction of service to office operations

The impacts of a major earthquake would be felt beyond the campus and have long reaching effects. The risk of casualties and damages would likely extend to the homes and workplaces of members of the office community including staff and faculty. The effects on the regional economy may be negatively altered as commercial and industrial facilities may not be functional due to damaged goods and/or facilities. The cessation of businesses would result in job losses and greater needs among members of the community. The trauma associated with experiencing a large earthquake often requires mental health assistance to victims and may result in fears to return indoors while aftershocks continue.

**Probability of Future Occurrence of the Hazard**

The Working Group on California Earthquake Probabilities (WGCEP), a collaboration between the United States Geological Survey (USGS), the Southern California Earthquake Center (SCEC), and the California Geological Survey (CGS) develops Uniform California Earthquake Forecasts (UCERFs) using the best currently available science and technology. The UCERF version 3 provides a three-dimensional view of the likelihood a region in
California will experience a Magnitude 6.7 or greater earthquake in the next 30 years. The likelihood for the Los Angeles County fault systems surrounding Long Beach is included in the following table.

Table 27-19: Major Potentially Active Faults in Proximity to CSU Chancellor’s Office

<table>
<thead>
<tr>
<th>Fault Zone</th>
<th>Recurrence</th>
<th>Maximum Magnitude</th>
<th>UCERF3 Likelihood</th>
</tr>
</thead>
<tbody>
<tr>
<td>Compton</td>
<td>Historic: Unknown</td>
<td>6.5 to 7.1</td>
<td>1%</td>
</tr>
<tr>
<td>Hollywood</td>
<td>Historic: 1,600 years</td>
<td>5.8 to 6.5</td>
<td>1-2%</td>
</tr>
<tr>
<td>Newport-Inglewood</td>
<td>Historic: Unknown</td>
<td>6.0 to 7.4</td>
<td>1%</td>
</tr>
<tr>
<td>Palos Verdes</td>
<td>Historic: Unknown</td>
<td>6.0 to 7.0</td>
<td>3%</td>
</tr>
<tr>
<td>San Andreas</td>
<td>Varies: 100-300 years</td>
<td>6.8 to 8.0</td>
<td>18-20%</td>
</tr>
<tr>
<td>Santa Monica</td>
<td>Historic: Unknown</td>
<td>6.0 to 7.0</td>
<td>1%</td>
</tr>
<tr>
<td>Sierra Madre</td>
<td>Historic: 1,000-3,000 years</td>
<td>6.0 to 7.0</td>
<td>1-2%</td>
</tr>
<tr>
<td>Verdugo</td>
<td>Historic: Unknown</td>
<td>6.0 to 6.8</td>
<td>1%</td>
</tr>
<tr>
<td>Whittier</td>
<td>Historic: Unknown</td>
<td>6.0 to 7.2</td>
<td>1%</td>
</tr>
</tbody>
</table>

Based on the earthquake shaking potential in the Los Angeles Basin, the proximity to the above listed fault systems, the probability of seismic ground shaking generating damage is considered Possible.

Vulnerability to the Hazard

A considerable challenge regarding earthquakes is they generally occur without warning. The fault systems surrounding the region all cross major transportation routes potentially reducing the availability of access and the supply chain. The geographic location of Long Beach places the office in a busy commercial and industrial areas that is heavily populated. Earthquake effects experienced in the neighboring local community will likely spill over onto the facility. The entirety of the facility is designated as a liquefaction zone and may be impacted by the effects of tidal influences.

The known fault systems generating the threat to Long Beach generally surround the city and some cross into the city, including near to the CSU Chancellor’s Office. The proximity and potential for large earthquake development from these surrounding systems expose

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40 2019 County of Los Angeles All-Hazards Mitigation Plan, 2019

significant vulnerabilities. The potential for earthquake damaged structures being left uninhabitable will result in numerous displaced individuals and households. The lack of earthquake insurance will cause extreme financial burdens on those affected. Chancellor’s Office buildings and equipment would be vulnerable to damages from building, seismic shaking, secondary fires, and secondary building floods from broken pipes.

Elements of the vulnerability to a major earthquake on the CSU Chancellor’s Office will vary depending on when the earthquake were to strike. The primary basis of vulnerability is based on the population affected and the built environment exposed. In general, newer construction will be more earthquake resistant than older buildings as building codes and construction technology have improved. A locally centered earthquake, even from moderate events, would have the potential for more damaging results when associated with the moderate liquefaction zones of the area. This would particularly be seen with greater damages to unreinforced masonry buildings.

Generally, people are safer when at home in wood frame structures as earthquakes tend to generate less structural damage to wood construction than in commercial or industrial facilities. The greater number of people on campus at the time of an earthquake will result in more people being exposed to effects from damaged campus facilities or equipment and require greater evacuation assistance. However, in region-wide events this vulnerability may simply shift to the homes and workplaces of members of the campus community and their families.

The aftermath of a major earthquake will likely result in widespread search and rescue operations for trapped and injured individuals. The demand on emergency services will be great, potentially requiring the office community to be prepared for these scenarios and initiate response actions as needed. There will be needs for emergency medical care, shelter, water, and food for individuals who have been displaced by the earthquake. In earthquakes causing significant damages, there may be a need to assist with identification and support to local agencies in mass fatality management.

There may be a need to evacuate members of the campus community from the campus and to other locations that are deemed to be safer locations. As the CSU Chancellor’s Office is areas exposed to levee facilities, the decision to evacuate will need to verify whether flood control facilities are filled with water and the actual threat to the dam or levees.

Certain campus populations will experience greater challenges to a post-earthquake environment. Vulnerable populations including those that rely on specific services, require electrical power, experience disabilities, non-English speakers, those whose age make evacuating difficult, and others will be most affected. These individuals will likely need to navigate through earthquake generated debris, extreme stresses of a disaster, an inability to communicate to or gain access to support networks and find difficulty in accessing equipment or supplies to aid in a specific need.
Estimate of Potential Losses

Estimates of potential losses will be influenced by a variety of factors. The intensity of the earthquake will determine what scale of damages affecting campus infrastructure, equipment, and other impacted features. Losses will be generated by the physical damages, the loss of revenue, loss of academic research, loss of building contents, and community-wide economic reductions.

Based on estimated replacement costs of facilities and structures on campus, the maximum total replacement costs due to earthquake are unknown.

Table 27-20: HAZUS Peak Ground Acceleration (PGA) Zone Estimated Losses

<table>
<thead>
<tr>
<th>PGA Zone Designation</th>
<th>Intensity</th>
<th>No. of Buildings</th>
<th>Maximum Replacement Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Extreme X+</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Violent IX</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Severe VIII</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Very Strong VII</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Strong VI</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Moderate V</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Light IV</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Weak II-III</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Not Felt I</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>NA</td>
<td>NA</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>No Building Value Data Provided*</td>
<td>NA</td>
<td>1</td>
<td>Unknown</td>
</tr>
</tbody>
</table>

*Buildings with no value defined are also included in the respective Zones they are found in.

Vulnerability Assessment Conclusions

It is difficult to predict the severity of casualties, property, and cascading impacts generated by future seismic events affecting the greater Los Angeles region and the CSU Chancellor’s Office. Each of the earthquake generated effects will vary widely based on the intensity of the earthquake, location of the epicenter, proximity to people and development, time of day and year, the soil composition under the impacted structures, building construction, among others. In any case, the potential for a major earthquake exists affecting the campus and causing extensive challenges to the CSU Chancellor’s Office and community.

In the event that a major earthquake were to occur along the many fault systems surrounding Long Beach, the effects could be significant to the office community and facility operations. The widespread impacts generated by a major earthquake would extend the effects of casualties, damages, and other impacts to the broader Los Angeles...
region creating large-scale regionwide needs for critical assistance and a heavy demand on limited emergency resources. The threat and impacts presented to the campus will be shared with the campus community from their homes and places of work. The facility will likely be required to address critical needs independently during early phases of the disaster.

The office population are additionally vulnerable to the effects of major ground shaking that are far reaching. The psychological and social impacts a major earthquake will give rise to will potentially harm individuals and cause tremendous fear. The willingness to return indoors may be hampered especially as after-shocks continue. These effects are magnified for populations having specific vulnerabilities or access limitations. Populations having various limitations or specific needs may be vulnerable to reduced or eliminated access to essential services that have been rendered incapable to respond.

Identified Data Limitations

Data limitations include missing campus structural replacement costs, and lack of a complete inventory of building construction types to include status of earthquake retrofitting. HAZUS generated analysis is focused on the broader community level versus fine-tuning the analysis to the micro-level for facilities such as a university campus.

**Erosion**

**Description of the Hazard**

The US Geological Survey (USGS) defines erosion as “the process whereby materials of the earth’s crust are loosened, dissolved, or worn away and simultaneously moved from one place to another.”\(^{42}\) Erosion may occur in areas of streams and rivers, along bluffs, around immovable objects (such as buildings or bridge abutments), or as a cascading result of other natural hazards, such as earthquakes or wildfires. When erosion occurs along bodies of water, the removal of material causes the shore to move further landward.

Forces such as sea level rise and changes in sediment supply impact erosion gradually and can be difficult to recognize. In contrast, the impacts of short-term events, such as storms and flooding, can be severe and are immediately recognizable. Along the Pacific coast, rain, wind, and waves can induce significant short-term erosion.

**Location of the Hazard**

Erosion is a relatively non-spatial hazard that can occur in any location with conducive soil structure and a source of movement such as water or wind. An area’s potential for erosion is determined by several factors, including rainfall, topography, soil

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characteristics, and vegetative cover. Erosion is a severe hazard in coastal communities, where sea level rise and storms contribute to de-sedimentation and the retreat of coastal cliffs, bluffs, and beaches. As such, for the purpose of this campus-level analysis, the erosion hazard poses a consistent risk across the terrain of the CSU Chancellor’s Office campus with erosion-prone characteristics.

Extent of the Hazard
Erosion is occurring on the Pacific coastline west of the Chancellor’s Office. While there is no published scale of severity or extent for this geologic hazard at the Chancellor’s Office location, erosion is likely to occur if conditions are favorable. Given no historical occurrence of erosion on campus, the planning committee ranks the extent of this hazard as Low.

History of the Hazard
There is no record of past incidents of erosion at the Chancellor’s Office.

Potential Impacts of the Hazard
Erosion causes instability in soil. During high-intensity rain events, for example, eroded areas will continue to erode, resulting in additional loss of soil and ground stability in the area. This removal of sediment can result in damage to infrastructure, public health, and safety. Coastal erosion can result in severe impacts to local infrastructure, including the undermining of foundations, exposure of underground infrastructure, and breaches of natural or constructed protections. The latter can expose communities to the destructive forces of floodwaters, surge, and debris impacts. At the Chancellor’s Office, areas of erosion can create pedestrian and transportation hazards, and structures may become unsafe if erosion is not controlled. Public health and safety, structures, and infrastructure can all be negatively impacted, damaged, or destroyed by the erosion hazard.

Probability of Future Occurrence of the Hazard
Erosion is an on-going and dynamic process that occurs regularly. As climate change raises sea levels and induces more frequent and intense weather events, coastal and other erosion may generally become more widespread or severe. These events can cause erosion or exacerbate areas already experiencing erosion. As a result, and in consideration of the potential extent of erosion, the probability of at least a limited degree of erosion in the future is likely over the long term, though Possible on an annual basis.

Vulnerability to the Hazard
Topography, soil structure, land use, and precipitation are all factors of erosion. Chancellor’s Office infrastructure and buildings are not located on steep slopes; however, areas with little vegetation, or in areas with conducive soil types will be vulnerable to erosion.
In the wider community, erosion vulnerabilities include agricultural sector job loss, degradation of riverine ecosystems and coastlines, and loss of water quality.

**Estimate of Potential Losses**

The historic and potential impacts of erosion on property statewide include reduced agricultural productivity, lower surface water quality, and damaged drainage networks.

Current modeling is not precise enough to allow for an assessment of potential losses to buildings and infrastructure on the CSU Chancellor’s Office campus. Campus leadership may choose to conduct an assessment, should modeling improvements be made.

**Vulnerability Assessment Conclusions**

While the ability to predict future erosion at the Chancellor’s Office is limited, the core issues shaping erosion vulnerability on campus are flora and landscaping. If left unchecked, erosion can cause significant damage to campus infrastructure and the surrounding environment.

**Identified Data Limitations**

The complex interactions between soil erosion factors make predictive modeling, determination of hazard areas, and quantification of loss difficult. Localized data on this hazard is also limited, resulting in more generalized findings.

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**Extreme Temperatures (Includes Extreme Cold and Extreme Heat)**

**Description of the Hazard**

What is considered an excessively hot temperature varies according to the normal climate for that region. However, when temperatures are extremely high, people are at higher risk for heat-related illnesses, such as dehydration, heat exhaustion, heat stroke, and in severe cases, death.43

Hazards from extreme heat are made worse when high temperatures are accompanied by high levels of humidity, which is defined as the amount of moisture in the air.44 As the temperature climbs, the air is able to hold more moisture. High humidity prevents the human body from cooling down naturally, which leads people to perceive that the

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44 National Weather Service. *Discussion on Humidity.* Retrieved 01.27.21 from: https://www.weather.gov/lmk/humidity
temperatures “feel” hotter. The combination of temperature and humidity is known as the heat index.45

Heat stroke, the most serious heat-related illness, occurs when the body is unable to control its temperature. Body temperature rises rapidly, the sweating mechanism fails, and the body cannot cool down.46 In extreme causes, heat stroke can cause confusion and unconsciousness, so the victim is unable to seek treatment without assistance.

There are several groups of people who are uniquely vulnerable to the effects of extreme heat, such as infants and children, older adults aged 65 and up, athletes and outdoor workers, low-income households, and individuals with certain chronic medical conditions.47

Location of the Hazard

Extreme heat events are a non-spatial hazard and may occur throughout the CSU Chancellor’s Office planning area.

Extent of the Hazard

Extreme heat has a wide range of extent and severity markers and characteristics. Monthly average maximum temperatures in June through October range approximately from the high 70s to mid-80s in Long Beach. According to data from the National Climatic Data Center (NCDC), the highest daily temperature recorded at the Long Beach Daugherty Airport was 111° F on September 27, 2010. Based on extreme heat’s historical (and potential) public health impacts and power outage disruptions, and more than 85 days over 100 degrees (1980 – 2018) as reported by the NCDC and NCEI, the planning committee ranks the extent of the hazard as Moderate.

The National Weather Service issues a Heat Advisory when the heat index value is expected to reach 100° – 104° F within the next 12 to 24 hours. Excessive Heat Warnings are issued when there is an anticipated heat index of 105° F or greater that will last for two (2) or more hours. Excessive Heat Warnings are issued by the county when any location in the county is expected to reach those criteria.48 In anticipation of an Excessive Heat Warning, an Excessive Heat Watch may be issued 1 to 2 days in advance, when the Heat Warning criteria is 50 – 79% likely to occur.

45 Ibid.
Figure 27-10 (following) depicts the National Weather Service’s methodology for determining the heat index, using the % humidity and the actual temperature.
As the heat index rises, so does the potential danger to people and animals. Table xx (following) shows the health hazards associated with extreme heat.

Table 27-21: Health Risks Associated with Heat Index

<table>
<thead>
<tr>
<th>Category</th>
<th>Heat Index</th>
<th>Health Hazards</th>
</tr>
</thead>
<tbody>
<tr>
<td>Extreme Danger</td>
<td>130° F or higher</td>
<td>Heat stroke / sunstroke is likely with continued exposure.</td>
</tr>
<tr>
<td>Danger</td>
<td>105° – 129° F</td>
<td>Sunstroke, heat cramps, and/or heat exhaustion is likely with prolonged exposure and/or physical activity.</td>
</tr>
<tr>
<td>Extreme Caution</td>
<td>90° – 104° F</td>
<td>Sunstroke, heat cramps, and/or heat exhaustion is possible with prolonged exposure and/or physical activity.</td>
</tr>
<tr>
<td>Caution</td>
<td>80° – 89° F</td>
<td>Fatigue is possible with prolonged exposure and/or physical activity.</td>
</tr>
</tbody>
</table>

History of the Hazard

Based on data gathered from the National Centers for Environmental Information (NCEI) Storm Events Database, there have been five excessive heat events in Los Angeles County since 2007. These events were grouped together as part of the same heat waves.

**August 30, 2007; September 1, 2007; September 3, 2007:** A combination of high temperatures and high humidity produced an extreme heat event across Southern California. Heat index values ranged from 105° to 112° F. There were eight deaths attributable to this excessive heat event.

**June 20-21, 2008:** During this large-scale heat wave that impacted much of the state, afternoon high temperatures climbed as high as 114° F. The heat resulted in several power outages due to excessive electrical use.

The NCDC database also lists 85 additional times that the recorded temperature at the Long Beach Daugherty Airport has reached 100° F or greater between 1980 and 2018.

Potential Impacts of the Hazard

The CSU Chancellor’s Office may experience impacts from extreme heat due the strain on the utility systems.

In addition to the threat extreme heat poses to humans, high temperatures also pose a threat to utility production, which, in turn, threaten facilities and operations that rely on utilities. As temperatures rise, more people stay indoors, increasing the demand for air conditioning, fans, and other electronics. This puts a strain on the electrical grid, which can cause temporary outages. These outages can impact operations throughout campus, resulting in interruptions and delays in service. Outages may also negatively impact research efforts on campus, as the inability to maintain a steady, constant temperature may impact research specimens and experimental results.

Probability of Future Occurrence of the Hazard

Based on NCDC data, 85 days of 100-degree or more temperatures have occurred since 1980 for an annual average of 2.1 events. Using the scale provided, it is **Likely** that at least 100-degree temperatures will occur annually. Excessive Heat Warnings are issued when there is an anticipated heat index of 105° F or greater that will last for two (2) or more hours. It is reasonable to assume that such an index was reached during many of the 85 recorded events since 1980. 50

Vulnerability to the Hazard

50 Hazard Mitigation Plan, City of Long Beach. *Table of Contents.* Print. Retrieved 01.27.21 from: https://www.longbeach.gov › longbeach-hazard-mitigation-plan
When dealing with an extreme heat event, the most common impacts are those generally felt by the people living in the targeted area. For people in particular, heat can kill when the body is pushed beyond its limits. Most heat disorders occur because the victim has been overexposed to heat. As discussed, the major human risks associated with extreme heat include dehydration, sunburn, fatigue, heat exhaustion, heat stroke, and in severe cases, death.

Some portions of the population are more at risk to the effects of extreme heat. The very young, the elderly, and certain groups with chronic medical conditions (such as asthma or other pulmonary illnesses, heart disease, poor blood circulation, neurological illnesses, and obesity) are generally more vulnerable to the effects of extreme heat, and are more likely to suffer illness or death as a result. This is especially true if exposure is extended for a period of time and preventative measures are not taken immediately.

Estimate of Potential Losses

Based on the previous historical occurrences, annualized losses are considered to be negligible. In an extreme heat event, loss of human life or health impacts are a greater concern than is property damage.

Vulnerability Assessment Conclusions

While the ability to predict future heat events at the CSU Chancellor’s Office is limited, the effects of climate change may provide some information. According to the Environmental Protection Agency (EPA), Southern California has warmed about three degrees on average over the last century, with less rainfall. This may lead to stronger and longer-lasting heat events, drought, and an increased risk of wildfires.

Identified Data Limitations

Numerous public and private actors conduct research, acquire data and disseminate meteorological information and forecasting to the general public, including the CSU university system. Currently, it is assumed that, apart from regular access to climate change models on changes to temperature extremes over time, the CSU community maintains sufficient access to the data needed to plan for, respond to, and mitigate the effects of extreme heat and cold.

**Flood**

**Description of the Hazard**

The incredible geographic diversity in California presents tremendous challenges for flood planning and response. The state is home to extensive mountain ranges such as the Sierra Nevada, Cascades, Klamath, Coastal Ranges, and the Southern California Transverse Range all creating tremendous watersheds. Large river systems drain the mountains traveling through populated communities including the Sacramento and San Joaquin Rivers draining into the California Delta. The state has a complex system of reservoirs, dams, and levees providing water storage and flood protection. Finally, California’s 840-mile coastline exposes the coastal regions to tidal influences.

Floods are characterized by the rising and overflowing of excess water from a water source such as a stream, river, lake, canal, or coastal body onto an area of normally dry floodplain. A floodplain is a lowland area downstream and adjacent to water bodies that are subject to flood events. Flooding is a naturally occurring event that becomes hazardous when populations and property are affected.

Flooding can result from excessive precipitation from weather systems generating prolonged rainfall, excessive snowmelt from watersheds upstream from the floodplain, infrastructure failure, exceeding the capacity of dams or levees, tidal influences, or a combination from any of the previous factors.

Flooding represents one of the costliest and most frequent natural disasters that influences human suffering and economic impact in the United States. Flooding will likely result in significant damage to structures, infrastructure, utilities, landscapes, and the environment. Erosion of stream banks, roadways, and other features may result from the movement of flood waters. The saturated ground resulting from standing flood waters may cause ground instability, collapse, erosion, or other damage. Further, floods will often generate substantial debris that will accumulate and be deposited throughout the flooded areas.

Floods can be either slow-rise or rapid onset floods. With slow rise floods, there is often warning preceding water rise by hours or days before dangerous conditions present themselves. Slow rise floods that are expected to enter populated areas generally allow for some time to initiate evacuation and sand bagging efforts. Flooding that occurs rapidly conversely are water events that present extremely limited warning times and a limited ability to take response actions until flooding has already begun to occur.

Flooding may take on different forms:

- **Flash Flooding** – Flash flooding is typically characterized by a rapid rise, short duration, and large volume of water in a localized area. Heavy rainfall in areas that have limited drainage capacities often contribute to flash flooding conditions. These flooding events frequently occur with limited notice requiring immediate evacuation or rapid response efforts such as sand bagging. Flash
flooding may arrive with fast moving water creating added hazardous conditions.

- **Riverine Flooding** – Riverine flooding is usually caused by prolonged rainfall or rainfall combined with heavy snowmelt. When soils are already saturated, the ability for the ground to absorb water is minimized. In a riverine flood, the waterway exceeds channel capacity and extends into areas outside of the channel, often in developed communities. In California, riverine flooding is most likely to occur from November through April. The duration of riverine floods may vary from a period of hours to weeks.

- **Localized Flooding** – Localized flooding is commonly the result of stormwater drainage systems being overwhelmed by unusually heavy rainfall. These flooding events frequently occur in areas that are urbanized or developed with greater amounts of impervious surfaces not allowing ground absorption. This generates added runoff into the drainage systems and onto roadways creating backups.

- **Infrastructure Failure** – Failures of dams or levees presents a serious flooding concern for areas downstream from the compromised structure. This situation may result in a catastrophic flood with limited warning time and widespread areas affected.

- **Coastal Flooding** – Coastal flooding can occur in multiple areas along the California coastline. Flooding may result from intense storms coming from the Pacific Ocean that generate elevated water levels or storm surge. The size, duration, winds generated, and intensity of the storm will influence the effect the waves will have on the shoreline. Periods of high tide can aggravate the conditions allowing greater wave impingement into coastal areas.

**Atmospheric Rivers**

California, including the location of this campus, is subject to the effects of a phenomenon referred to as atmospheric rivers. These weather events consist of long, narrow regions in the atmosphere transporting tremendous amounts of water vapor from the tropics. These weather regions behave like rivers in the sky. They can carry heavy volumes of water vapor compared to the amount of water flow at the mouth of the Mississippi River. As these atmospheric rivers arrive in California, they tend to generate significant rain and snow.

Atmospheric rivers can arrive in many different shapes and sizes. The larger events are able to generate extreme rainfall amounts resulting in flooding. They can stall over watersheds vulnerable to flooding, often saturated with heavy snow amounts. The atmospheric rivers known as “Pineapple Express” coming from the tropics and arriving with warmer air may produce heavy rains that will melt ground snow adding to the water volume that will be added in the flood runoff.
These events can produce heavy amounts of precipitation creating extensive damage. However, these events may present as weaker systems that produce precipitation that is enough to be beneficial for the local water supply. At the higher elevations in the California mountains, these events have the potential to generate a tremendous snowpack providing a source of water during the dry summer months.

Figure 27-11: The Science Behind Atmospheric Rivers

Location of the Hazard

Long Beach is at the south end of the South Bay communities and at the terminus is the Los Angeles and San Gabriel Rivers. The area around Long Beach is relatively flat and sits between the Palos Verdes Hills and hills further to the east. These include the Puente and Chino Hills which provide a potential for developing water run-off during heavy precipitation events. The rivers that drain into the Pacific Ocean serve as drainages for the watersheds of the Santa Monica and San Gabriel Mountains. There are several flood retention basins and flood control channels along the base of these hills that drain towards Long Beach to protect Los Angeles and Orange County communities. The area

surrounding the office is a developed urban environment immediately adjacent to a coastal waterfront predominately consisting of commercial land uses.
The CSU Chancellor’s Office sits within a Special Flood Hazard Area (SFHA) Zone X: Area with Reduced Flood Risk Due to Levee designation on the Flood Insurance Rate Map. The Office is located on the waterfront of the Pacific Ocean at the point where the Los Angeles River drains into the ocean. The office is 5 miles west of the San Gabriel River; however, this is not a flooding factor for the office. The Los Angeles River watershed receives the majority of its water from snowfall from the Santa Monica and San Gabriel Mountains. The Los Angeles River further collects water and precipitation runoff from urban areas in the San Fernando Valley and Los Angeles Basin.

Extent of the Hazard

Access routes and critical infrastructure to the west, east, and north are located in Zone X: Area with Reduced Flood Risk Due to Levee. Even though the CSU Chancellor’s Office resides in a minimally threatened flood zone, flood events are still possible and isolated heavy precipitation events and tidal influences can still pose localized flooding hazards. This specific hazard would substantially alter the ability of the office to maintain operations. In addition, 6 Federally Declared events have occurred in LA County during
the 25-year period from 1996-2021. Based on these facts, the planning committee ranks the extent of the hazard on campus as **Moderate**.

In support of the NFIP, FEMA identifies those areas that are more vulnerable to flooding by producing Flood Hazard Boundary Maps (FHBM), Flood Insurance Rate Maps (FIRM), and Flood Boundary and Floodway Maps (FBFM). Several areas of flood hazards are commonly identified on these maps, including the 1% annual chance flood zone. Flood zones are further delineated by risk and are assigned a letter signifier. The flood zone designations are defined and described in the following table.

Table 27-22: Flood Zone Designations and Descriptions

<table>
<thead>
<tr>
<th>Zone Designation</th>
<th>Percent Annual Chance of Flood</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Zone V</td>
<td>1%</td>
<td>Areas along coasts subject to inundation by the 1% annual chance of flooding with additional hazards associated with storm-induced waves. Because hydraulic analyses have not been performed, no BFEs or flood depths are shown.</td>
</tr>
<tr>
<td>Zones VE and V1-30</td>
<td>1%</td>
<td>Areas along coasts subject to inundation by the 1% annual chance of flooding with additional hazards associated with storm-induced waves. BFEs derived from detailed hydraulic analyses are shown within these zones. (Zone VE is used on new and revised map in place of Zones V1-30.)</td>
</tr>
<tr>
<td>Zone A</td>
<td>1%</td>
<td>Areas with a 1% annual chance of flooding and a 26% chance of flooding over the life of a 30-year mortgage. Because detailed analyses are not performed for such areas, no depths or base flood elevations are shown within these areas.</td>
</tr>
<tr>
<td>Zone AE</td>
<td>1%</td>
<td>Areas with a 1% annual chance of flooding and a 26% chance of flooding over the life of a 30-year mortgage. In most instances, BFEs derived from detailed analyses are shown at selected intervals within these zones.</td>
</tr>
<tr>
<td>Zone AH</td>
<td>1%</td>
<td>Areas with a 1% annual chance of flooding where shallow flooding (usually areas of ponding) can occur with average depths between 1 – 3 feet.</td>
</tr>
</tbody>
</table>
Areas with a 1% annual chance of flooding, where shallow flooding average depths are between 1 – 3 feet.

Represents areas between the limits of the 1% annual chance flooding and 0.2% chance flooding.

Areas outside of the 1% annual chance floodplain and 0.2% annual chance floodplain, areas of 1% annual chance sheet flow flooding where average depths are less than one (1) foot, areas of 1% annual chance stream flooding where the contributing drainage area is less than one (1) square mile, or areas protected from the 1% annual chance flood by levees. No BFEs or depths are shown within this zone.

History of the Hazard

Flooding in Long Beach and the broader Los Angeles County region have typically occurred during the winter months when Pacific storms are more common. The occurrences of significant flooding typically have been the result of successive intense storms with heavy precipitation. The region has experienced flood events that have caused tens of millions of dollars in damages and casualties. The following provides insight into information of past flooding events that are significant to the CSU Chancellor’s Office.

Table 27-23: Historic Flooding Events in Los Angeles County

<table>
<thead>
<tr>
<th>Date</th>
<th>Event</th>
<th>Declaration</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>March 1962</td>
<td>Flood</td>
<td>DR-122-CA</td>
<td>Countywide</td>
</tr>
<tr>
<td>October 1962</td>
<td>Flood</td>
<td>DR-138-CA</td>
<td>Countywide</td>
</tr>
<tr>
<td>February 1963</td>
<td>Flood; Heavy Rains</td>
<td>DR-145-CA</td>
<td>Countywide</td>
</tr>
<tr>
<td>February 1978</td>
<td>Flood; Winter Storms</td>
<td>DR-547-CA</td>
<td>Countywide</td>
</tr>
<tr>
<td>February 1980</td>
<td>Flood; Winter Storms</td>
<td>DR-615-CA</td>
<td>Countywide</td>
</tr>
<tr>
<td>December 1988</td>
<td>Winter Storms</td>
<td>DR-812-CA</td>
<td>Countywide</td>
</tr>
<tr>
<td>February 1992</td>
<td>Winter Storms</td>
<td>DR-935-CA</td>
<td>Countywide</td>
</tr>
<tr>
<td>January 1993</td>
<td>Winter Storms</td>
<td>DR-979-CA</td>
<td>Countywide</td>
</tr>
</tbody>
</table>

54 2019 County of Los Angeles All-Hazard Mitigation Plan, 2019
January 1995 | Flash Flood; Heavy Rains | DR-1044-CA | Countywide
---|---|---|---
March 1995 | Flash Flood; Heavy Rains | DR-1046-CA | Countywide
December 1996 | Flood; Winter Storms | DR-1155-CA | Countywide
January 1997 | Flood | DR-1155-CA | Countywide
February 1998 | Flood; Winter Storms | DR-1203-CA | Countywide
January 2005 | Flood; Winter Storms | DR-1577-CA | Countywide
February 2005 | Flood; Debris Flows | DR-1585-CA | Countywide
January 2017 | Flood; Winter Storms | DR-4305-CA | Countywide

Potential Impacts of the Hazard

A flood will potentially result in extensive amounts of water entering developed areas. The force and volume of water that is generated by a flood may cause extensive structural damage in areas subject to standing or moving water. The effects of flooding may spread over significant distances covering large areas of land. The extent of the impacts would vary based on several factors such as the volume of water flooding, the time of the flood event, the amount of warning provided, the location and extent of the flood boundary, facility elevation, and distance from the flood source. Potential impacts resulting from flooding include:

- Injuries or loss of life
- Property destruction or damage
- Loss of property contents
- Infrastructure damage including roadways, bridges, other transportation means
- Public health hazards resulting from mold, mildew, and disease due to flood water
- Flooded or destroyed lifelines/supply routes
- Damaged or destroyed utilities
- Loss of community economic base
- Employment losses
● Agricultural (crops and livestock) damages or destruction
● Environmental damage
● Prolonged periods of necessary dewatering
● Flooding erosion may alter natural drainage channels
● Societal and community impacts
● Psychological impacts of impacted populations
● Disruptions to education delivery to community
● Damage or destruction of university materials, documents, and equipment contained within the office
● Damage or destruction of university computer systems and networks
● Damaged university infrastructure
● Inability for campus operations to resume
● Reduced capacity to support or coordinate system-wide academic and student programs
● Reductions in university revenues

Additionally, individuals who were unable to evacuate in time or refused to leave may need assistance or rescue from the flooded area. Remaining in or being trapped by flood waters places individuals in significant risk of injury or death. The impacts extend beyond the danger placed upon the affected individual and place greater resource demands on agencies and organizations making efforts to rescue trapped individuals.

Probability of Future Occurrence of the Hazard

Floods can occur at any time but are most common in the Los Angeles area with winter storms saturated with subtropical moisture. Flooding occurs on average every 6.1 years from heavy precipitation that could generate potential 50- or 100-year floods in the area of the CSU Chancellor’s Office. The CSU Chancellor’s Office is located within a Zone X Special Flood Hazard Area (Area with Reduced Flood Risk Due to Levee) and adjacent to the confluence of the Los Angeles River with the Pacific Ocean.

As such, the planning committee ranks the probability of future occurrence for flooding as Possible.

Vulnerability to the Hazard

The CSU Chancellor’s Office is subject to the effects of flooding resulting primarily from excessive precipitation and isolated strong storms. A more remote potential exists for severe flooding and damage on campus and surrounding residential and commercial areas of Long Beach due to tidal influences or overflow or damage to flood control systems. The flood control channels and drainage systems that surround the Long Beach area have limited storage or volume capacities and may impact access or supply routes.
The office and the staff community are vulnerable to the effects generated by flooding from these systems.

Vulnerability to flooding on the CSU Chancellor’s Office will vary depending on the severity of flooding and when the flood was to occur. Members of the office community may become trapped on the facility depending on the level of flooding occurring on surface streets. However, in region-wide events this vulnerability may be extended to the homes and workplaces of members of the campus community and their families.

The CSU Chancellor’s Office is in proximity to a variety of industrial and commercial facilities in the surrounding communities including the facilities at the Port of Long Beach. When these facilities are inundated with flood water, the potential exists for chemical release and exposure to individuals from the office community. These facilities line many of the primary access routes in and out of the campus.

The Chancellor’s Office buildings and infrastructure are vulnerable to low probability and large-scale flooding. Office utilities and communication capabilities could be impacted, rendering them disabled. A flood covering a large portion of the city might affect communication capabilities well beyond the boundaries of the campus. Remaining flood waters will leave behind molds and other health concerns in affected campus buildings and facilities which might require extensive restoration or demolishing. Flood waters may result in damage to office equipment, communication systems, protected documents, artwork, academic materials, computer systems, research, and other critical activities on lower levels of buildings.

Certain office populations will experience greater challenges to a post-flood / failure environment. Vulnerable populations will likely need to navigate through flood generated debris, face extreme health safety issues from flood waters, experience extreme stresses of a disaster, an inability to communicate to or gain access to support networks, and find difficulty in accessing equipment or supplies to aid in a specific need. Staff remaining on the facility such as those unable to evacuate would be particularly vulnerable especially those without access to adequate transportation.

**Estimate of Potential Losses**

Estimates of potential losses will be influenced by a variety of factors. The volume and force of the water will determine the scale of damage affecting campus infrastructure, equipment, and other impacted features. The location and elevation above flood waters will affect the level of damage and individuals exposed. The time of the day of week, and hour in which the flooding was to occur will influence the number of people in the office and potential casualties. The severity of the storms producing precipitation, the speed of the storms moving across the area, the level of snowpack in the higher elevations, and amount of resulting snowmelt will produce varying effects on damages produced and costs incurred. Losses will be generated by physical damages, loss of revenue, loss of academic research, loss of building contents, and community wide economic reductions.
Based on estimate replacement costs of facilities and structures on campus, the maximum total replacement costs due to flood are unknown. However, it is unlikely for flooding to cause destructive losses to the entire facility.

Table 27-24: Special Flood Hazard Area (SFHA) Estimated Losses

<table>
<thead>
<tr>
<th>Zone Designation</th>
<th>No of Buildings</th>
<th>Maximum Replacement Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Zone V</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Zone VE &amp; V 1-30</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Zone A</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Zone AE</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Zone AH</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Zone AO</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Zone X .2%</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Zone X Levee Reduced Risk</td>
<td>1</td>
<td>Unknown</td>
</tr>
<tr>
<td>Zone X Minimal Risk</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Not in a SFHA</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>No Building Value Data Provided*</td>
<td>0</td>
<td>Unknown</td>
</tr>
</tbody>
</table>

*Buildings with no value defined are also included in the respective Zones they are found in.

Vulnerability Assessment Conclusions

The campus’ primary vulnerabilities are exposed mostly by localized flooding from isolated or large-scale storms that produce heavy amounts of precipitation directly over the campus and surrounding neighborhoods. The consequences of a low probability, widespread flood could generate disaster effects to communities including Long Beach. The campus’ proximity to the Los Angeles River and the Pacific Ocean adds a minimal degree of vulnerability for the campus.

The potential for flooding generates the potential for several cascading effects such as disruptions to the local economy, utility failures, disruptions to providing for the needs of the community, and development of public health hazards. These effects would be exacerbated by effects of seasonal flooding, ongoing heavy precipitation, or excessive run-off from the watershed contributing to the river system. The potential for widespread flooding and damage of structures, while unlikely, has exponentially powerful impacts on particular segments of the office community including those with access or functional needs, international students, the homeless, and students residing in the residence halls.
Identified Data Limitations

Data limitations include missing campus structural replacement costs, and an incomplete inventory of both building construction features and mitigation efforts to lessen the impact due to flood inundation. HAZUS generated analysis is focused on the broader community level versus fine-tuning the analysis to the micro-level for facilities such as a university campus.

Hazardous Materials

Description of the Hazard

A hazardous material is defined in California’s State Hazardous Materials Incident Contingency Plan (1991) as “a substance or combination of substances which, because of quantity, concentration, physical, chemical, or infectious characteristics may: cause, or significantly contribute to an increase in deaths or serious illnesses; and/or pose a substantial present or potential hazard to humans or the environment.” Hazardous materials are one or more of the following: flammable, corrosive or an irritant, oxidizing, explosive, toxic (poisonous or infectious), thermally unstable or reactive, or radioactive. Hazardous materials are ubiquitous in modern society and may be found at all stages of production, consumption, and disposal.

Federal and state laws permit the intentional release of some hazardous materials into the environment such that the risk to human health and the environment is thought to be acceptable. However, sometimes releases are unintentional, resulting from leaks, accidents, or natural hazards. This section focuses on such accidental releases and fall into the following key categories:

Fixed Hazardous Materials Incident: A fixed hazardous materials incident is the accidental release of chemical substances or mixtures during production or handling at a fixed facility.

Transportation Hazardous Materials Incident: A transportation hazardous materials incident is the accidental release of chemical substances or mixtures during highway, waterway, or air transport. Populations, and built and natural environments are potentially impacted.

Pipeline Incident: A pipeline transportation incident occurs when a break in a pipeline creates the potential for an explosion or leak of a dangerous substance (oil, gas, etc.)
requiring evacuation. An underground pipeline incident can be caused by environmental disruption, accidental damage, or sabotage. Incidents can range from a small, slow leak to a large rupture where an explosion is possible. Inspection and maintenance of the pipeline system along with marked gas line locations and an early warning and response procedure can lessen the risk to those near the pipelines.

Hazardous materials can also be classified according to worker safety and health. Information provided by the California Division of Safety and Health includes guidelines related to:

- **Safety hazards**: fire and fire byproducts, electricity, flammable gases, unstable structures, demolition, sharp or flying objects, excavations)
- **Health hazards**: carbon monoxide ash, soot and dust; asbestos; hazardous liquids; other hazardous substances; heat illness)

**Natural-Technological Incidents (Natechs):** During the past two decades, increasing attention has been given to hazardous materials releases resulting from Natechs or a natural disaster event that triggers a technological hazard event. Natechs are of particular concern for the following reasons:

- They can produce a simultaneous effect on many industrial facilities
- Can overwhelm response capacity
- Containment systems may fail
- May produce cascading disasters
- Response may be hindered by a disaster’s impact on the physical environment

**Location of the Hazard**

Hazardous materials and infrastructure such as fuel, chemicals, hazardous waste sites and gas pipelines are located on each campus. (Please refer to the hazardous materials map identifying the location of hazardous materials on the CSU – Chancellor’s Office campus). At larger scales (beyond the campus planning area) hazardous materials are

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located throughout Long Beach and Los Angeles County, and reflect diverse types, configurations and scales dispersed across these geographic areas.

Extent of the Hazard

There is no comprehensive statewide vulnerability assessment available at this time. As such, the true extent of the hazardous materials risk in California and its communities is not known, meaning no overarching conclusions have been reached which have been able to integrate all qualitative and quantitative risk factors to produce a comprehensive measure of the extent of the hazard. However, for the CSU – Chancellor’s Office planning committee, based on the degree of hazardous materials near the campus (see hazmat mapping), the history of hazmat events in Long Beach and near the campus, and because the assessment of risk is so complex, it is prudent to rank the extent of the hazard for the CSU – Chancellor’s Office campus as Very High and to consider worst case scenarios as the main driver of policy in order to fully mitigate all possible hazardous materials event outcomes.

For example, according to the 2018 CA State Hazard Mitigation Plan, 400 hazardous materials problems are tied to 32 past earthquakes, including over 150 problems from the Loma Prieta Earthquake alone. 60

That said, the plan indicates that it is likely that many such hazardous materials releases have received little attention in the past because public authorities, the media, and the public have overlooked them in the rush to address and recover from immediate disaster threats, and that responsible parties may have an incentive to understate the extent of releases or not to report them at all.

History of the Hazard

According to the CA Governor’s Office of Emergency Services’ Hazardous Materials Spill Report, the state experiences from 10 to 30 spill events daily. As of April 20th, 2021 already 2096 spill events had occurred. Such events have occurred in all the cities and/or counties where CSU campuses are located. 61

Source:
https://w3.calema.ca.gov/operational/malhaz.nsf/$defaultView?OpenView&Start=121&ExpandView

According to the 2018 CA State Hazard Mitigation Plan, with regard to natural-technological hazard events (Natechs), 400 hazardous materials events are tied to 32 past earthquakes, including over 150 Natech events from the Loma Prieta Earthquake alone.

https://pubs.usgs.gov/pp/pp1553/pp1553c/

https://w3.calema.ca.gov/operational/malhaz.nsf/$defaultView?OpenView&Start=121&ExpandView
With regard to hazmat incidents at the CSU – Chancellor’s Office, no events have originated on site. However, according to the planning committee, toxic gas releases occur 6 or more times per year originating from the Port of Long Beach. Oil refineries nearby also off-gas toxic chemicals 6 or 7 times per year. Also, in approximately 2010, the Port produced a toxic fire from a gas release that was so prevalent that it created a toxic cloud over the Port. As a result, the Chancellor’s Office had to close all air intakes.

Potential Impacts of the Hazard

A large hazardous materials release could affect an entire community or city under certain conditions related to direction of air flow (air-based chemical release) and population density or the contamination of a community’s main water supply. Either type of release could necessitate large scale evacuation. By contrast, in the rural unincorporated areas where population densities are low, even in the event of a large release, the number of homes that may need to be evacuated would be significantly lower than in an urban environment. The occurrence of a hazmat incident can also result in the shut-down of transportation corridors which can last for hours at a time while the impacted area is stabilized.

The release of some toxic gases may cause immediate death, disablement, or sickness if absorbed through the skin, injected, ingested, or inhaled. Contaminated water resources become unsafe and unusable, depending on the amount of contaminant. Some chemicals cause painful and damaging burns if they come in direct contact with skin. Prolonged and concentrated exposure to such chemicals can produce severe long-term impacts to respiratory, endocrine and nervous systems, heart and brain health.

In addition to the historical event impacts, the potential impacts of chemicals and toxic gases discussed here also apply to the staff and environment on the CSU – Chancellor’s Office campus.

With regard to the natural environment overall, contamination of air, ground, or water may result in harm to fish, wildlife, livestock, and crops. The release of hazardous materials into the environment may cause debilitation, disease, or birth defects over a long period of time. Loss of livestock and crops may lead to economic hardships within the community.

Recent California examples include the 2016 Aliso Canyon methane gas leak, which caused evacuation of nearby residents, many of whom experienced temporary health problems such as difficulty breathing and eye irritation; and the 2016 Fruitland metal recycle plant fire in Maywood, which released heavy metals such as lead, magnesium, copper, aluminum, antimony, calcium, iron, sulfur, tin, potassium, and zinc which pose
severe risks to public health. Health effects from exposure to these metals included short-term symptoms such as irritation to the eyes, nose, throat, and lungs.

**Potential Impact of the Hazard (Natecs)**

Natural disasters, including earthquakes, floods, and wildfire also pose risks to public health and the environment. For example, following the Northridge Earthquake, California State University (CSU) Northridge laboratories and chemical storage rooms experienced multiple chemical spills. Such incidents, triggered by a natural disaster, pose a significant risk to students, faculty, staff, and first responders. At a minimum, all CSU campuses with a science lab is at risk of potential impact from a natural-technological (combined impact) event.

In a severe flood event, floodwaters are often contaminated with hazardous materials posing a threat to public and animal health, groundwater, and other parts of the environment. These hazardous materials may be released from damaged or flooded underground tank sites (e.g., gas stations or chemical storage facilities), propane tanks, manure or human waste handling facilities, fertilizer and pesticide storage, agricultural sites, and household hazardous waste.

In a fire event, (such as the October 2017 Northern California firestorms which destroyed approximately 6,000 residences) entire neighborhoods can be burned to the ground. Hazardous material release creates public health concerns which can delay the initial steps of fire recovery, including reopening burned areas to residents and initiating debris removal activities. The post-fire “toxic sweep” poses a risk of coming into contact with toxic substances due to the presence of synthetic and hazardous materials.

**Probability of Future Occurrence of the Hazard**

The probability of occurrence for a hazmat release on the CSU – Chancellor’s Office campus can be viewed in two different ways: the history of occurrence serves as a sound predictor of future probability assuming current risk and vulnerability factors remain somewhat constant. For the purposes of the current estimate, no current data clearly indicates otherwise. As such, the probability of occurrence is Highly Likely because the CSU – Chancellor’s Office experiences several recurring hazmat events annually which originate at the Port and from nearby oil refineries. That said, hazmat occurrences are largely based on human error, and any changes in risk and vulnerability factors such as a decreased vigilance in materials oversight and handling practices or changes in the amount of chemicals or exposure will likely increase the probability on campus.

**Vulnerability to the Hazard**

Hazardous materials pose a risk to the CSU – Chancellor’s Office campus. As identified by the campus planning committee and on the hazmat map, the Chancellor’s office staff and

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operations are regularly affected by toxic gas releases from the Port and from oil refineries. In some cases, the levels of toxic air require suspension of operations, building closure and/or evacuation of the staff.

Although it is quite difficult to produce a quantitative measure of vulnerability because (unlike natural hazards) the probability of occurrence is dependent on human error, which itself is variable based upon a fluctuating set of interrelated factors, some of which lack prediction or control, given the complexity of how all natural and built environments and hazmat risks factors interrelate at the local or campus level, it is prudent to assume for planning purposes that the campus’ vulnerability is a sub-set of the larger community’s vulnerability. As such, the CSU – Chancellor’s Office leadership maintains vigilance to mitigate the campus’ vulnerabilities identified above at a minimum.

**Estimate of Potential Losses**

As discussed previously, it is difficult if not impossible to produce an accurate quantitative measure of vulnerability because of the variable nature of a hazardous materials spill. For example, the release of a toxic airborne chemical in a populated area has severe impact potential, whereas the impact potential of a small chemical spill in a remote or rural area is most likely limited to remediation of soil. And, in both cases, the probability of occurrence is dependent on human error, which itself is variable based upon a fluctuating set of interrelated factors, some of which lack prediction or control. In all cases, different types and amounts of hazardous materials interact with fluctuating combinations of human error to produce different event outcomes with variable impact costs.

**Vulnerability Assessment Conclusions**

It is well understood that with regards to hazmat vulnerability, each campus and its surrounding community (including the CSU – Chancellor’s Office) operates through a complex and dynamic interaction between industrial and commercial inputs and outputs and the natural and built environment. Such activity produces hazardous materials that move through the environment along both convergent and divergent routes and across all levels of land-use from site to campus to city and county and beyond. It is also clear from a review of the City of Long Beach and Los Angeles County hazard mitigation plans and Cal OES’ records of hazardous material spills, that such events occur with great frequency and varying degrees of severity across jurisdictions statewide. As such, in assessing the vulnerability of the CSU – Chancellor’s Office campus, campus-level risks and vulnerabilities are not discreet or isolated but can become exacerbated or augmented through connections to broader community-level hazmat risks and vulnerabilities.

Finally, in order to draw conclusions on vulnerability, it should be noted that any identified vulnerabilities at the campus level and/or community level are circumscribed and potentially reduced by targeted policy and program interventions. Numerous policies and programs have been established in recent years in response to California’s widespread and complex and integrated hazardous materials risks - California established the Unified Program which consolidates and integrates the administrative requirements,
permits, inspections, and enforcement activities of the following environmental and emergency response programs: the Aboveground Petroleum Storage Act (APSA) Program, Area Plans for Hazardous Materials Emergencies, the California Accidental Release Prevention (CalARP) Program, the Hazardous Materials Release Response Plans and Inventories (Business Plans), Hazardous Material Management Plan (HMMP) and Hazardous Material Inventory Statement (HMIS) requirements (California Fire Code), the Hazardous Waste Generator and Onsite Hazardous Waste Treatment (tiered permitting) Programs, and the Underground Storage Tank Program.

**Identified Data Limitations**

The CSU – Chancellor’s Office planning committee has provided information on campus-level hazmat materials and risks. Data limitations pertain to a comprehensive understanding of human activity and error related to materials control over the long term.

**Landslide**

Description of the Hazard

A landslide is a down-slope movement of soil, rock, or other debris, and can also be referred to as a mass movement or slope failure. These geological hazards can range in size from a few feet to over a mile in length and width and, when heavy and rapidly moving, can cause serious damage and loss of life.

Landslides are classified based on the type of material and type of movement involved. They can range from slow-moving earth flows to fast-moving debris flows, though many large slope failures involve more than one type of movement. The primary natural triggers of slope failures are water, seismic activity, and volcanic activity. Slope saturation by water can occur from intense rainfall, snowmelt, changes in ground-water levels, and surface-water level changes along coastlines. In winter months, El Nino storms or other high rainfall events may saturate soils and trigger slope failure.

**Deep-Seated Landslides**

Deep-seated landslides, ranging in depth from ten to several hundred feet, occur as a result of geologic and hydraulic changes, such as earthquakes or increased levels of groundwater. These landslides can move slowly or quickly and can cause extensive property damage, but rarely result in loss of life.

**Debris Flows Related to Shallow Landslides**

Shallow landslides may mobilize into rapidly moving debris flows and typically occur after sudden saturation of the ground. These types of debris flows are typically more dangerous because they move rapidly, causing both property damage and loss of life.

Debris flows may also occur as a result of post-fire conditions, where wildfires have left barren ground exposed to heavy rainfall. Intense rainfall, generally greater than .5 inch per hour, has the potential to trigger a post-fire debris flow. These landslides may impact lives and properties within its deposition zone, and can result in downstream flooding. These post-fire debris flows often occur during the fall and winter following major summer fires.

**Location of the Hazard**

The susceptibility of an area to landslides depends on several variables, including magnitude of slope gradients, water content, ground cover, presence of erosion, and slope material and structure. However, landslides are most prevalent in terrain with weak material and steep slopes, and the highest risk is found in areas with high rainfall or high earthquake potential. Slope failures are also most likely to occur in areas where they have occurred in the past. In California, the most landslide-prone areas are found along the coast and in the northern Franciscan Formation.

General landslide vulnerability can be estimated from the distribution of weak rocks and steep slopes as seen in Figure 27-14. The Chancellor’s Office is not located in or near any landslide susceptibility zones.

**Figure 27-13: Deep-Seated Landslide Susceptibility Surrounding CSU Chancellor’s Office**

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Extent of the Hazard

In Los Angeles County, landslides are more likely to occur in the steep slopes outside of the metropolitan area and along the coastline. The San Gabriel mountains, both steep and erosive, contain steeply walled canyons above areas with high population density. When heavy rain occurs, there is significant potential for floods and landslides throughout the County, and the indirect impacts of landslides may cover an even larger geographical extent. However, because the CSU Chancellor’s Office is a significant distance from any landslide hazard zone and there is no history of landslide events on or near campus, the planning committee ranks the extent of the landslide hazard for the campus as **Low**.

History of the Hazard

FEMA has declared thirteen major disasters involving landslides, mudslides, debris flows, or mud flows in Los Angeles County since 1978. NOAA has recorded five debris flow events in the County since 2004, most of which occurred in the areas directly surrounding metropolitan Los Angeles. The 2018 mudflows in Santa Barbara / Montecito damaged 40 to 45 homes in Sun Valley and caused a vehicle to strike a natural gas pipeline, which began to leak.
Potential Impacts of the Hazard

The Chancellor’s Office may be impacted by the disruption of services as a result of landslides in the region. Landslides can result in physical damage to buildings and property and have the potential to significantly affect infrastructure. As a landslide moves, it distresses structural foundations by settlement, cracking, and tilting. Fast-moving flows can remove entire structures in one instance, while other types of flows can cause damage gradually.

Transportation and utility infrastructure are particularly vulnerable to landslides, since the failure of any component can disrupt service over a large area. The loss of power and communication and disruption of transportation can have cascading effects throughout an area, including impaired disposal of sewage, contamination of water supplies, and the release of flammable fuels. Transportation routes are also often expensive to clean up, and prolonged obstruction can disrupt the movement of people and goods for long periods of time.

Probability of Future Occurrence of the Hazard

Slope failures are also often triggered by other natural hazards such as heavy rainfall and earthquakes, so landslide frequency is often related to the frequency of these other hazards. As climate change impacts the frequency and intensity of triggers such as rain events, fires, and coastal erosion, landslides may generally occur more often. Historically, landslides have occurred frequently in the San Gabriel Mountains and therefore are highly likely to occur in the future. However, the CSU Chancellor’s Office is a significant distance from any landslide hazard zone and there is no history of landslide events on or near the campus; as a result, the probability of future occurrence of the landslide hazard is considered to be Unlikely.

Vulnerability to the Hazard

The vulnerability of the built environment to landslides depends on exposure and is more likely to incur damage as a result of proximity, rather than inferior structural design. The structures most vulnerable to landslides are buildings and utility/transportation lifelines, which can be impacted by either impact or ground deformation. Utilities and transportation infrastructure are particularly vulnerable, due to their geographic extent and susceptibility to physical distress. Also, any population proximal to a landslide when it occurs is vulnerable to its impacts. The Chancellor’s office does not exhibit any of the vulnerabilities identified above.

Estimate of Potential Losses

There are no current models for estimating potential losses from a landslide directly impacting the campus.

Although the economic impact of landslide damage can exceed that of the direct repair costs, there are currently no applicable methods for estimating indirect costs related to the Chancellor’s Office.
Vulnerability Assessment Conclusions

Community exposure to landslides varies depending on their physical locations – whether in flat plains or on steep hillsides – and on their dependence on critical infrastructure located in landslide hazard zones.

Landslides could impact the campus in a variety of ways, primarily related to indirect impacts to transportation and utilities. Utility outages can impact health, particularly for vulnerable populations, and can cause interruptions in operations. Interruptions may an employee’s ability to travel to campus and the delivery of classes and events.

Identified Data Limitations

The ability to predict future landslides at the Chancellor's Office is limited. However, the USGS estimates that climate change-induced shifts in weather will increase the frequency of post-wildfire landslides, which are expected to occur almost every year in California.13

Power Outage

Description of the Hazard

Most aspects of modern life, and almost all aspects of urban life, rely on the availability of reliable utilities, such as electricity, water, and natural gas. An interruption in the supply or distribution of these commodities can leave highly populated areas like San Luis Obispo without basic services, such as electricity or sanitation. These interruptions can be cascading effects from other hazard events, such as windstorms, floods, wildfires and earthquakes, or they can be caused by intentional disruptions of transmission lines. Due to the City of Long Beach’s location and that of the Chancellor’s Office, Public Safety Power Shutoffs (PSPS) due to wildfires are not a factor the campus regularly experiences.

A power outage event can interrupt day-to-day operations of the CSU Chancellor’s Office campus, impede or limit digital, telephonic or radio communications, create traffic jams around the busy avenues and boulevards surrounding the campus, and close restaurants around campus and outside the campus.

Additionally, a severe outage to Los Angeles County or to the City of Long Beach would directly affect the campus and the community creating social, economic, and potential health and safety impacts.

Electric power disruptions and outages fall into two categories: intentional and unintentional.

The four types of intentional disruptions are:

- Planned: Some disruptions are intentional and can be scheduled based on maintenance or upgrading needs.
- Unscheduled: Some intentional disruptions must be done "on the spot" in response to an emergency.
**Demand-Side Management:** Some customers (i.e., on the demand side) have entered into an agreement with their utility provider to curtail their demand for electricity during periods of peak system loads.

**Load Shedding:** When the power system is under extreme stress due to heavy demand and/or failure of critical components, it is sometimes necessary to intentionally interrupt the service to selected customers to prevent the entire system from collapsing. These intentional interruptions result in rolling blackouts.

**Unintentional** or unplanned disruptions are outages that come with essentially no advance notice or warning. This type of disruption is the most problematic. The following are categories of unplanned disruptions:

- Accident by the utility, utility contractor, or others.
- Malfunction or equipment failure.
- Equipment overload (utility company or customer).
- Reduced capability (equipment that cannot operate within its design criteria).
- Tree contact other than from storms.
- Vandalism or intentional damage.
- Weather, including lightning, wind, earthquake, flood, and broken tree limbs taking down power lines.
- Wildfire that damages transmission lines.

**Location of the Hazard**

Although power outages can take place within a certain area, it has the potential to affect the entire planning area equally. (Note: If the Chancellor’s Office is experiencing a power outage, there is a high probability that the City of Long Beach is experiencing a power outage, as well.)

**Extent of the Hazard**

The California Independent System Operator (CAISO) is tasked with managing the power distribution grid that supplies most of California, except in areas served by municipal utilities. CAISO is thus the entity that coordinates statewide flow of electrical supply. CAISO uses a series of stage alerts to the media based on system conditions. The alerts are:

- Stage 1 - reserve margin falls below 7 percent.
- Stage 2 - reserve margin falls below 5 percent.
- Stage 3 - reserve margin falls below 1.5 percent.

Rotating blackouts become a possibility when Stage 3 is reached. Utility agencies aim to advise affected areas approximately 48 hours in advance of a potential PSPS event and
will attempt notification again approximately 24 hours before power is shut off. Campus staff respond accordingly.

Given the prevalence of rolling blackouts and other power outages in California, as well as a history recorded outages have taken place near campus (in the City of Long Beach), the planning committee ranks the extent of the power outage hazard for the CSU Chancellor’s Office as Moderate.

History of the Hazard

The California State University Chancellor’s Office did not report experiencing any power outages in recent years.

Historically, the most consistent reason that power outages occur in the City of Long Beach is falling trees. Extremely wet weather conditions can also present a threat due to saturated soils weakening tree foundations and allowing trees to fall in high-wind winter storms.

The City of Long Beach has experienced power outages over time. Their electric utility provider, Southern California Edison (SCE) has experienced outages, which have affected the residents of Long Beach over the years. Major power outages impacting the City of Long Beach in recent years have affected a large number of residents as seen below:

- **July 18, 2015:** The City of Long Beach experienced a power outage for three days, in what is known as the worst blackout since the 1950’s. Most residents and businesses experienced this large power outage. The power outage was due to an underground electrical fire. A maintenance hole cover flew into the air, with pressurized flames and smoke shooting into the air along with it. The fire led to 4,800 homes and businesses losing power.
- **February 20, 2021:** A loss of power occurred in South Long Beach due to arcing wires touching down on some parked vehicles. Southern California Edison crews repaired the issue over several hours to de-energize the power cables. The power outage affected approximately 3,000 Long Beach residents.

Potential Impacts of the Hazard

The California State University Chancellor’s Office and the entire university system infrastructure rely on electricity for basic business and educational operations. During a widespread power failure, it may take anywhere from several hours to days to restore operations if a significant event occurs. Electrical power may be the only cooling source for many individuals around the campus and its community, and long-term outages can potentially put people’s health and life at risk. Disruptions in the supply of heating fuel may put people and property at risk during extremely cold weather if it relies on electric generation or heating mechanisms instead of gas. Additionally, many medical devices, communications devices, and security rely on power to maintain their functions.
During a power outage, the CSU Chancellor’s Office cannot continue regular functions at normal levels.

**Climate Change and Energy Shortage**

Climate change is expected to bring more frequent and intense natural disasters. Over the years, what was once a disaster uncharacteristic to landscape is now occurring outside of historical areas. These changes have created a variability at a rate that makes historical data a poor predictor of future climate. For example, the warmest years on record in California occurred in 2014, 2015, and 2016. The 2016-2017 year broke the record as the wettest ever recorded in the northern Sierra Nevada Mountains.

Changes in temperatures, precipitation patterns, extreme events, and sea-level rise have the potential to decrease the efficiency of thermal power plants and substations, decrease the capacity of transmission lines, render hydropower less reliable, spur an increase in electricity demand, and put energy infrastructure at risk of flooding.

With climate warming, higher costs from increased demand for cooling in the summer are expected to outweigh the decreases in heating costs in the cooler seasons. Hotter temperatures in California will mean more energy (typically measured in “cooling-degree days”) needed to cool homes and businesses both during heat waves and on a daily basis, during the daytime peak of the diurnal temperature cycle. During future heat waves, historically cooler coastal cities (e.g., San Francisco and Los Angeles) are projected to experience greater relative increases in temperature, such that areas that never before relied on air conditioning will experience new cooling demands.

Secondary impacts of energy shortages are most often felt by vulnerable populations. For example, those who rely on electric power for life-saving medical equipment, such as respirators, are extremely vulnerable to power outages. Also, during periods of extreme heat emergencies, the elderly and the very young are more vulnerable to the loss of cooling systems requiring power sources.

**Probability of Future Occurrence of the Hazard**

The probability of California experiencing a power outage can be difficult to quantify but is a hazard that occurs annually during the same seasonal periods of temperature variance throughout the calendar year. The City of Long Beach and Los Angeles County experience such outages. As such, the probability ranking for the Long Beach area is **Likely**. Although the Chancellor’s Office campus has not recorded power outage events, it is connected to the power grid of the surrounding community; as a result, it is prudent to assign this same ranking to the campus.

Climate models suggest summer global temperatures are likely to increase while changes between temperature extremes would be more pronounced. As such, it is expected that power outages will occur more frequently in the future.

**Vulnerability to the Hazard**
Based on the data available, and in consideration of the increasing effects of climate change, the CSU Chancellor’s Office remains vulnerable to power outages in terms of impacts to people, power infrastructure and campus operations. Office leadership would be well-advised to reduce vulnerabilities through consistent use of safety and operational protocols and emergency power sources to mitigate an interruption to electrical power.

**Estimate of Potential Losses**

California’s energy infrastructure is designed to cope with the state’s highly variable conditions and frequent disruptions from wildfires, storms, and floods. Generally, power outages caused by these events are short-term and limited to regional impacts. Of more concern are system-wide outages or shortages caused by a major disruption in supply or transmission.

**Vulnerability Assessment Conclusions**

The primary concern for campus leadership is that a loss of power can lead to potential hazards to staff at the CSU Chancellor’s Office. Elevators, entry ways, air filtration systems and lighting provide the campus community with the necessary infrastructure and systems to function and navigate through the campus and to maintain a safe campus environment and visibility during nighttime hours. The vulnerable population, especially employees with physical disabilities may be the most heavily affected by loss of power as they rely on elevators, entry ways with automatic doors and locks and lights may impede on a disabled employee’s ability to travel and utilize the campus and its structures safely.

The use of communication devices, billing, records, and electrical tools may also become unusable due to a loss of electricity. Many records and billing items may have to revert to “by-hand” procedures and paper copies may have to be kept continuing operations. Additionally, offices may not be usable if lighting equipment is not functioning impacting a semester or quarter’s progress for the academic year.

**Identified Data Limitations**

The CSU Chancellor’s Office did not report any monetary or life losses due to a power outage. Also, the campus did not report any incidents involving a power outage directly affecting the campus community and operations.

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**Tsunami**

**Description of the Hazard**

A tsunami is a wave triggered by any form of land displacement along the edge or bottom of an ocean or lake. Land displacement can be in the form of submarine landslides or submarine dip-slip faults. These types of faults cause ruptures that result in seafloor uplift or down-drop. This mass movement translates to a tsunami or gravity wave within the overlying water at the surface.
Tsunamis travel radially outward from the area of initiation. The size of a tsunami is proportional to the mass that moved to generate the tsunami. As a tsunami approaches the shore and the depth of the water column decreases, the energy in the wave pushes the wave crest above the water surface resulting in a larger wave height. Wave runup is the elevation above mean sea level on dry land that a tsunami reaches. Run-up is what causes inundation of coastal areas that are below the run-up height.

There are two types of source regions for tsunamis—resulting in local and distant source tsunamis as viewed from the affected shoreline. Local tsunamis are typically more threatening because they afford at-risk populations only a few minutes to find safety. California is vulnerable to, and must consider, both types. Identifying tsunami hazards requires 1) evaluating the potential for submarine mass movement both locally and at great ocean distances, and 2) identifying coastal regions within the direct or indirect path of a potential tsunami wave that are below the run-up height.

Tsunamis can travel at speeds of over 600 miles per hour in the open ocean and can grow to over 50 feet in height when they approach a shallow shoreline, potentially causing severe damage to coastal development. At the shoreline, tsunamis may take the form of a fast-rising tide, a cresting wave, or a bore (a large, turbulent wall-like wave). The bore phenomenon resembles a step-like change in the water level that advances rapidly (from 10 to 60 miles per hour). The first wave is usually followed by several larger and more destructive waves.

Location of the Hazard

The campus of the CSU - Chancellor’s Office (City of Long Beach) is located in the tsunami inundation zone. See tsunami map (below) with campus location identified within the zone. Also, see the tsunami inundation zone map for the City of Long Beach for the larger geographic range of the coastal inundation area.

Figure 27-14: Tsunami Line near Chancellor’s Office
Extent of the Hazard:

The factors shaping the extent or severity of the hazard are a combination of geophysical forces (the amount of vertical and horizontal motion of the sea floor, the area over which it occurs, and the efficiency with which energy is transferred from the earth’s crust to the ocean water) and the geographic range of coastal development to be impacted.

More specifically, as a tsunami approaches the shore, wave *run-up* is the elevation above mean sea level on dry land that a tsunami reaches. A tsunami’s potential severity can be forecasted as a function of the wave’s mass along with the difference between the wave’s run-up height and the ground elevation of the affected coastal location.

There are two types of source regions for tsunamis—resulting in local and distant source tsunamis as viewed from the affected shoreline. Local tsunamis are typically more threatening because they afford at-risk populations only a few minutes to find safety. California is vulnerable to, and must consider, both types. Identifying tsunami hazards requires 1) evaluating the potential for submarine mass movement both locally and at
great ocean distances, and 2) identifying coastal regions within the direct or indirect path of a potential tsunami wave that are below the run-up height. 66

Given the historical occurrence of tsunamis in Southern California (including Long Beach), and the catastrophic potential impact due to the Chancellor’s Office location within the tsunami inundation zone, with a maximum potential run-up height of 42 feet, the CDSU planning committee ranks the extent of the hazard as High.

History of the Hazard

The California Seismic Safety Commission report, the Tsunami Threat to California Findings and Recommendations on Tsunami Hazards Risks, published in December 2005, indicates that over 80 tsunamis have been observed or recorded along the coast of California in the past 150 years. That said, no tsunamis have impacted CSU campus locations.

According to the National Centers for Environmental Information (NCEI), have been eight tsunamis have caused damage to ports and harbors or coastal inundation in California since 1946. The most significant events are as follows:

- In 1964, a tsunami caused by a Magnitude 9.2 earthquake offshore from Alaska resulted in 13 deaths in California and destroyed portions of downtown Crescent City.
- A 2006 tsunami (originating in the Kuril Islands region north of Japan) caused approximately $20 million in damage to Crescent City harbor.
- A 2010 tsunami (originating offshore from Chile) caused millions of dollars in damage to ports and harbors in the state.
- A tsunami in 2011 (caused by a Magnitude 9.0 earthquake offshore of Japan) killed one person at the mouth of the Klamath River and caused up to $100 million of damage to 27 ports, harbors, and marinas throughout the State. The most damage occurred in Crescent City, Santa Cruz and Moss Landing harbors and a federal disaster was declared in Del Norte, Santa Cruz, and Monterey Counties. Both Crescent City and Santa Cruz harbors sustained damage to all docks, and oil spills and water/sediment contamination that resulted from sunk or damaged boats. Because recovery efforts in these two harbors took several years to complete, both harbors incurred business/economic losses that have been difficult to recapture.

In addition, the Worldwide Tsunami Database, www.ngdc.noaa.gov provides information on tsunami run-up levels and earthquake magnitude factors. Although data for the most recent events is not available, additional (earlier) tsunami events are recorded.

### Table 27-25: Tsunami Events in California 1930-2013

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<th>Date</th>
<th>Location</th>
<th>Maximum Run-up (m)</th>
<th>Earthquake Magnitude</th>
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</tr>
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<td>Santa Monica</td>
<td>6.1</td>
<td>5.2</td>
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</tr>
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<td>5.0</td>
<td>Unknown</td>
</tr>
<tr>
<td>06/15/2005</td>
<td>N. California</td>
<td>0.1</td>
<td>7.2</td>
</tr>
</tbody>
</table>

* The City of Long Beach has not been impacted by a tsunami previously, according to the 2016 City of Long Beach Hazard Mitigation Plan. That said, a tsunami event is recorded (above) in 1933, though the run-up height of 0.1 meters or 4 inches, so it is understandable that no event was observed on the ground.

### Potential Impacts of the Hazard

Tsunamis can travel at speeds of over 600 miles per hour in the open ocean and can grow to over 50 feet in height when they approach a shallow shoreline, potentially causing total devastation to coastal development.

The configuration of the coastline, the shape of the ocean floor, and the characteristics of advancing waves play important roles in the destructiveness of the waves. Bays, sounds, inlets, rivers, streams, offshore canyons, islands, and flood control channels may cause various effects that alter the level of damage. Offshore canyons can focus tsunami wave energy, and islands can filter the energy. It has been estimated that a tsunami wave entering a flood control channel could reach a mile or more inland, especially if it enters at high tide. The orientation of the coastline determines whether the waves strike head-on or are refracted from other parts of the coastline.
Potential impacts to the campus of the CSU – Chancellor’s Office in Long Beach include destruction of campus buildings and infrastructure, destruction of the natural environment, destruction of boats and coastal development, and loss of life in the area surrounding the campus. Tsunamis that impact both harbors and communities also can produce free-floating debris hazards and environmental contamination from chemical spills.

Probability of Future Occurrence of the Hazard:

The California Seismic Safety Commission report, the Tsunami Threat to California Findings and Recommendations on Tsunami Hazards Risks, published in December 2005, indicates that over 80 tsunamis have been observed or recorded along the coast of California in the past 150 years. If we consider historical occurrence as one data set for estimating future events, the average rate of occurrence over the past 150 years is 1 tsunami every 1.9 years statewide. Currently, no analysis is available which differentiates this statewide probability specifically for Long Beach, CA. Although 1 event is registered for Long Beach and 6 events for the Southern CA region, it is prudent to utilize the 1.9-year recurrence internal for planning purposes given extreme difficulties predicting tsunami points of origin. As such, the planning committee ranks the annual probability of a tsunami for the campus as Possible.

That said, the rate of future occurrence may change and may be able to make target estimates for specific locations in the future; the California State Tsunami Program is trying to refine the accuracy of the data. In doing so, the State Tsunami Program is completing a set of Probabilistic Tsunami Hazard Analysis (PTHA) maps representing risk levels from 100-year to 3000-year average return periods. Analysis using these probabilistically based products will allow for a more common platform for comparison to other seismic and flood probabilistic analyses. 67

Vulnerability to the Hazard

With regard to CSU campus locations, direct vulnerability of assets and people to tsunami only applies to Humboldt State University in Arcata CA, and the CSU Chancellor’s Office in Long Beach, CA, as these are the only 2 campuses located in a mapped tsunami zone.

Regarding the vulnerabilities for the Chancellor’s Office location, the greatest vulnerability are properties located near Oceanfront and the Port of Long Beach. Tsunami “maximum run-up” projections were modeled by the University of Southern California and distributed by the California Office of Emergency Services for the purposes of identifying tsunami hazards. The tsunami model was the result of a combination of inundation modeling and onsite surveys and determined the maximum projected inundation levels from tsunamis along the entire coast of Los Angeles County.

67 2018 State of California Hazard Mitigation Plan
The maximum run-up for is approximately 42 feet. This means that based on the worst-case scenario tsunami, the displaced water level would be approximately 42 feet above the normal tide for that day and time. As such, given that the Chancellor’s Office is located on the oceanfront, it is vulnerable to catastrophic loss, as are any staff or visitors unable to evacuate with proper lead-time.68

Population Vulnerability
The populations most vulnerable to the tsunami hazard are the elderly, disabled and very young who reside near beaches, low-lying coastal areas, tidal flats and river deltas that empty into ocean going waters. In the event of a local tsunami generated near the coast, little warning time would exist, so more of the population would be vulnerable, and to some extent, this vulnerability pertains to the Chancellor’s Office location in Long Beach. Though no data is currently available for Long Beach, it is densely populated which creates a high degree of vulnerability.

Property Vulnerability
The impact of tsunami waves and the scouring associated with debris that may be carried in the water could be damaging to all structures along beaches, low-lying coastal areas, tidal flats and river deltas. The most vulnerable structures are those in the front line of tsunami impact and those that are structurally unsound. According to the 2018 State of California Hazard Mitigation Plan, Long Beach exhibits among the state’s highest number of businesses located in the tsunami zone.

Critical Facilities and Infrastructure
The following infrastructure is vulnerable to damage in Long Beach, CA:

- Water Proximate Infrastructure—Breakwaters and piers collapse, sometimes because of scouring actions that sweep away their foundation material and sometimes because of the sheer impact of the tsunami waves.
- Flood Control Systems—Floodwaters can back up drainage systems, causing localized flooding. Culverts can be blocked by debris from tsunami events, also causing localized urban flooding.
- Utility Systems—Floodwaters can get into drinking water supplies, causing contamination. Sewer systems can be backed up, causing waste to spill into homes, neighborhoods, rivers and streams. Tsunami waves can knock down power lines and radio/cellular communication towers. Power generation facilities can be severely impacted by wave action and by inundation from floodwater.
- Fuels—Destruction of fueling infrastructure and related environmental and potable water contamination can occur.

68 2016 City of Long Beach Hazard Mitigation Plan.
Estimates of potential losses specific to CSU campuses have not been conducted yet. In addition, no estimated loss data is currently available for the City of Long Beach, although the local mitigation plan indicates concern for losses related to fires from damaged ships in ports or from ruptured coastal oil storage tanks and refinery facilities in the port area. That said, according to the State plan, technological improvements have been made in the ability to estimate losses from tsunami impacts which can be brought to bear on loss estimation for CSU campuses in the future.

Vulnerability Assessment Conclusions:

According to the 2018 State of California Hazard Mitigation Plan, community exposure to tsunamis in California varies considerably—some communities may experience great losses that reflect only a small part of their community and others may experience relatively small losses that devastate them. Among the 94 incorporated communities and 83 unincorporated areas of the 20 coastal counties, the communities of Alameda, Oakland, Long Beach, Los Angeles, Huntington Beach, and San Diego have the highest number of people and businesses in the tsunami inundation zone.

For improving assessments of vulnerability, FEMA has developed a new tsunami loss estimation module for HAZUS using existing numerical model results for tsunami inundation, flow depth, velocity, and force. This HAZUS module allows new capability for estimation of economic losses, and site-specific analysis of content losses, casualties, infrastructure damage, and evacuation time. The module calibrates losses based on safe zones and community preparedness levels. Such technological improvements in assessment capability can be utilized for tsunami hazard analysis and planning purposes for the CSU Chancellor’s Office.

Along with new probability-based tsunami maps, the HAZUS module will improve the ability to compare tsunami impacts to those of other hazards. Moreover, the probability mapping will be used for numerous applications including identifying potential tsunami hazard “zones of required investigation” under the Seismic Hazards Mapping Act and will assist state and local agencies in making land use planning decisions. They will also help regional and state planners understand the flood potential from tsunamis representing different risk levels. The improved analysis and data will be utilized by the SU Chancellor’s Office through its partnerships with key stakeholder organizations.69

**Note:** To download the Community Exposure to Tsunami Hazards in California report visit the USGS website: http://pubs.usgs.gov/sir/2012/5222/.

69 2018 State of California Hazard Mitigation Plan
Identified Data Limitations

As identified in the vulnerability conclusions (above), with regard to the current planning effort, the primary data limitations for assessing the tsunami hazard for CSU campuses (Chancellor’s Office and Humboldt State University) are comprehensive asset valuations lying within the tsunami inundation zone, and the need to apply FEMA’s new probability mapping techniques and tsunami loss estimation module to the footprint of each campus. That said, CSU leadership and planning teams intend to pursue such data in the future.

Volcano (Associated Air Quality)

Description of the Hazard

The US Geological Service defines volcanoes as “openings or vents where lava, tephra (small rocks), and steam erupt on to the Earth’s surface. Through a series of cracks within and beneath the volcano, the vent connects to one or more linked storage areas of molten or partially molten rock (magma). This connection to fresh magma allows the volcano to erupt over and over again in the same location.”

A volcanic eruption occurs when magma, lighter than surrounding rock, is driven upwards by its buoyancy and by pressure from the dissolved gases contained within it. Gases are released from magma as it reaches the surface and pressure decreases. Magma can be erupted in several ways and violent eruptions typically cause tiny pieces of tephra (ash) to be carried away by the wind. This ash is hard, does not dissolve in water, is extremely abrasive and mildly corrosive, and conducts electricity when wet. The gases released in an eruption include carbon dioxide, sulfur dioxide, hydrogen sulfide, and hydrogen halides. Depending on their concentration, these are potentially hazardous to people, animals, agriculture, and property.

Location of the Hazard

There are eight volcanic areas located throughout California. Seven of these - Medicine Lake Volcano, Mount Shasta, Lassen Volcanic Center, Clear Lake Volcanic Field, Long Valley Volcanic Region, Coso Volcanic Field, and Salton Buttes – are considered active volcanoes. No portion of Los Angeles County is located within a volcano hazard zone.

Extent of the Hazard

Volcanic hazards are most severe within a few miles of the volcano vent and the severity generally decreases with distance. Ash impact zones can range from tens to hundreds of kilometers.

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miles from the vent source. The US Geological Survey has estimated zones surrounding active volcanoes wherein 2 inches or more of ashfall following an eruption is possible. While the Chancellor’s Office does not fall within an estimated ashfall zone, lighter dustings of ash outside of those areas may directly or indirectly impact the office. As such, the planning committee ranks the extent of the hazard for the campus as **Low**.

**History of the Hazard**

No historical eruption events in California have affected the campus. Over the last 1,000 years, there have been at least 12 eruptions in California. The most recent volcanic eruption in California occurred at Lassen Peak about 100 years ago, when a major explosion delivered windborne ash over 275 miles away.

**Potential Impacts of the Hazard**

The specific impacts vary widely and depend on which type of volcano erupts, the style of explosion, the volume of lava, the eruption duration, and the local water conditions. As the Chancellor’s Office is not proximal to an active volcano, only the potential impacts of ashfall and gases have been detailed. While both these hazards can be widespread, their most severe impacts are generally seen closer to the volcanic source.

Although ashfall is typically a nonlethal volcanic hazard, it is the most widespread and disruptive. Falling ash can damage crops, electronics, and machinery. It can also impact human health by irritating the respiratory tract, eyes, and skin. The particles may enter drinking water and structures and may cause structure failure if it is thick and heavy enough. Even a fine layer of ash can disrupt utilities. A portion of California’s major electric transmission lines, aerial telecommunication lifelines, transportation corridors, and water storage and conveyance lie within the state’s volcano hazard zones. Impacts to any of these can impact operations at the Chancellor’s Office.

The potential impacts of gases released during volcanic eruptions are as follows:

- Carbon dioxide typically becomes diluted very quickly and is not life threatening. However, it can become trapped in higher concentrations in low-lying areas and has the potential to be fatal.
- Sulfur dioxide can cause acid rain and air pollution downwind of a volcano.
- Hydrogen sulfide can cause irritation of the upper respiratory tract. At high concentrations it can cause unconsciousness and death.
- Hydrogen halides can coat ash particles and, once deposited, poison drinking water, agricultural crops, and grazing land.

**Probability of Future Occurrence of the Hazard**

The US Geological Survey, based on the record of volcanic activity in California, estimates that the probability of another small- to moderate-sized eruption in the next thirty years is about 16 percent. As such, the annual probability of future occurrence for the campus is ranked by the committee as **Unlikely**.
Vulnerability to the Hazard

Populations living near volcanoes are the most vulnerable to eruptions and lava flows. However, volcanic ash can travel and affect populations miles away. The location and thickness of ash in any given area is a function of the severity of the eruption and wind speed and direction. For the Chancellor’s Office, there is low vulnerability to the immediate impact of volcanic eruptions due to the limited area affected and remote potential of an eruption. In the event of a widespread ashfall event, the elderly, infants, and populations with existing respiratory disease will be at higher risk.

Estimate of Potential Losses

Impacts to critical infrastructure, agriculture, and property from ashfall have the potential to cause widespread disruption, damage, and economic loss throughout the state. In the event of a widespread ashfall event, impacts will be immediate.

Current modeling is not precise enough to allow for an assessment of potential losses from ashfall to structures or infrastructure on or surrounding the campus.

Vulnerability Assessment Conclusions

The Chancellor’s Office is unlikely to experience the direct impacts of a volcanic event. While the campus may be indirectly impacted by ashfall elsewhere in the state, direct ashfall impacts are generally unlikely but possible in a widespread event. However, the likelihood of any volcanic eruption in the state impacting the campus is very low.

Identified Data Limitations

Not all active volcanoes in California have been zoned for hazards by the US Geological Survey. This fact, together with the infrequent occurrence of volcanic explosions and number of factors determining type and extent of impacts, make the quantification of potential loss difficult.

Wildfire

Description of the Hazard

While wildfires are a natural part of California’s ecosystem, wildfires in California represent a hazard that presents one of the greatest probabilities of destruction along with a demonstrated history of catastrophic fire events in recent years. The destructive fire seasons of 2017 to 2020 illustrated the destructive forces fire presents to communities across the state. Wildfires may result in structural loss, infrastructure loss, dangerous air quality, environmental damage, economic impacts, injuries, and loss of life. In many communities throughout California, wildfire presents the greatest risk to human life and property.
Wildfires have been defined as any free burning vegetation fire that initiates from an unplanned ignition, whether natural or human caused demanding fire suppression actions to contain. These fires are prone to become uncontrolled, spreading through vegetative fuels rapidly exposing people and structures to harm. Wildfires present a significant risk to communities across the state, as evidenced by increasing trends of structural losses from wildland fires. This risk is elevated in areas where development and community growth has intersected, also known as the wildland-urban interface (WUI). In the interface setting, development itself can provide additional fuel for large fires. Recent fires have also demonstrated the ability of fire to consume populated areas in extreme conditions.

California’s Mediterranean climate in combination with its geography and vast population creates a combination of factors that promote an optimal environment for large fire growth and consequences. As there is great diversity of geographic characteristics across the state, the risks and potential consequences of wildfire must be assessed locally. The physical location, weather patterns, local fuel types and volume, extent of the WUI, topography, and additional factors will factor differently from part of the state to another.

The behavior of wildfires in California is significantly influenced by three distinct geographic factors. These factors will help shape the size, direction of spread, rate of combustion, fire intensity, and ability to pre-heat fuels. The physical factors contributing to wildfire behavior include:

- **Topography** – The rate in which wildfires spread increases with greater slopes in topography. The greater the slope will result in more pre-heating of fuel above the advancing fire. The direction that a slope faces will also influence fire behavior as south facing slopes receive greater solar radiation and thus drier vegetation that is more susceptible to combustion. Ridgetops often denote the end of fire spread as fire has greater difficulty spreading downhill.

- **Weather** – Weather factors substantially influence the behavior of wildfires. Wind, temperature, humidity, lightning, and lack of precipitation all contribute to a fire’s ability or inability to spread and intensify. California routinely experiences conditions in which these factors are in alignment to contribute to extreme fire behavior during the summer and fall seasons. High winds, low humidity, and high temperatures provide an environment promoting extreme fire activity.

- **Fuels** – Certain types of vegetation are increasingly prone to igniting and promote more intense burning. Areas with greater “fuel loading” (amount of fuel present in terms of weight of fuel per unit of area) increases the amount of fuel to fuel a fire. Greater volumes of dead or dry vegetation compared to live plants is a critical factor. Vegetation during drought conditions will experience

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decrease in moisture content increasing the conditions for combustion. Fuels close proximity to one another allows for rapid spread through contact or radiant exposures.

A risk assessment for wildfires should be implemented within a geospatial context focusing on the specific location features and incorporates the three components of the wildfire risk triangle – likelihood, intensity, and susceptibility.

Location of the Hazard

Substantial portions of the State of California are exceptionally vulnerable to wildfire activity or reside in a wildland-urban interface (WUI) area due to the vast open spaces, rangelands, forests and other lands with high susceptibility to fire occurring throughout the state. CSU Chancellor’s Office and the City of Long Beach are located in the southern end of the Los Angeles Basin along the coast. This area near the Chancellor’s Office is dominated by urban and coastal communities with limited to no direct exposures to wildland fire and the campus is not located within any Fire Hazard Severity Zones.

The CSU Chancellor’s Office is located in the southern side of Long Beach along the waterfront of the confluence of the Los Angeles River and the Pacific Ocean. The office is 7 miles east of the closest area designated as having a high fire hazard in the Palos Verdes Peninsula where there is a mix of residential neighborhoods and hillsides with moderate vegetative fuels.

However, the CSU Chancellor’s Office is surrounded by mountain ranges hosting three national forests with extensive history of large fire development. The fires that burn in these areas have the potential to develop vast quantities of smoke that can fill the basin in the right wind conditions. The geography of the Los Angeles Basin and San Gabriel, San Fernando, and San Bernardino valleys creates a topography that captures air pollutants including smoke and the CSU Chancellor’s Office is located in a region in which wildfire smoke can saturate the air around the facility.
Figure 27-16: Fire Hazard Severity Zones

Extent of the Hazard

While the threat to fire directly affecting the campus is minimal, the direct effect of fire generated smoke might occur. Fires are likely to occur in areas close enough to the campus that generate substantial amounts of smoke that could envelop the campus in the right atmospheric conditions. Fires that are large enough to generate volumes of smoke to cover great distances have the potential to affect the air quality of the Los Angeles County area including the campus. This will especially be the case in weather conditions creating strong offshore winds. The potential for this impact has been demonstrated during the summers of 2018, 2019, and 2020 as fires burned across the state and spread smoke over vast distances. Fires burning outside of the Los Angeles County region have the potential to distribute smoke onto the CSU Chancellor’s Office.

Given that the area immediately surrounding the Chancellor’s Office is not in proximity to fire hazard zones designated as a High Fire Hazard Severity Zones, and the campus does not have a history of wildfire activity occurring within proximity to the campus, it nevertheless has experienced impacts to air quality from smoke. Therefore, the planning committee ranks the extent of the hazard as Low to Moderate.

Moreover, as a large number of wildfires are ignited due to human caused factors, the ability to determine when or where a wildfire might occur is impossible. Only the conditions for a wildfire can be predicted with any accuracy.

The National Fire Danger Rating System (NFDRS) is the current system in use for rating and classifying the potential danger of fire. The NFDRS tracks the effects of previous weather events on both dead and live fuel loads and adjusts accordingly based on future or predicted weather conditions. These complex relationships and equations are computed, and the outputs are expressed in terms that users can quickly and easily understand. The current NFDRS is used by all federal and most state agencies to assess fire danger conditions. The following table depicts the NFDRS, from the US Forest Service’s Wildland Fire Assessment System.

Table 27-26: National Fire Danger Rating System

<table>
<thead>
<tr>
<th>Rating</th>
<th>Basic Description</th>
<th>Detailed Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>CLASS 1: Low Danger (L)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>COLOR CODE: Green</td>
<td>Fires not easily started</td>
<td>Fuels do not ignite readily from small firebrands. Fires in open or cured grassland may burn freely a few hours after rain, but wood fires spread slowly by creeping or smoldering and burn in irregular fingers. There is little danger of spotting.</td>
</tr>
<tr>
<td>CLASS 2: Moderate Danger (M)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>COLOR CODE: Blue</td>
<td>Fires start easily and spread at a moderate rate</td>
<td>Fires can start from most accidental causes. Fires in open cured grassland will burn briskly and spread rapidly on windy days. Woods fires spread slowly to moderately fast. The average fire is of moderate intensity, although heavy concentrations of fuel – especially draped fuel -- may burn hot. Short-distance spotting may occur but is not persistent. Fires are not likely to become serious and control is relatively easy.</td>
</tr>
<tr>
<td>CLASS 3: High Danger (H)</td>
<td>Fires start easily and spread at a rapid rate</td>
<td>All fine dead fuels ignite readily, and fires start easily from most causes. Unattended brush and campfires are likely to escape. Fires spread rapidly and short-distance spotting is common.</td>
</tr>
</tbody>
</table>

### COLOR CODE: Yellow

<table>
<thead>
<tr>
<th>CLASS 4: Very High Danger (VH)</th>
<th>High intensity burning may develop on slopes or in concentrations of fine fuel. Fires may become serious and their control difficult, unless they are hit hard and fast while small.</th>
</tr>
</thead>
<tbody>
<tr>
<td>COLOR CODE: Orange</td>
<td>Fires start very easily and spread at a very fast rate. Fires start easily from all causes and immediately after ignition, spread rapidly and increase quickly in intensity. Spot fires are a constant danger. Fires burning in light fuels may quickly develop high-intensity characteristics - such as long-distance spotting - and fire whirlwinds when they burn into heavier fuels. Direct attack at the head of such fires is rarely possible after they have been burning more than a few minutes.</td>
</tr>
<tr>
<td>COLOR CODE: Red</td>
<td>Fires under extreme conditions start quickly, spread furiously, and burn intensely. All fires are potentially serious. Development into high intensity burning will usually be faster and occur from smaller fires than in the Very High Danger class (4). Direct attack is rarely possible and may be dangerous, except immediately after ignition. Fires that develop headway in heavy slash or in conifer stands may be unmanageable while the extreme burning condition lasts. Under these conditions, the only effective and safe control action is on the flanks, until the weather changes or the fuel supply lessens.</td>
</tr>
</tbody>
</table>

Agencies across the nation have adopted the use of the Air Quality Index (AQI) to communicate and provide a consistent approach to air quality measurements and categorization. The AQI primarily focuses on the health effects caused by pollutants in the air such as smoke.

The goal of the AQI is to provide advisories to assist the public in determining when to reduce exposure to inhalation of air pollution as pollution levels rise.
History of the Hazard

The State of California has a long history of chronic and destructive wildfires throughout the state. On average, 8,300 wildfires have caused burnt 928,245 acres across the state over the 20-year period between 2000 and 2020. Los Angeles County also has a long history of wildfire activity primarily in the foothills and mountains of the San Gabriel and Santa Monica Mountains. Wildfires occurring in Los Angeles County have resulted in hundreds of thousands of acres burned and hundreds of millions of dollars in damage.

The area immediately surrounding the CSU Chancellor’s Office is not in proximity to fire hazard zones designated as a High Fire Hazard Severity Zones. The office does not have a history of wildfire activity occurring within proximity to the campus. However, the County is surrounded by areas that are considered to be of high fire threat that would produce vast quantities of smoke and particulates into the air. The Long Beach Chancellor’s Office has experienced multiple days of poor air quality due to fires burning in Los Angeles, Orange, Riverside, and San Bernardino Counties. The 2017, 2018, and 2020 fire seasons in particular illustrated the increase in wildfire generated smoke saturating the air of communities throughout the state including Los Angeles County. CSU Chancellor’s Office personnel reported the ongoing development of procedures to address the response to poor air quality days.


76 California Department of Forestry and Fire Protection, Stats and Events, https://www.fire.ca.gov/stats-events/
Table 27-27: Historic Large-Scale Fires Near CSU Chancellor’s Office\(^\text{77}\)

<table>
<thead>
<tr>
<th>Date</th>
<th>Fire</th>
<th>Location</th>
<th>Declaration</th>
<th>Damages</th>
</tr>
</thead>
<tbody>
<tr>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
</tr>
</tbody>
</table>

Potential Impacts of the Hazard

The CSU Chancellor’s Office is surrounded by areas of urban development and water removed from areas with a fire hazard places a minimal direct threat from wildfire to the office. The potential impacts of wildfire exist with members of the campus community who reside or work in these fire hazard zones.

Potential impacts to the campus community resulting from wildfires include:

- Injuries or loss of life
- Campus property destruction or damage
- Residential property destruction or damage
- Commercial property destruction or damage
- Loss of property contents
- Infrastructure damage
- Damaged or destroyed lifelines/supply routes
- Damaged or destroyed utilities
- Damaged or destroyed critical facilities supporting campus emergency support needs
- Loss of community economic base
- Employment losses
- Loss to ground supporting vegetation on hillsides resulting in erosion or landslides in future precipitation events
- Agricultural (crops and livestock) damages or destruction
- Environmental damage
- Societal and community impacts
- Damage to organizations and facilities providing support services to vulnerable populations
- Greater evacuation challenges for those most vulnerable

\(^{77}\) 2019 Los Angeles County All-Hazards Mitigation Plan, 2019
• Psychological impacts of impacted populations
• Disruptions to education delivery to community

Potential impacts resulting from wildfire generated smoke include:

• Dangerous levels of air pollution
• Human Health Effects
  • Similar health impacts to pets
• Air conditioning systems overwhelmed
• Greater demands on air filtration systems
• Greater demands on healthcare systems
• Reduced outdoor work productivity
• Closures of academic sessions

Additionally, there remains a number of secondary impacts from wildfires that could affect the campus community. Utilities feeding areas of Los Angeles County including the campus may be damaged resulting in power outages. Fire related damage in the watersheds may cause future landslides, degradation to plants supporting hillsides, and impact hydroelectric power capabilities. Fires may present threats to areas of recreation, scenic value, and wildlife that are a part of the culture of the campus community. Finally, the campus may experience effects of evacuated individuals arriving on campus from other areas as a location of refuge.

Probability of Future Occurrence of the Hazard

Based on the minimal wildfire threat potential in the area surrounding the CSU Chancellor’s Office, including the distance to Fire Hazard Severity Zones and density of residential and commercial development, the probability of wildfire related damage is considered **Unlikely**.

Based on the wildfire threat potential in the area surrounding Southern California including the hills and mountains throughout the region, the volume of areas in elevated Fire Hazard Severity Zones throughout the southern portions of the state, and the historic occurrences of smoke, the probability of wildfire generated smoke impacts to air quality is considered **Possible**.

Vulnerability to the Hazard

The CSU Chancellor’s Office is not likely to be subject to direct impact from wildfire due to the campus location in an urban/waterfront area of Long Beach. The vulnerabilities to the effects of wildfire would largely lie within the office community who may reside or work in locations that are exposed to the Fire Hazard Severity Zones outside of Long Beach. Wildfires occurring in other areas of the region may result in the displacement of large numbers of people. These effects may spill onto the office in the form of needed assistance or facility support to emergency resources.
Fire directly threatening the campus would likely take the form of localized fires involving single structures or small areas. Smaller vegetation fires are possible surrounding the campus in the urban forest or open areas surrounding the city. These incidents would likely have little impact to the office.

The primary basis of vulnerability is based on the population affected and the built environment exposed. In general, newer construction will be more fire resistant than older buildings as building and fire codes and construction technology have improved. Density of buildings and proximity of fuels to buildings or equipment at risk of combustion would additionally influence the fire’s ability to spread to structures.

Some areas of particular vulnerability on the campus include:

- Staff engaging in outdoor activities when the air is determined to be unhealthy are vulnerable to adverse health effects.
- Buildings with ineffective HVAC or do not have HVAC will cause limitations in filtering of air during smoke filled days
- Power outages or brownouts during days with high levels of smoke will limit shelter in place options during heat events in summer.
- Santa Ana wind events may push large volumes of smoke into the Los Angeles Basin

The greater concerns regarding vulnerabilities to wildfire on CSU Chancellor’s Office are related to the smoke that fires in the area would produce. The recent summer seasons have clearly demonstrated the reality of large wildfires producing enough smoke to fill the Los Angeles Basin even from substantial distances away. These recent fires have displayed how the effects of this smoke impact the general population and especially vulnerable populations. CSU Chancellor’s Office personnel both on the facility and off the facility face these same vulnerabilities related to smoke filled air.

Individuals with existing health problems such as respiratory or cardiac illnesses are increasingly vulnerable to wildfire generated smoke. Staff who work in roles requiring outdoor activity will be increasingly exposed during days where the air quality index is considered unhealthy or worse. Staff participating in outdoor tasks including aerobic activities are increasingly vulnerable to the effects of wildfire which will vary depending on when the air quality were to reach unhealthy levels. However, in region-wide events this vulnerability may be shared with the homes and workplaces of members of the office community and their families.

Vulnerable populations will likely face disproportionate health safety issues from smoke filled air, experience increased stresses, may require the need to remain away from the office enclosed at home, and may find difficulty in accessing equipment or supplies to aid in a specific need.

Estimate of Potential Losses
Estimates of potential losses will be influenced by a variety of factors. Costs would also be likely to include mitigation or repairs of HVAC systems, sealing of doors and windows, and other methods of keeping smoke from entering buildings. Secondary costs would include lost academic days during campus closures, lost staff on campus productivity, and health and medical interventions for affected members of the campus community.

Based on estimate replacement costs of facilities and structures on campus, the maximum total replacement costs due to wildfire are unknown. Due to the lack of a complete inventory of building and facility costs, the total replacement estimate is likely much higher. However, the location of the campus in an urban/suburban setting removed from hazard prone areas makes wildfire related damages unlikely.

Table 27-28: Wildfire Hazard Potential (WHP) Zone Estimated Losses

<table>
<thead>
<tr>
<th>WHP Zone</th>
<th>No of Buildings</th>
<th>Maximum Replacement Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Extreme</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Very High</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>High</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Moderate</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Low</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Very Low</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Non-Burnable</td>
<td>1</td>
<td>Unknown</td>
</tr>
</tbody>
</table>

*Buildings with no value defined are also included in the respective Zones they are found in.

Vulnerability Assessment Conclusions

The occurrence of wildfires has been a frequent event in Los Angeles County; however, wildfire incidents do not pose a direct risk to the CSU Chancellor’s Office. The location of the CSU Chancellor’s Office, surrounded by densely developed commercial and industrial land uses adjacent to ocean waterfront, mitigates any vulnerabilities of wildfire hazards to the office community or facilities.

Communities located within or near the Wildland Urban Interface may be subject to damaging fires. These same communities may be home to members of the office community. The staff of CSU Chancellor’s Office who live or work in these hazard areas may experience vulnerabilities to the direct exposure to wildfire not likely at the office. These effects may create tremendous challenges that could impact their ability to maintain engagement with university academic or professional activities. The potential
for large-scale wildfires in the region further generates the added potential for a number of cascading effects such as disruptions to the local economy, utility failures, disruptions to providing for the needs of the community, and development of public health hazards.

Additionally, the topography of Southern California surrounded by mountains allows for smoke filled air to linger in the valleys of the Los Angeles Basin with the potential for unhealthy air quality depending on wind conditions. Fires in surrounding mountains generating tremendous quantities of smoke present tremendous health related vulnerabilities to members of the office community. The office community exposed to these unhealthy air conditions are vulnerable to a variety of potential health related effects.

Identified Data Limitations

Data limitations include missing campus structural replacement costs, and lack of both a complete inventory of building construction types and mitigation efforts to lessen the impact due to fire activity. HAZUS generated analysis is focused on the broader community level versus fine-tuning the analysis to the micro-level for facilities such as a university campus.

Severe Weather (Wind, Tornado, Hail, and Lightning)

Description of the Hazard

Severe weather can be described as a variety of weather or climate events that are beyond or near the ends of the range of observed weather patterns and behavior. These events can include high or extreme winds, storms, lightning, hail, tornadoes, heat waves, unusually cold temperatures, extreme rainfall, and flooding. According to the Intergovernmental Panel on Climate Change (IPCC), to be classified as severe (or extreme), the occurrence of each value of a climate or weather variable (e.g., wind, hail, lightning, tornado, etc.) must be “above (or below) a threshold value near the upper (or lower) ends of the range of observed values of the variable.”

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Severe weather in California can be generated by local, regional, and/or global weather and climate influences. From the individual thunderstorm to the Santa Ana wind event to the strong El Niño, damaging weather elements that are produced by and accompany severe weather and climate phenomena (e.g., damaging winds, hail, lightning, and tornadoes) occur throughout California and the California State University (CSU) system.

**Global Scale Influences on Severe Weather in California: El Niño, La Niña, and ENSO**

The El Niño-Southern Oscillation (ENSO) is a recurring climate pattern involving changes in the temperature of waters in the central and eastern tropical Pacific Ocean. On periods ranging from about three (3) to seven (7) years, the surface waters across a large swath of the tropical Pacific Ocean warm or cool by anywhere from 1°C to 3°C, compared to normal. This oscillating warming and cooling pattern, referred to as the ENSO cycle, directly affects rainfall distribution in the tropics and can have a strong influence on weather across the United States and other parts of the world.

El Niño and La Niña are extreme phases of the ENSO cycle, with a third phase occurring between them called the Neutral phase. El Niño phase is characterized by unusually warm ocean temperatures and weaker-than-normal east winds in the Equatorial Pacific, while the La Niña phase is characterized by unusually cold ocean temperatures and stronger-than-normal east winds in the Equatorial Pacific. Both extreme ENSO phases lead to significant differences from the average ocean temperatures, winds, surface pressure, and rainfall across parts of the tropical Pacific. The Neutral phase indicates that conditions are near their long-term average.

The extreme ENSO phases affect the frequency and intensity of weather events across the world, including in California. On average, areas across California experience exceptionally stormy winters with increased precipitation under El Niño conditions, but experience less stormy and drier winters under La Niña conditions. This variability in storminess and precipitation brought on by El Niño and La Niña events affects the both the frequency and intensity of severe weather conditions experienced by all CSU campuses, including the CSU Chancellor’s Office.

**Regional Climate Influences on Severe Weather across California**

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80 Retrieved on 07.18.2021 from https://www.weather.gov/mhx/ensowhat


83 Retrieved on 07.16.2021 from https://www.pmel.noaa.gov/elnino/what-is-el-nino

Most of the weather in California is influenced by the wet-winter/dry-summer Mediterranean climate pattern. In the summer months, Pacific storm tracks are deflected north due to the position of the Pacific High (i.e., a large-scale atmospheric circulation over the Northeast Pacific Ocean), preventing Pacific storms from reaching California. As a result, most summer storms are generated due to the incursion of moist air from the Gulf of Mexico or the Gulf of California, and occur as scattered, locally heavy showers in the desert and mountain regions of the state. In the winter months, the Pacific High decreases in intensity and moves south, permitting powerful Pacific storms to move into and across the state; these storms can produce extreme winds, heavy rains (including “atmospheric river” events), and widespread coastal and inland flooding. (Please see the Flood Hazard profile in this document for information on Floods.) As a result, storm events accompanied by precipitation in California are far more frequent in the winter months than they are in the summer months.85

While the Mediterranean climate pattern influences the seasonal frequency, intensity, geographic spread, and type of some severe weather events CSU campuses experience (including the CSU Chancellor’s Office), other severe weather phenomena may occur in California at any time of the year. For example, near the coast and over the Central Valley, there appears to be no defined seasonality to thunderstorms, and these storms are usually light and infrequent. Thunderstorms are more intense and more frequent in the intermediate and higher elevations of the Sierra Nevada and occur with greater frequency during the summer months.86

**Types of Storms in California**

The 2018 California State Hazard Mitigation Plan (SHMP) defines a storm as a violent atmospheric disturbance occurring over land and/or water that is distinguished by its strength, characteristics, and the scale of the resulting damage.87 The SHMP also lists the following types of storms that produce hazardous conditions and potential damage throughout the state of California.88 These storms affect (in varying degrees) all CSU campuses, including the CSU Chancellor’s Office.

- **Thunderstorm:** A rain-bearing cloud that also produces lightning. Thunderstorms can produce some of nature’s most destructive and deadly weather including

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85 Retrieved on 07.17.2021 from https://wrcc.dri.edu/Climate/narrative_ca.php
86 Retrieved on 07.17.2021 from https://wrcc.dri.edu/Climate/narrative_ca.php
tornadoes, hail, strong winds, lightning and flooding. Thunderstorms are caused by an atmospheric imbalance from warm unstable air rising rapidly into the atmosphere. Lightning, which occurs during all thunderstorms, can strike anywhere. Thunderstorms can produce some of nature’s most destructive and deadly weather including tornadoes, hail, strong winds, lightning and flooding. Severe thunderstorms are more intense, violent, and dangerous thunderstorms. The National Oceanic and Atmospheric Administration (NOAA) defines a severe thunderstorm as any storm that produces one or more of the following elements: Damaging winds or speeds of 58 mph (50 knots) or greater, hail 1 inch in diameter or larger, and/or a tornado.

- **Hailstorm:** a type of storm that precipitates round chunks of ice. Hailstorms usually occur during regular thunderstorms.
- **Wind storm:** marked by high wind with little or no precipitation.
- **Winter storm:** A storm that can produce a combination of freezing rain, sleet, heavy snow, and/or strong winds.
- **Coastal storm:** large wind-driven waves and/or storm surge that strike the coastal zone.
- **Ice storm:** Ice storms are one of the most dangerous forms of winter storms. When surface temperatures are below freezing, but a thick layer of above-freezing air remains aloft, rain can fall into the freezing layer and freeze upon impact into a glaze of ice. In general, 8 millimeters (0.31 inch) of accumulation is all that is

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92 Retrieved on 07.15.2021 from https://www.noaa.gov/explainers/severe-storms

93 Retrieved on 07.15.2021 from https://www.weather.gov/safety/thunderstorm


required, especially in combination with breezy conditions, to start downing power lines as well as tree limbs. Ice storms also make unheated road surfaces too slick to drive on. Ice storms can vary in time range from hours to days and can cripple small towns and large urban centers alike.98

- **Snowstorm**: A heavy fall of snow accumulating at a rate of more than 5 centimeters (2 inches) per hour that lasts several hours. Snowstorms, especially ones with a high liquid equivalent and breezy conditions, can down tree limbs, cut off power, and paralyze travel over a large region.99

**Severe Weather Hazard Elements: Wind Hazards, Hail, and Lightning**

This hazard profile concentrates on the following types of severe weather hazards: **wind hazards (including tornadoes), hail, and lightning**. These hazards are produced by a variety of weather phenomena, including thunderstorms, coastal storms, winter storms, and topographically enhanced downslope winds. While storm and downslope wind hazards are responsible for severe weather events across the CSU system, only the wind, tornado, hail, and lightning elements generated by these hazards are covered in this profile. (Storm-related hazards such as flooding and extreme temperatures are covered in other sections of this document.)

**Wind Hazards**

**Wind** is the horizontal movement of air past any given point. Wind begins with differences in air pressures; pressure that is higher at one point than another sets up a force, pushing the high towards the low pressure.100 Wind gusts are defined as “rapid fluctuations in the wind speed with a variation of 10 knots or more between peaks and lulls.”101

Wind hazards in California take several forms: High Wind, Strong Winds, Thunderstorm Winds, Mountain-Valley (Downslope) Winds, and Tornadoes. These hazards are encountered across California and have the potential to cause harm to or loss of life and/or property throughout California and the CSU system (including the CSU Chancellor’s Office).

**High Winds, Strong Winds, and Thunderstorm Winds**

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The National Weather Service reports three (3) types of wind events that occur areas over land: High Winds, Strong Winds, and Thunderstorm Winds. Collectively, these reports are used to determine the frequency with which wind hazard events have affected areas across the U.S., including California.

**High Winds**

High winds are defined as sustained non-convective winds of 35 knots (40 mph) or greater lasting for 1 hour or longer, or gusts of 50 knots (58 mph) or greater for any duration (or otherwise locally/regionally defined). In some mountainous areas, the above numerical values are 43 knots (50 mph) and 65 knots (75 mph), respectively.102

**Strong Winds**

Strong winds are defined as non-convective winds gusting less than 50 knots (58 mph), or sustained winds less than 35 knots (40 mph), resulting in a fatality, injury, or damage.103

**Thunderstorm Winds**

Thunderstorm winds are winds that arise from thunderstorm convection (occurring within 30 minutes of lightning being observed or detected), with speeds of at least 50 knots (58 mph). They can also be winds of any speed (non-severe thunderstorm winds below 50 knots (58 mph)) producing a fatality, injury, or damage.104

Please note: *Straight-line wind* is a term used to define any thunderstorm wind that is not associated with rotation. It is used mainly to differentiate from the rotational winds found in tornado-producing storms.105 However, it is not a term used in the NCEI Storm Events Database, and therefore cannot be used to determine severe weather history of or potential impacts to CSU campuses.

**Tornadoes**

A tornado is an extreme severe weather wind hazard. A tornado is a rapidly rotating column of air extending from a thunderstorm to the surface of the Earth.106 This column extends between clouds and the Earth’s surface. The damaging power from tornadoes comes from intense winds and flying debris. It is believed that rotational wind speeds can

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106 Retrieved on 07.15.2021 from https://www.earthnetworks.com/tornado/
be as high as 300 mph in the most violent tornadoes.\textsuperscript{107} On a local scale, tornadoes are the most violent and most destructive of all atmospheric phenomena.\textsuperscript{108}


\textbf{Santa Ana Winds}. A type of wind hazard that is peculiar to Southern California is called a \textit{Santa Ana Wind}. Santa Ana winds are strong, topographically enhanced, extremely dry downslope winds that originate inland and affect coastal southern California and northern Baja California (Mexico).\textsuperscript{109} They occur when air from a region of high pressure over the dry, desert region of the southwestern U.S. flows westward towards low pressure located off the California coast. This creates dry winds that flow east to west through the mountain passages in Southern California. These winds have a strong seasonal component; they are most common during the cooler months of the year, occurring from September through May. Santa Ana winds typically feel warm (or even hot) because as the cool desert air moves down the side of the mountain, it is compressed, which causes the temperature of the air to rise. If strong enough, Santa Ana winds can cause major property damage, and may present difficulties for airborne and seagoing transportation. They also may increase wildfire risk because of the dryness of the winds and the speed at which they can spread a flame across the landscape.\textsuperscript{110} (Note: The Wildfire hazard is profiled elsewhere in this document.)

Figure below illustrates the mechanisms involved in the generation of Santa Ana winds across Southern California.

\textsuperscript{107} Retrieved on 07.15.2021 from https://www.nssl.noaa.gov/education/svrwx101/tornadoes/faq/

\textsuperscript{108} Retrieved on 07.15.2021 from https://www.weather.gov/bgm/severedefinitions


**What Drives a Santa Ana Wind?**

1. High surface pressure builds over the Great Basin region with lower pressure off Southern Cal Coast. (Fall-mid Spring)

2. Air remains relatively cold across the deserts. As the air extends through the mountain passes...it become compressed and warms. (See lower right map) Lower relative humidity also occurs helping to dry out vegetation and can fan any existing fires.

3. Wind speed increases as it squeezes through the mountain and valley canyons. Wind gusts can vary from 45 to 100 mph depending on the strength of the Santa Ana event.

4. Strong winds create turbulence for area flights and can make interstate travel difficult as well as choppy seas for mariners.

**Cross Section over the Los Angeles and Ventura County Mountains to the Pacific Ocean**

Source: National Weather Service

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**Diablo Winds.** The Diablo wind is another type of topographically enhanced downslope wind phenomenon that occurs in the North-Central areas of California. Diablo winds are offshore wind events that flow northeasterly over Northern California’s Coast Ranges, often creating high wind speeds downwind of major canyons and over ridges, and extreme fire danger for the San Francisco Bay Area. Diablo winds are driven by a surface pressure gradient that forms in response to an inverted pressure trough that develops over California.¹¹²

**Sundowner Winds.** Sundowner winds are significant and potentially damaging downslope wind and warming events that periodically occur along a short segment of the southern California coast in the vicinity of Santa Barbara, CA. The unique topography of this coastal region promotes the development of Sundowner wind events: over a length of about 100 km, the coastline is oriented approximately west–east, with the adjoining

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narrow coastal plain bounded by a steeply rising (to elevations greater than 1200 m) and coast-parallel mountain range. Called Sundowner winds because they often begin in the late afternoon or early evening, their onset is typically associated with a rapid rise in temperature and decrease in relative humidity, and the winds tend to blow from the north from the Santa Ynez Mountains to the coast of Santa Barbara County, California. During the more intense Sundowner wind events, wind speeds can be of gale force 39-54 miles per hour) or higher and can even reach hurricane force (≥ 74 miles per hour) in the most extreme cases. Temperatures over the coastal plain, and even at the coast itself, can rise significantly above 37.8°C (100°F). Seasonally, Sundowner winds peak in March, April, and May, with a minimum during summer and a secondary peak in winter that often corresponds with Santa Ana winds. In addition to causing a dramatic change from the more typical marine-influenced local weather conditions, Sundowner wind episodes have produced significant wind-related property and agricultural damage, as well as conditions of extreme fire danger.113 114 115

**Hail**

Hail is a form of precipitation consisting of solid ice that forms inside thunderstorm updrafts.116 It is roughly round in shape and at least 0.2’ in diameter. Hail develops in the upper atmosphere as ice crystals that are bounced about by high velocity updraft winds; the ice crystals accumulate frozen droplets and fall after developing enough weight. The size of hailstones varies and is a direct consequence of the severity and size of the storm that produces them – the higher the temperatures at the Earth’s surface, the greater the strength of the updrafts and the amount of time hailstones are suspended, and therefore the greater the size of the hailstone.117

**Lightning**

Lightning is an electrical discharge produced by a thunderstorm. Lightning rapidly heats the air in its immediate vicinity to about 50,000°F - about five times the temperature of the surface of the sun. This compresses the surrounding air and creates a supersonic shock wave, which decays to an acoustic wave that is heard as thunder.118

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The discharge may occur within or between clouds, between the cloud and air, between a cloud and the ground, or between the ground and a cloud.\textsuperscript{119} Lightning that is produced from thunderstorms in which precipitation evaporates before reaching the ground is called “dry lightning.”

**Location of the Hazard**

Severe weather is a non-spatial hazard, and can occur anywhere in the CSU system, including on the CSU Chancellor’s Office campus. No one area of the campus – or of the surrounding community – is subject to experiencing severe weather more than any other area.

There is geographic variability among the different types of mountain and valley wind events (as a sub-category of the severe weather hazard). Santa Ana winds occur in Southern California, Diablo winds occur in North-Central California, and Sundowner winds occur almost exclusively in Santa Barbara County, California.

**Extent of the Hazard**

Severe weather hazards are non-spatial hazards that potentially affect all of the CSU Chancellor’s Office campus areas equally. However, the smallest geographic unit of measurement for almost all official severe weather event data is at the county level. Because the severe weather data used do not exist at the campus level, it is assumed that the same (or similar) severe weather risks to the CSU Chancellor’s Office reflect those of the surrounding community and County. As a result, all assets and people at the CSU Chancellor’s Office are at risk from the effects of severe weather and can expect to experience at least some (or the complete range of) endemic severe weather hazards. In consideration of the campus’ design, layout, and operations, the severe weather history and degree of severity in the Long Beach area, and the history and degree of severity of each severe weather sub-type identified by the extent scales (below), the campus planning committee ranks the overall extent of the Severe Weather hazard as Moderate. See each sub-hazard below for the planning committee’s sub-type extent ranking.

*Wind Hazard: Non-Rotational*

The Beaufort Scale is an empirical measure that relates wind speed to observed conditions at sea or on land. Its full name is the Beaufort wind force scale.\textsuperscript{120} First developed in 1805, it is still used today to estimate wind strengths.\textsuperscript{121}


\textsuperscript{120} Retrieved on 07.15.2021 from https://www.rmets.org/resource/beaufort-scale

\textsuperscript{121} Retrieved on 07.15.2021 from https://www.weather.gov/mfl/beaufort
<table>
<thead>
<tr>
<th>Force</th>
<th>Speed (mph)</th>
<th>Speed (knots)</th>
<th>Description</th>
<th>Specifications for use at sea</th>
<th>Specifications for use on land</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0-1</td>
<td>0-1</td>
<td>Calm</td>
<td>Sea like a mirror.</td>
<td>Calm; smoke rises vertically.</td>
</tr>
<tr>
<td>1</td>
<td>1-3</td>
<td>1-3</td>
<td>Light Air</td>
<td>Ripples with the appearance of scales are formed, but without foam crests.</td>
<td>Direction of wind shown by smoke drift, but not by wind vanes.</td>
</tr>
<tr>
<td>2</td>
<td>4-7</td>
<td>4-6</td>
<td>Light Breeze</td>
<td>Small wavelets, still short, but more pronounced. Crests have a glassy appearance and do not break.</td>
<td>Wind felt on face; leaves rustle; ordinary vanes moved by wind.</td>
</tr>
<tr>
<td>3</td>
<td>8-12</td>
<td>7-10</td>
<td>Gentle Breeze</td>
<td>Large wavelets. Crests begin to break. Foam of glassy appearance. Perhaps scattered white horses.</td>
<td>Leaves and small twigs in constant motion; wind extends light flag.</td>
</tr>
<tr>
<td>4</td>
<td>13-18</td>
<td>11-16</td>
<td>Moderate Breeze</td>
<td>Small waves, becoming larger; fairly frequent white horses.</td>
<td>Raises dust and loose paper; small branches are moved.</td>
</tr>
<tr>
<td>5</td>
<td>19-24</td>
<td>17-21</td>
<td>Fresh Breeze</td>
<td>Moderate waves, taking a more pronounced long form; many white horses are formed.</td>
<td>Small trees in leaf begin to sway; crested wavelets form on inland waters.</td>
</tr>
<tr>
<td>6</td>
<td>25-31</td>
<td>22-27</td>
<td>Strong Breeze</td>
<td>Large waves begin to form; the white foam crests are more extensive everywhere.</td>
<td>Large branches in motion; whistling heard in telegraph wires; umbrellas used with difficulty.</td>
</tr>
<tr>
<td>7</td>
<td>32-38</td>
<td>28-33</td>
<td>Near Gale</td>
<td>Sea heaps up and white foam from breaking waves begins to be blown in streaks along the direction of the wind.</td>
<td></td>
</tr>
</tbody>
</table>

---

<table>
<thead>
<tr>
<th>No.</th>
<th>Range</th>
<th>Wind</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>8</td>
<td>39-46</td>
<td>Gale</td>
<td>Whole trees in motion; inconvenience felt when walking against the wind. Moderately high waves of greater length; edges of crests begin to break into spindrift. The foam is blown in well-marked streaks along the direction of the wind. Breaks twigs off trees; generally impedes progress.</td>
</tr>
<tr>
<td>9</td>
<td>47-54</td>
<td>Severe Gale</td>
<td>High waves. Dense streaks of foam along the direction of the wind. Crests of waves begin to topple, tumble and roll over. Spray may affect visibility. Slight structural damage occurs (chimney-pots and slates removed).</td>
</tr>
<tr>
<td>10</td>
<td>55-63</td>
<td>Storm</td>
<td>Very high waves with long overhanging crests. The resulting foam, in great patches, is blown in dense white streaks along the direction of the wind. On the whole the surface of the sea takes on a white appearance. The tumbling of the sea becomes heavy and shock-like. Visibility affected. Seldom experienced inland; trees uprooted; considerable structural damage occurs.</td>
</tr>
<tr>
<td>11</td>
<td>64-72</td>
<td>Violent Storm</td>
<td>Exceptionally high waves (small and medium-size ships might be for a time lost to view behind the waves). The sea is completely covered with long white patches of foam lying along the direction of the wind. Everywhere the edges of the wave crests are blown into froth. Visibility affected. Very rarely experienced; accompanied by widespread damage.</td>
</tr>
<tr>
<td>12</td>
<td>73+</td>
<td>Hurricane</td>
<td>The air is filled with foam and spray. Sea completely white with driving spray; visibility very seriously affected.</td>
</tr>
</tbody>
</table>

Based on those extent ranking factors identified (above), the planning committee ranks the extent of non-rotational wind hazards as **Moderate.**
Tornadoes have their own severity/extent scale. Until 2007, tornadoes were measured and described according to the Fujita Scale. In February 2007, use of the Fujita Scale was discontinued. In its place, the Enhanced Fujita (EF) Scale is used. The Enhanced Fujita scale considers how most structures are designed and is thought to be a much more accurate representation of the surface wind speeds in the most violent tornadoes. Like the original Fujita scale, the Enhanced Fujita scale is a set of wind *estimates* (not measurements) based on damage.

It is important to note the *date* that a tornado occurred. Tornadoes that occurred prior to February 2007 are classified using the original Fujita scale and will not be converted to the Enhanced Fujita Scale.

The Table below illustrates the Fujita Scale in use prior to February 2007.

Table 27-30: Fujita Tornado Scale (Pre-February 2007)

<table>
<thead>
<tr>
<th>F-Scale Number</th>
<th>Intensity Phrase</th>
<th>Wind Speed</th>
<th>Type of Damage</th>
</tr>
</thead>
<tbody>
<tr>
<td>F0</td>
<td>Gale tornado</td>
<td>40-72 mph</td>
<td>Some damage to chimneys; breaks branches off trees; pushes over shallow-rooted trees; damages sign boards.</td>
</tr>
<tr>
<td>F1</td>
<td>Moderate tornado</td>
<td>73-112 mph</td>
<td>The lower limit is the beginning of hurricane wind speed; peels surface off roofs; mobile homes pushed off foundations or overturned; moving autos pushed off the roads; attached garages may be destroyed.</td>
</tr>
<tr>
<td>F2</td>
<td>Significant tornado</td>
<td>113-157 mph</td>
<td>Considerable damage. Roofs torn off frame houses; mobile homes demolished; boxcars pushed over; large trees snapped or uprooted; light object missiles generated.</td>
</tr>
<tr>
<td>F3</td>
<td>Severe tornado</td>
<td>158-206 mph</td>
<td>Roof and some walls torn off well-constructed houses; trains</td>
</tr>
</tbody>
</table>

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overturned; most trees in forest uprooted.

<table>
<thead>
<tr>
<th>Class</th>
<th>Description</th>
<th>Wind Speed</th>
<th>Damage Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>F4</td>
<td>Devastating tornado</td>
<td>207-260 mph</td>
<td>Well-constructed houses leveled; structures with weak foundations blown off some distance; cars thrown and large missiles generated.</td>
</tr>
<tr>
<td>F5</td>
<td>Incredible tornado</td>
<td>261-318 mph</td>
<td>Strong frame houses lifted off foundations and carried considerable distances to disintegrate; automobile sized missiles fly through the air in excess of 100 meters; trees debarked; steel reinforced concrete structures badly damaged.</td>
</tr>
<tr>
<td>F6</td>
<td>Inconceivable tornado</td>
<td>319-379 mph</td>
<td>These winds are very unlikely. The small area of damage they might produce would probably not be recognizable along with the mess produced by F4 and F5 wind that would surround the F6 winds. Missiles, such as cars and refrigerators would do serious secondary damage that could not be directly identified as F6 damage. If this level is ever achieved, evidence for it might only be found in some manner of ground swirl pattern, for it may never be identifiable through engineering studies.</td>
</tr>
</tbody>
</table>

Table below illustrates the Enhanced Fujita (EF) Scale, currently in use. Tornadoes that have occurred since February, 2007 are classified using the Enhanced Fujita Scale.
**Table 27-31: Enhanced Fujita Scale (February 2007 and Later)**

<table>
<thead>
<tr>
<th>Enhanced Fujita Category</th>
<th>Wind Speed</th>
<th>Potential Damage</th>
</tr>
</thead>
<tbody>
<tr>
<td>EF0</td>
<td>65-85 mph</td>
<td>Light damage. Peels surface off some roofs; some damage to gutters or siding; branches broken off trees; shallow-rooted trees pushed over.</td>
</tr>
<tr>
<td>EF1</td>
<td>86-110 mph</td>
<td>Moderate damage. Roofs severely stripped; mobile homes overturned or badly damaged; loss of exterior doors; windows and other glass broken.</td>
</tr>
<tr>
<td>EF2</td>
<td>111-135 mph</td>
<td>Considerable damage. Roofs torn off well-constructed houses; foundations of frame homes shifted; mobile homes completely destroyed; large trees snapped or uprooted; light-object missiles generated; cars lifted off ground.</td>
</tr>
<tr>
<td>EF3</td>
<td>136-165 mph</td>
<td>Severe damage. Entire stories of well-constructed houses destroyed; severe damage to large buildings such as shopping malls; trains overturned; trees debarked; heavy cars lifted off the ground and thrown; structures with weak foundations blown away some distance.</td>
</tr>
<tr>
<td>EF4</td>
<td>166-200 mph</td>
<td>Devastating damage. Well-constructed houses and whole frame houses completely levelled; cars thrown and small missiles generated.</td>
</tr>
<tr>
<td>EF5</td>
<td>&gt;200 mph</td>
<td>Incredible damage. Strong frame houses levelled off foundations and swept away; automobile-sized missiles fly through the air in excess of 100 m (107 yd); high-rise buildings have significant structural deformation; incredible phenomena will occur.</td>
</tr>
</tbody>
</table>

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Based on the extent ranking factors identified (above), the planning committee ranks the extent of tornados as **Low**.

**Extent: Hail**

The National Oceanic and Atmospheric Administration and the Tornado and Storm Research Organization (TORRO) have combined efforts to create the Hailstorm Intensity Scale. Table below provides details of this scale.

Table 27-32: Combined NOAA/TORRO Hailstorm Intensity Scale

<table>
<thead>
<tr>
<th>Size Code</th>
<th>Intensity Category</th>
<th>Typical Hail Diameter</th>
<th>Approximate Size</th>
<th>Typical Damage Impacts</th>
</tr>
</thead>
<tbody>
<tr>
<td>H0</td>
<td>Hard Hail</td>
<td>Up to 0.33”</td>
<td>Pea</td>
<td>No damage</td>
</tr>
<tr>
<td>H1</td>
<td>Potentially Damaging</td>
<td>0.33” – 0.60”</td>
<td>Marble or Mothball</td>
<td>Slight damage to plants and crops</td>
</tr>
<tr>
<td>H2</td>
<td>Potentially Damaging</td>
<td>0.60” – 0.80”</td>
<td>Dime or grape</td>
<td>Significant damage to fruit, crops, and vegetation</td>
</tr>
<tr>
<td>H3</td>
<td>Severe</td>
<td>0.80” – 1.20”</td>
<td>Nickel to Quarter</td>
<td>Severe damage to fruit and crops, damage to glass and plastic structures, paint and wood scored</td>
</tr>
</tbody>
</table>

---

<table>
<thead>
<tr>
<th>Extent Rank</th>
<th>Magnitude</th>
<th>Size Range</th>
<th>Size Comparison</th>
<th>Hazard</th>
<th>Classification</th>
</tr>
</thead>
<tbody>
<tr>
<td>H4</td>
<td>Severe</td>
<td>1.20” – 1.60”</td>
<td>Half Dollar to Ping Pong Ball</td>
<td>Widespread glass damage, vehicle body damage</td>
<td></td>
</tr>
<tr>
<td>H5</td>
<td>Destructive</td>
<td>1.60” – 2.0”</td>
<td>Silver Dollar to Golf Ball</td>
<td>Wholesale destruction of glass, damage to tiled roofs, significant risk of injuries</td>
<td></td>
</tr>
<tr>
<td>H6</td>
<td>Destructive</td>
<td>2.0” – 2.4”</td>
<td>Lime or Egg</td>
<td>Aircraft body dented; brick walls pitted</td>
<td></td>
</tr>
<tr>
<td>H7</td>
<td>Very Destructive</td>
<td>2.4” – 3.0”</td>
<td>Tennis Ball</td>
<td>Severe roof damage, risk of serious injuries</td>
<td></td>
</tr>
<tr>
<td>H8</td>
<td>Very Destructive</td>
<td>3.0” – 3.5”</td>
<td>Baseball to Orange</td>
<td>Severe damage to aircraft body</td>
<td></td>
</tr>
<tr>
<td>H9</td>
<td>Super Hailstorms</td>
<td>3.5” – 4.0”</td>
<td>Grapefruit</td>
<td>Extensive structural damage, risk of severe or fatal injuries to persons caught in the open</td>
<td></td>
</tr>
</tbody>
</table>

Based on those extent ranking factors identified (above), the planning committee ranks the extent of the hail hazard as **LOW**.
Extent: Lightning

The National Weather Service (NWS) uses a Lightning Activity Level (LAL) scale to indicate the frequency and character of cloud-to-ground (C/G) lightning. The scale uses a range of 1 – 6, with 6 being the high end of the scale. The Table below provides details of the LAL scale.

Table 27-33: Lightning Activity Level (LAL) Scale\textsuperscript{127}

<table>
<thead>
<tr>
<th>Rank</th>
<th>Cloud and Storm Development</th>
<th>Areal Coverage</th>
<th>Counts C/G per 5 Minutes</th>
<th>Counts C/G per 15 Minutes</th>
<th>Average C/G per Minute</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>No Thunderstorms</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>2</td>
<td>Cumulus clouds are common but only a few reaches the towering stage. A single thunderstorm must be confirmed in the rating area. The clouds mostly produce virga, but light rain will occasionally reach ground. Lightning is very infrequent.</td>
<td>&lt;15%</td>
<td>1-5</td>
<td>1-8</td>
<td>&lt;1</td>
</tr>
<tr>
<td>3</td>
<td>Cumulus clouds are common. Swelling and towering cumulus cover less than 2/10 of the sky. Thunderstorms are few, but 2 to 3 occur within the observation area. Light to moderate rain will reach the ground, and lightning is infrequent.</td>
<td>15% to 24%</td>
<td>6-10</td>
<td>9-15</td>
<td>1-2</td>
</tr>
</tbody>
</table>

\textsuperscript{127} Retrieved on 07.19.2021 from https://graphical.weather.gov/definitions/defineLAL.html
## Lightning Activity Level Scale

<table>
<thead>
<tr>
<th>Rank</th>
<th>Cloud and Storm Development</th>
<th>Areal Coverage</th>
<th>Counts C/G per 5 Minutes</th>
<th>Counts C/G per 15 Minutes</th>
<th>Average C/G per Minute</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>Swelling cumulus and towering cumulus cover 2-3/10 of the sky. Thunderstorms are scattered but more than three must occur within the observation area. Moderate rain is commonly produced, and lightning is frequent.</td>
<td>25% to 50%</td>
<td>11-15</td>
<td>16-25</td>
<td>2-3</td>
</tr>
<tr>
<td>5</td>
<td>Towering cumulus and thunderstorms are numerous. They cover more than 3/10 and occasionally obscure the sky. Rain is moderate to heavy, and lightning is frequent and intense.</td>
<td>&gt;50%</td>
<td>&gt;15</td>
<td>&gt;25</td>
<td>&gt;3</td>
</tr>
<tr>
<td>6</td>
<td>Dry lightning outbreak. (LAL of 3 or greater with majority of storms producing little or no rainfall.)</td>
<td>&gt;15%</td>
<td>None</td>
<td>None</td>
<td>None</td>
</tr>
</tbody>
</table>

Based on those extent ranking factors identified (above), the planning committee ranks the extent of the lightning hazard as **Low**.

**Extent: Thunderstorms that Generate Wind, Tornado, Hail, and Lightning Hazard Events**

Thunderstorms are not explicitly identified as a severe weather category for this hazard profile. However, they are responsible for most tornado, lightning, and hail hazard events – as well as a significant number of wind hazard events – across California and the CSU system. While individual thunderstorms affect relatively small areas, there are many instances in which thunderstorms can cluster together and/or travel in a line over long distances, producing significant damage over large geographic areas.

A thunderstorm is classified as “severe” when certain meteorological parameters within the thunderstorm are reached (i.e., damaging winds or speeds of 58 mph (50 knots) or greater, hail 1 inch in diameter or larger, and/or a tornado). However, there is currently no
established, objective severity scale for thunderstorms.\textsuperscript{128} \textsuperscript{129} That said, according to the \textit{Glossary of Meteorology} published by the American Meteorological Society (AMS), a thunderstorm is reported as \textit{light, medium, or heavy} according to following five (5) characteristics:

- the nature of the lightning and thunder;
- the type and intensity of the precipitation, if any;
- the speed and gustiness of the wind;
- the appearance of the clouds;
- the effect upon surface temperature.\textsuperscript{130}

A thunderstorm may also be classified by the nature of the overall weather situation in which the thunderstorm is produced, including:

- \textbf{Airmass Thunderstorm}: A thunderstorm produced by local convection within an unstable air mass;\textsuperscript{131}

- \textbf{Frontal Thunderstorm}: An individual thunderstorm the initiation of which results from rising motion associated with a front, or a thunderstorm within a convective system generated and organized by frontal rising motion;\textsuperscript{132} or

- \textbf{Squall-line Thunderstorm}: An individual thunderstorm included within a squall line (i.e., a continuous or broken line of active deep moist convection frequently associated with thunder).\textsuperscript{133} \textsuperscript{134}

Based on the extent ranking factors identified (above) in relation to campus layout and operations, and past event low degree of severity, the planning committee ranks the extent of the thunderstorm hazard as \textbf{Low}.

\textbf{History of the Hazard}

\textsuperscript{128} Retrieved on 07.15.2021 from https://www.noaa.gov/explainers/severe-storms
\textsuperscript{129} Retrieved on 07.15.2021 from https://www.weather.gov/safety/thunderstorm
Severe weather hazards have been an annual occurrence in Los Angeles County and on the CSU Chancellor’s Office campus. Historical data for these hazards are presented below.

**Historical Storm Data Collection: NCEI Storm Events Database**

Historical information regarding severe weather hazards can be found using The National Centers for Environmental Information (NCEI) Storm Events Database. The Storm Events Database contains searchable, archived National Weather Service (NWS) storm data from January 1950 to April 2021, as entered by NOAA’s National Weather Service (NWS). Due to changes in the data collection and processing procedures over time, there are unique periods of record available depending on the event type.\(^{135}\) For example, from 1950 through 1954, only tornado events were recorded; from 1955 through 1995, only tornado, thunderstorm wind, and hail events were introduced into the database; from 1996 to present, 45 additional event types are recorded, including high wind, strong wind, and lightning events.\(^{136}\) To obtain the most accurate portrayal of severe weather event frequency, searches of the Storm Events Database are conducted using data collected since 01/01/1996. As a reminder, all official severe weather event data is at the county level. Severe weather data do not exist at the campus level. That said, it may be the case that the campus, to some degree, experiences those severe weather events reported for the surrounding community and County.

**Wind Hazards (excluding Tornadoes)**

Information obtained from the NCEI Storm Event Database website shows the number of events (or occurrences) of wind hazard events in Los Angeles County since 1996.\(^{137}\) Here, wind hazard events include all “High Wind,” “Strong Wind,” and “Thunderstorm Wind” storm reports.\(^{138}\)

- **High Wind**: at least 387 events, or approximately 15.28 events per year\(^{139}\)


\(^{139}\) National Climatic Data Center. Storm Events Database. Retrieved 07.29.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28Z%29+High+Wind&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=LOS%2BANGELES%3A37&hailfilter=0.00&tornfilter=0.00&windfilter=0.00&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA
- **Strong Wind:** at least 3 events, or 0.12 events per year\(^{140}\)
- **Thunderstorm Wind:** at least 43 events, or approximately 1.70 events per year\(^{141}\)
- **All Wind Hazard events** (excluding Tornadoes): at least 427 events, or approximately 16.86 events per year.\(^{142}\) (Note: This was determined by conducting a simultaneous search of the component wind hazards of high wind, strong wind and thunderstorm wind.)

Overall, in Los Angeles County, there have been at least 427 wind hazard events since 1996, excluding tornadoes.\(^{143}\) That translates to an approximate average historical frequency of occurrence of **16.86** wind hazard events per year.

Please note: Differences between the sums of individual component wind hazard event Database searches (i.e., 433 events) and simultaneous Database searches of all wind hazard events (i.e., 427 events) are due to multiple event types in the same record (e.g., "Thunderstorm Wind/Hail" or "Hail/Tornado").\(^{144}\) When such a discrepancy arises, the more conservative aggregate hazard wind event value (i.e., 427 events) is used to determine the historical frequency of occurrence for the severe weather hazard.

Please note: Differences between the sums of individual component severe weather hazard event Database searches (i.e., 433 events) and simultaneous Database searches of all severe weather hazard events (i.e., 427 events) may be due to the following factors: (1)

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\(^{140}\) National Climatic Data Center. Storm Events Database. Retrieved 07.29.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28Z%29+Strong+Wind&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=LOS%2BANGELES%3A37&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA

\(^{141}\) National Climatic Data Center. Storm Events Database. Retrieved 07.29.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Thunderstorm+Wind&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=LOS%2BANGELES%3A37&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA

\(^{142}\) National Climatic Data Center. Storm Events Database. Retrieved 07.29.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28Z%29+High+Wind&eventType=%28Z%29+Strong+Wind&eventType=%28C%29+Thunderstorm+Wind&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=LOS%2BANGELES%3A37&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA

\(^{143}\) National Climatic Data Center. Storm Events Database. Retrieved 07.29.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28Z%29+High+Wind&eventType=%28Z%29+Strong+Wind&eventType=%28C%29+Thunderstorm+Wind&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=LOS%2BANGELES%3A37&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA

multiple event types are in the same record (e.g., "Thunderstorm Wind/Hail" or "Hail/Tornado;" and/or (2) severe weather hazard events such as “Thunderstorm Wind” or “Hail” that are reported for Los Angeles County have actually taken place hundreds of miles away, but are erroneously recorded as events that have occurred in the County. When such a discrepancy arises, the more conservative aggregate hazard wind event value (i.e., 427 events) is used to determine the historical frequency of occurrence for the severe weather hazard. The origin of this discrepancy is unknown at this time.

**Historical Wind Hazard Losses for Los Angeles County since 1996**

According to the NCEI Storm Events Database, the wind hazard events that Los Angeles County has experienced since 1996 have been costly. There have been 2 deaths and 4 injuries reported from wind hazard events (excluding tornadoes) in Los Angeles County; no property or crop damage has been reported.

**Tornado Wind Hazards**

Information from the NCEI Storm Events Database indicates that since 1996, there have been 12 reported events of tornadoes in Los Angeles County, which translates to approximately 0.47 tornado events per year.

The vast majority of tornado reports in Los Angeles County since 1996 have been of tornadoes with a severity rating of F0/EF0. Only one (1) or 12 of the tornadoes reported in has been rated F1/EF1 or higher (it was an F1 tornado that occurred in 1998); that translates to approximately 0.04 events of F1/EF1 tornadoes have occurred per year in Los Angeles County.

**Historical Tornado Hazard Losses for Los Angeles County since 1996**

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146 National Climatic Data Center. Storm Events Database. Retrieved 07.29.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28Z%29+High+Wind&eventType=%28Z%29+Strong+Wind&eventType=%28C%29+Thunderstorm+Wind&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=LOS%2BANGELES%3A37&hailfilter=0.00&tornfilter=0.00&windfilter=0.00&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA

147 National Climatic Data Center. Storm Events Database. Retrieved 07.29.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Tornado&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=LOS%2BANGELES%3A37&hailfilter=0.00&tornfilter=0.00&windfilter=0.00&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA

148 National Climatic Data Center. Storm Events Database. Retrieved 07.29.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Tornado&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=LOS%2BANGELES%3A37&hailfilter=0.00&tornfilter=0.00&windfilter=0.00&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA
According to the NCEI Storm Events Database, the tornado hazard events that Los Angeles County has experienced since 1996 have been minimal. There have been no deaths, or property or crop damage reported; however, one (1) injury has been reported.\(^{149}\) (Note: An F1/EF1 tornado that occurred in Los Angeles County in 1998 caused the one (1) reported injury.)

**Hail**

Information from the NCEI Storm Events Database indicates that since 1996, there have been 18 reported events of hail in Los Angeles County, which translates to approximately 0.71 hail events per year.\(^{150}\) (Note: The NCEI Storm Event Database search results for hail indicate that there has been a total of 19 reports of hail since 1996. However, one (1) entry is for a hail event in San Diego County, over 100 miles away from Los Angeles County. The origin of this error is unknown at this time.)

**Historical Hail Hazard Losses for Los Angeles County since 1996**

According to the NCEI Storm Events Database, the hail hazard events that Los Angeles County has experienced since 1996 have been costly. While there have been no deaths, injuries, or crop damage, property damage estimates have totaled approximately $3,500,000; the property damage estimate reflects one (1) hail hazard event that occurred in 2003.\(^{151}\) (Note: The San Diego County hail event that was included erroneously in the search results for hail hazard events in Los Angeles County accounted for all injuries (i.e., 5) and crop damage estimates (i.e., $300,000) presented in the search results.)

**Lightning**

Information from the NCEI Storm Events Database indicates that since 1996, there have been 9 reported events of lightning in Los Angeles County, which translates to approximately 0.36 lightning events per year.\(^{152}\)

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\(^{149}\) National Climatic Data Center. Storm Events Database. Retrieved 07.29.2021 from [https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Hail&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=LOS%2BANGELES%3A37&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA](https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Hail&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=LOS%2BANGELES%3A37&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA)

\(^{150}\) National Climatic Data Center. Storm Events Database. Retrieved 07.29.2021 from [https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Lightning&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=LOS%2BANGELES%3A37&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA](https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Lightning&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=LOS%2BANGELES%3A37&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA)

\(^{151}\) National Climatic Data Center. Storm Events Database. Retrieved 07.29.2021 from [https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Hail&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=LOS%2BANGELES%3A37&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA](https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Hail&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=LOS%2BANGELES%3A37&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA)

\(^{152}\) National Climatic Data Center. Storm Events Database. Retrieved 07.29.2021 from [https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Lightning&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=LOS%2BANGELES%3A37&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA](https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Lightning&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=LOS%2BANGELES%3A37&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA)
Historical Lightning Hazard Losses for Los Angeles County since 1996

According to the NCEI Storm Events Database, the lightning hazard events that Los Angeles County has experienced since 1996 have been costly. While no property or crop damage has been reported, there have been 2 deaths and 13 injuries attributed to lightning hazard events.153

All Severe Weather Hazard Events Recorded by the NCEI Storm Events Database

Information obtained from the NCEI Storm Events Database indicates that there have been 466 occurrences of the severe weather hazard in Los Angeles County. This translates to 18.39 severe weather hazard occurrences per year.154

Please note: Differences between the sums of individual component severe weather hazard event Database searches (i.e., 473 events) and simultaneous Database searches of all severe weather hazard events (i.e., 466 events) may be due to the following factors: (1) multiple event types are in the same record (e.g., "Thunderstorm Wind/Hail" or "Hail/Tornado;" and/or (2) severe weather hazard events such as “Thunderstorm Wind” or “Hail” that are reported for Los Angeles County have actually taken place hundreds of miles away, but are erroneously recorded as events that have occurred in the County.155

When such a discrepancy arises, the more conservative aggregate hazard wind event value (i.e., 466 events) is used to determine the historical frequency of occurrence for the severe weather hazard. The origin of this discrepancy is unknown at this time.

Historical, Aggregated Severe Hazard Losses for Los Angeles County since 1996

According to the NCEI Storm Events Database, the severe weather events that Los Angeles County has experienced since 1996 have been costly. There have been 4 deaths and 18 injuries, and property damage estimates have totaled approximately $3,500,000; no crop damage has been reported. It is important to note that for all Los Angeles County severe weather hazard events recorded on the Storm Events Database, lightning has

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153 National Climatic Data Center. Storm Events Database. Retrieved 07.29.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Lightning&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=LOS%2BANGELES%3A37&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA

154 National Climatic Data Center. Storm Events Database. Retrieved 07.29.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Hail&eventType=%28Z%29+High+Wind&eventType=%28C%29+Lightning&eventType=%28Z%29+Strong+Wind&eventType=%28C%29+Thunderstorm+Wind&eventType=%28C%29+Tornado&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=LOS%2BANGELES%3A37&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA

accounted for half of the deaths, and 13 out of 14 (92.9%) injuries reported. However, hail has accounted for all estimated property damage.

Wind Hazards Not Included in the NCEI Storm Events Database

Santa Ana Winds

Santa Ana wind events occur at least twice per month from October through April.\textsuperscript{156} From 1948 to 2012, a total of 2056 events on the 65-year record were recorded in the Southern California region, yielding an average of 32 occurrences per year. Typical Santa Ana wind events last 1–2 days and represent 27% of the occurrences, with events lasting up to 6 days accounting for 90% of all occurrences. The remaining 10% are made up almost entirely of events lasting between 7 and 12 days.\textsuperscript{157 158}

Figure below shows the mean monthly frequency per season of Santa Ana Wind events detected from 1948 to 2012. Extreme Santa Ana wind events are shown in dark red, and are defined as those events that are above the 90th percentile of all events on record.

Figure 27-19: Mean Annual Frequency of Santa Ana Wind events (1948-2012)\textsuperscript{159 160}


Diablo Winds

Diablo wind events occur approximately *2.5 events per year*. These events are most frequent during the fall and early winter seasons, with the highest frequency of events occurring in October. As a result, the highest risk of Diablo-wind-related damage is in the fall and early winter.\(^\text{161}\)

Figure below shows the monthly frequency of Diablo winds (along with average live fuel moisture content). The Diablo Wind data are derived from a 17-year climatology of San Francisco Bay Area regional surface weather stations.162

Figure 27-20: Monthly Frequency of Diablo Winds and Average Live Fuel Moisture Content (Dashed Line)163

**Sundowner Winds**

Strong sundowner wind events occur approximately **2-3 times per year**. These events can create sharp temperature rises, local gale force winds, and significant weather-related problems. Rare, “explosive” types of sundowner wind events occur about 6 times per century that present dangerous weather situations, generating extremely strong and hot winds that can reach gale force or higher speeds.164

**Historical Frequency of All Severe Weather Hazards**

Table below shows the average historical frequency of severe weather hazard events for Los Angeles County since 1996.)

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162 Retrieved on 07.15.2021 from https://www.fireweather.org/diablo-winds


Table 27-34: Severe Weather Hazard Event

Frequencies for Los Angeles County since 1996.

<table>
<thead>
<tr>
<th>Severe Weather Hazard Category</th>
<th>Average Number of Hazard Events Per Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wind (Includes High, Strong and Thunderstorm Winds ONLY)</td>
<td>16.86</td>
</tr>
<tr>
<td>Tornado</td>
<td>0.47</td>
</tr>
<tr>
<td>Hail</td>
<td>0.71</td>
</tr>
<tr>
<td>Lightning</td>
<td>0.36</td>
</tr>
<tr>
<td>Diablo Wind*</td>
<td>2.5</td>
</tr>
<tr>
<td>Santa Ana Wind</td>
<td>32</td>
</tr>
<tr>
<td>Sundowner Wind*</td>
<td>2 to 3</td>
</tr>
</tbody>
</table>

* Note: The Diablo and Sundowner wind hazards are not present in Los Angeles County. They are included here for information purposes only.

Potential Impacts of the Hazard

The significance (or priority) of a hazard’s potential impacts is based primarily on the frequency and resulting damage caused by the hazard, including deaths/injuries and property, crop, and economic damage. All assets and people within the CSU Chancellor’s Office campus areas are at risk from the effects of severe weather.

**Wind Hazards (Including Tornadoes)**

Wind hazard events have the potential to impact people, property, and operations on campuses across the CSU system. People caught in the open during an extreme wind event are exposed to high winds and debris and could be injured or killed.

The habitability of buildings can be compromised (by damaging roofs, windows, or other weak points in the building envelope), leading to long-term operational issues for the campus. As with most university campuses, space is always at a premium at the CSU Chancellor’s Office campus, and the loss of any currently utilized space due to building or structural damage would likely disrupt operations and the University’s mission.

Extreme wind events can result in power failure, which would impact the operation of the campus. Fallen tree limbs and other potential transportation hazards may also cause disruption to the surrounding community and limit ingress/egress to the campus.
According to the 2017 City of Long Beach Hazard Mitigation Plan Local Hazard, the “Windstorm” hazard (i.e., high wind, including tornado, that is primarily caused by Santa Ana winds) is a hazard that poses enough of a “significant” threat to the city that it could result in the declaration of a local disaster. On a scale of 1 (lowest) to 4 (highest), it is rated as 2.95 (out of 4) in terms of significance. As a result, the wind hazard is considered to be of medium to high significance, and therefore to have a moderate to high potential impact on both the city and (by extension) the CSU Chancellor’s Office campus. 165

**Hail**

Hail typically impacts property by damaging structures, cars, and utilities as it falls. Dents in cars, broken glass, and holes in roofs are common impacts of hail. Injuries to people from hail are less common, though they can happen, as hail is a hard object falling in an unpredictable manner at a fairly high rate of speed.

According to the 2017 City of Long Beach Hazard Mitigation Plan Local Hazard, hail hazards are not considered to be significant hazards, and are therefore not included in the hazards profiled by the Plan. As a result, the hail hazard is deemed to have low significance, and therefore to have a minimal potential impact on both the city and (by extension) the CSU Chancellor’s Office campus. 166

**Lightning**

Lightning strikes the United States about 20-25 million times a year. 167 Although most lightning occurs in the summer months, people can be struck at any time of year. Since 1990, lightning has killed an average of 39 people each year in the United States, and hundreds more have been injured. 168 Property losses due to lightning have been very costly across the U.S. For example, from 2005 through 2020, U.S. homeowner’s insurance claim payouts for lightning losses totaled approximately $15,334,600,000, or $958,412,500 worth of payouts per year. 169 (Commercial claim payouts for lightning losses for the U.S. were not available.)

According to the 2017 City of Long Beach Hazard Mitigation Plan Local Hazard, the lightning hazard is not considered to be significant hazard, and therefore is not included in the hazards profiled by the Plan. As a result, the lightning hazard is deemed to have

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low significance, and therefore has a minimal potential impact on both the city and (by extension) the CSU Chancellor’s Office campus.\textsuperscript{170}

**Probability of Future Occurrence of the Hazard**

Areas throughout California, including all California State University (CSU) campuses, experience severe weather events every year, and future occurrences of such events are projected to increase in both their frequency and intensity. The 2017 City of Long Beach Hazard Mitigation Plan states that the probability of “Windstorm” events (i.e., high wind events – including tornadoes – caused primarily by Santa Ana winds) occurring in Long Beach is “Highly Likely;” that is, they are frequent events with a well-documented history of occurrence and an annual probability of greater than 1 in 10 (>10%).\textsuperscript{171} Also, according to the NCEI Storm Events Database, severe weather wind hazard events (excluding tornadoes) have occurred in Los Angeles County 427 times since 1996, or an average of 16.86 times per year.\textsuperscript{172} Furthermore, while the severe weather hazard is a non-spatial hazard that affects all areas of the CSU Chancellor’s Office campus equally, the smallest geographic unit of measurement for almost all official severe weather event data is at the county level. Because the severe weather data used in this assessment do not exist at the campus level, it is assumed that the severe weather probabilities for the CSU Chancellor’s Office campus reflect those of the surrounding community and County identified in Table below.

Based on the data available from both the 2017 City of Long Beach Hazard Mitigation Plan and the NCEI Storm Events Database, the severe weather hazard is expected to occur on (or otherwise impact) the CSU Chancellor’s Office campus at least once on an annual basis. Therefore, the probability of future occurrence of the severe weather hazard for CSU Chancellor’s Office is **Highly Likely**. See Table 27-XX for probabilities of future occurrence for component severe weather hazards for the Los Angeles County and the campus.


\textsuperscript{172} National Climatic Data Center. Storm Events Database. Retrieved 08.07.2021 from https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28Z%29+High+Wind&eventType=%28Z%29+Strong+Wind&eventType=%28C%29+Thunderstorm+Wind&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1996&endDate_mm=04&endDate_dd=30&endDate_yyyy=2021&county=LOS%2BANGELES%3A37&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=6%2CCALIFORNIA
Table 27-35: Severe Weather Hazard Probabilities of Future Occurrence for Los Angeles County and the CSU Chancellor’s Office

<table>
<thead>
<tr>
<th>Severe Weather Hazard Category</th>
<th>Average Number of Hazard Events Per Year</th>
<th>Probability of Future Occurrence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wind (Includes High, Strong and Thunderstorm Winds ONLY)</td>
<td>16.86</td>
<td>Highly Likely</td>
</tr>
<tr>
<td>Tornado</td>
<td>0.47</td>
<td>Possible</td>
</tr>
<tr>
<td>Hail</td>
<td>0.71</td>
<td>Likely</td>
</tr>
<tr>
<td>Lightning</td>
<td>0.36</td>
<td>Possible</td>
</tr>
<tr>
<td>Diablo Wind**</td>
<td>2.5</td>
<td>Not Rated</td>
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<td>2 to 3</td>
<td>Not Rated</td>
</tr>
</tbody>
</table>

** Note: The Diablo and Sundowner wind hazards are not present in Los Angeles County, and therefore are not rated for probability of future occurrence. They are included here for information purposes only.

Vulnerability to the Hazard

People, structures, and assets on the CSU Chancellor’s Office campus are all vulnerable to the impacts associated with severe weather. Infrastructure can be damaged or destroyed by hail, wind, tornadoes, thunderstorms, and lightning, which can result in service interruptions and outages. Structures can be damaged or destroyed by hail, wind, tornadoes, thunderstorms, and lightning. People can be injured or killed by lightning, flying debris, hail, or extreme wind events. The CSU Chancellor’s Office campus also has vehicles, as well as off-campus conference and recreational facilities, that are all vulnerable to a severe weather event.

Estimate of Potential Losses

Severe weather is a non-spatial hazard that affects the entire CSU Chancellor’s Office campus. Each of the hazards associated with severe weather can result in losses throughout the planning area.

All structures within the CSU Chancellor’s Office campus are at risk from severe weather. There is only one (1) building on the CSU Chancellor’s campus that could be damaged by wind, hail, and/or lightning. If even a fraction of these assets were to be damaged, the resulting estimated losses would still be in the millions of dollars. Unfortunately, the total replacement costs due to severe weather hazard are unknown, as estimated
campus facility and structure values for the CSU Chancellor’s Office were not available. Moreover, an analysis of projected dollar losses to campus buildings from severe weather as a percentage of building replacement costs is also not currently available, though CSU leadership may pursue such data in the future.

The population at the CSU Chancellor’s Office campus varies throughout the day. As of Fall, 2019, the CSU Chancellor’s Office had 673 administrators and staff.\textsuperscript{173} All are at risk from severe weather events, with all 673 Chancellor’s Office employees being directly vulnerable in this scenario.\textsuperscript{174}

**Vulnerability Assessment Conclusions**

Severe weather presents a variety of hazards to the CSU Chancellor’s Office campus. People, assets, infrastructure, and vehicles can all be damaged by this hazard, and losses can quickly begin to rise. In the aggregate, severe weather is a frequently occurring hazard (mostly in the form of wind hazard events) that presents a variety of risks to the CSU Chancellor’s Office.

It is evident that the CSU Chancellor’s Office campus has vulnerabilities to and risks from severe weather hazard incidents, and that pre-event planning, communication, and mitigation efforts should be implemented. Public education and outreach regarding areas of shelter that could be used by campus populations during severe weather events is considered by campus leadership to be one viable mitigation option. The campus planning committee will continue to look for feasible and cost-effective options for the mitigation of severe weather risks going forward.

**Identified Data Limitations**

Numerous federal agencies maintain a variety of records regarding losses associated with hazards. Unfortunately, no single source is considered to offer a definitive accounting of all losses. The Federal Emergency Management Agency (FEMA) maintains records on federal expenditures associated with declared major disasters. The US Army Corps of Engineers (USACE) and the Natural Resources Conservation Service (NRCS) collect data on losses during the course of some of their ongoing projects and studies. Additionally, the National Oceanic and Atmospheric Administration’s (NOAA) National Centers for Environmental Information (NCEI) collects and maintains data about natural hazards in summary format, as well as occurrences, dates, injuries, deaths, and estimated costs for individual storm events. Many of these databases and other data collection services, including the NCEI, have inherent data limitations when searching for information at a scale as small as a single campus.

\textsuperscript{173} Retrieved on 07.19.2021 from https://www2.calstate.edu/csuc-system/about-the-csu/facts-about-the-csu/enrollment/Pages/default.aspx

\textsuperscript{174} Retrieved on 07.19.2021 from https://www2.calstate.edu/csuc-system/faculty-staff/employee-profile/csu-workforce/Pages/employee-headcount-by-campus.aspx
The best available data and records have been used throughout this section. Where no
data or records exist or could be located, that deficiency is noted.